MOBIUS FOUNDATION

Wonderous Wetlands

Discovering the Wealth Within

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discovering the wealth within

WONDEROUS WETLANDS—Discovering the Wealth Within

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WONDEROUS WETLANDS—Discovering the Wealth Within

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Lesser Adjutant stork or Leptoptilos javanicus
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Bhitarkanika Mangroves, Odisha
© Wetlands of India Portal

Here is the wetland pledge scripted by Ministry of Environment, Forest and Climate Change, Government of India, which reminds its citizens of their fundamental duties towards wetlands, and is aimed at securing their participation and stewardship in conservation and management efforts. So far, over 1,30,000 individuals have taken this pledge and the number continues to grow. It might strike readers as odd, that wetland areas in India, merit an oath or a pledge. But, there is good reason for this. *Kund, baoli, talaab, jheel, pukur, tanki, tso, spang, poyka, cheruvu, chhapri;* wetlands are known by hundreds of different names across India, bearing testament to the diverse ecosystems that exist here. Despite ancient wisdom and experience, wetlands not just in India but also across the globe are under threat. If jungles and forests are the earth's 'lungs', then wetlands are its 'kidneys'. And these 'kidneys' are under threat of irreversible renal failure! Wetlands International South Asia (WISA), in its Annual Report of 2020-21, has estimated that India has lost at least 30 per cent of its natural wetlands over the last four decades. The report further indicated an even more alarming status of urban wetlands: In Chennai, 90 per cent of wetlands have disappeared; Hyderabad has lost 55 per cent; Mumbai is down by 71 per cent, Ahmedabad has lost 57 per cent of its wetland cover, while Bengaluru and Pune have lost 56 per cent, and 37 per cent respectively, and finally, the Delhi-NCR has lost 38 per cent of its total wetlands.

Wetlands in India are facing a severe crisis of encroachment and degradation all across the country. The main threats to our wetlands are pollution, encroachment, eutrophication (the excessive loading of nutrients into water bodies due to pollution leading to the prolific growth of simple plant life like algae and plankton), illegal mining, over-exploitation and unregulated tourism etc.

Clockwise: Mr. Pradip Burman, Chairman, Mobius Foundation delivering the innaugural speech. Mr. Praveen Garg, President, Mobius Foundation, delivering the concluding note for the event. Dr. Suneesh Buxy, Member Secretary, Delhi Wetlands Authority delivering the keynote address. Ms. Jessica Gill, Sr. Research Associate, welcoming the panellists and distinguished guests. Insightful audience interaction during the Q&A session. The Mobius Foundation team. Esteemed guests at the event.

In an effort to draw attention to these issues and drive policy action, earlier this year, on February 23rd, Mobius Foundation, a New Delhi-based not-for-profit, organised a special event "Wetlands for Wellbeing-Preserving India's Wetlands". Held in the forecourt of the capital's beautifully restored Travancore House—a palace that once belonged to the erstwhile royal family of Travancore in modern day Kerala—the event saw discussions on the challenges and possible solutions to protect and conserve wetlands in India. The event was attended by various stakeholders from different walks of life—including members of civil society, policymakers, bureaucrats conservationists and academics. Most encouraging, a number of students—future custodians and eco warriors—from different colleges in Delhi also attended the event.

Hosted by Mr. Pradip Burman, Chairman, Mobius Foundation, the event started with his inaugural speech that emphasised the importance of wetlands for human wellbeing as well as for fighting climate change. Keynote speeches by Dr. Suneesh Buxy, Member Secretary, Delhi Wetlands Authority and Mr. Ramveer Tanwar, popularly known as the 'Pond Man of India', set the ball rolling; this was followed by an engaging audio-visual presentation on pond restoration in the Delhi-NCR area also by Mr. Tanwar. An interactive panel discussion featuring Mr. Soumitra Dasgupta, IFS (Retd), former Principal Chief Conservator of Forests and Head of Forest Force, West Bengal; Dr. Ritesh Kumar, Director, Wetlands International South Asia; Dr. Aditya Joshi, former PCCF, HOFF, CWLW, Government of Manipur and Advisor, Think Tank, Mobius Foundation; and Mr. Suresh Babu SV, Senior Director, Ecological Footprints, WWF India. The session, ably moderated by Ms Neha Sinha, Head of Policy and Communications, WWF India, Conservation Biologist and Author, kept the conversation freewheeling and interesting.

Esteemed panellists (L-R):Mr. Soumitra Dasgupta, Dr. Aditya Joshi, Dr. Ritesh Kumar, Mr. Suresh Babu SV, Ms. Neha Sinha.

Mr. Burman and Mr. Garg felicitated the panellists and dignitaries post-event.

What are Wetlands?

Wetlands are broadly defined as “areas of marsh, fen, peat land or water, whether natural or artificial, permanent or temporary, with water that is static or flowing, fresh, brackish or salt, including areas of marine water where the depth does not exceed six meters at low tide”—as articulated by the Ramsar Convention.

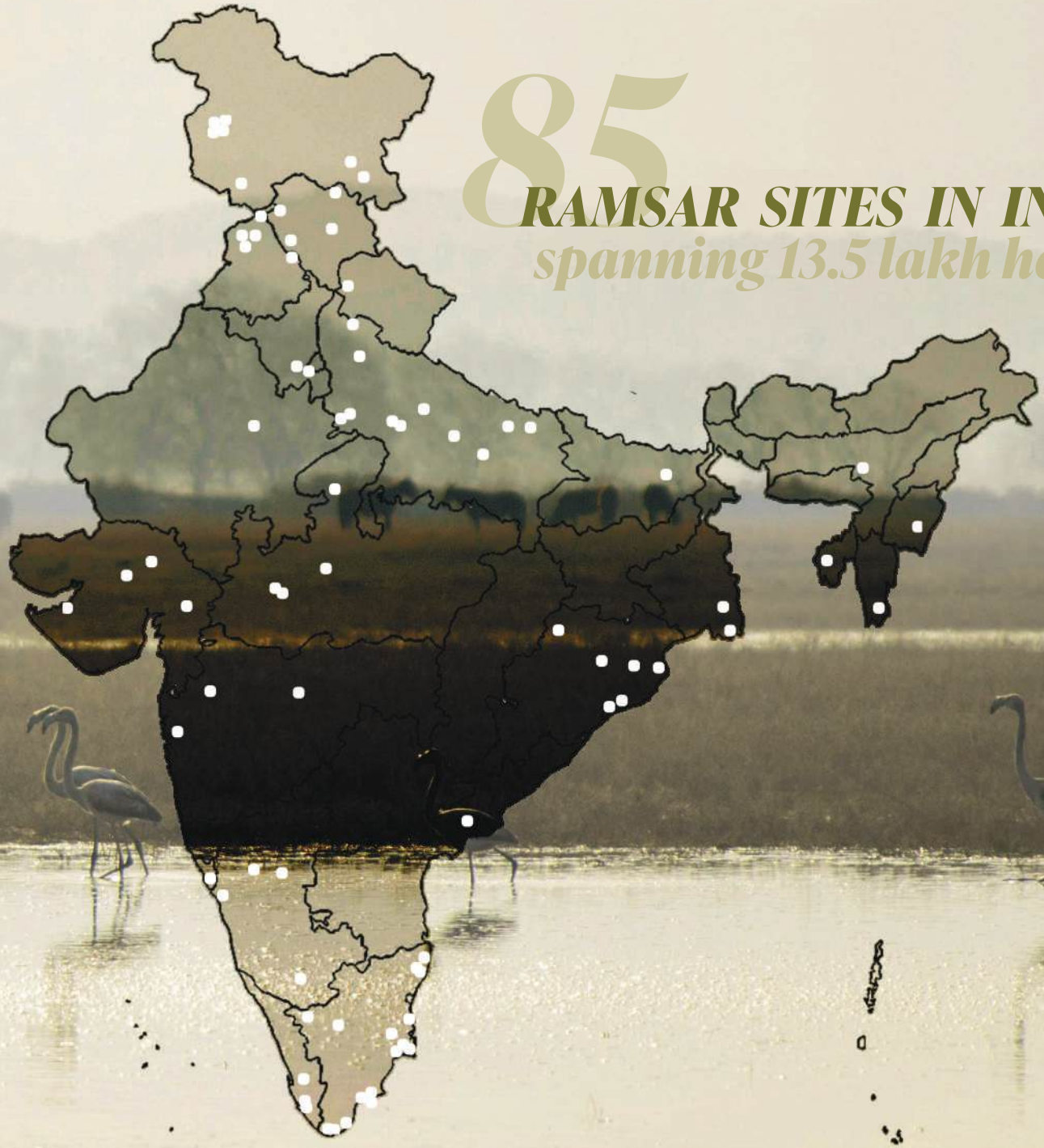
Over 50 years ago, an international treaty called the Convention on Wetlands, was adopted in the Iranian city of Ramsar on February 2nd 1971, and came into force in 1975. The Ramsar Convention provides the framework for the conservation and the wise use of wetlands and their resources through local and national actions and international cooperation. The creation of the Ramsar List which identified wetlands of international importance aims “to develop and maintain an international network of wetlands that are important for the conservation of global biological diversity and for sustaining human life through the maintenance of their ecosystem components, processes and benefits.” Since inception it has been adopted by 172 countries from across the world’s geographies. Each country joining the Convention must designate at least one wetland as a Ramsar Site. To commemorate this historic treaty, February 2nd is observed as World Wetlands Day, celebrating the vital role wetlands play in safeguarding human health and wellbeing.

Fig 1: Dr. S. A. Hejmadi representing the Government of India and signing the treaty, at the Convention on Wetlands held at Ramsar, Iran in 1971.

Wetlands are critically important ecosystems that contribute to world economies, biodiversity, climate mitigation and adaptation, freshwater availability and more. Wetlands are disappearing three times faster than our forests and are now, the earth’s most threatened ecosystem. Nearly 90 per cent of the world’s wetlands have been degraded since the 1700s. Human activities that lead to loss of wetlands include drainage and infilling for agriculture and construction, pollution, overfishing and overexploitation of resources, proliferation of invasive species and climate change. This in turn has threatened livelihoods and deepened poverty. The key challenge lies in changing mindsets and encouraging governments and communities to value and prioritise wetlands. It is urgent that we raise national and global awareness about wetlands in order to reverse their rapid loss and encourage actions to conserve and restore them.

85 RAMSAR SITES IN INDIA

spanning 13.5 lakh hectares



No. of sites per state:

Andhra Pradesh - 1
Assam - 1
Bihar -3
Goa - 1
Gujarat - 4
Haryana - 2
Himachal Pradesh - 3
Jammu and Kashmir - 5
Karnataka - 4
Kerala - 3
Ladakh - 2
Madhya Pradesh - 5
Maharashtra - 3
Manipur - 1
Mizoram - 1
Odisha - 6
Punjab - 6
Rajasthan - 2
Tamil Nadu - 18
Tripura - 1
Uttar Pradesh - 10
Uttarakhand - 1
West Bengal - 2

Source: ramsar.org
Map is not to scale
Sites have been marked roughly

There are currently over 2,400 Ramsar Sites globally, that cover more than 2.5 million square kilometres—an area larger than Mexico. India, with its sheer scale of size makes it home to extremes of climatic, geological and topographic diversity. As a result, the country is blessed with a rich diversity of wetlands, many of which are designated Ramsar Sites—as many as 85, the highest number in South Asia. These range from high-altitude lakes in the icy upper reaches of the Himalayas, marshes and swamps in the *Terai* as the sub-Himalayan foothills are called, to floodplains and ox-bows in the Gangetic-Brahmaputra alluvial basin, salt flats in the inhospitable Thar Desert and Rann of Kutch, the ponds and the reservoirs that dot the Deccan region, numerous temple tanks and step-wells that abound through the length and breadth of the country, and the extensive mangrove marshes and coral reef areas that are interspersed along the country's more than 8,000 km-long coastline. These ecosystems can vary from small village ponds—that may be smaller than one acre in area—to vast lagoons such as Chilika Lake in Odisha and the backwaters of Lake Vembanad in Kerala that together cover an expanse of over 1000 square kilometres.

Wetlands have a deep connection with Indian culture. Chanakya in *Arthashastra* has referred to wetlands as *anupa*, or incomparable. Loktak Lake in Manipur is revered as *'Ima'* or Mother, by locals whereas Khecheopalri Lake in Sikkim is popular as a 'wish fulfilling lake'. The Indian festival of *Chhath*, exuberantly celebrated mostly in the northern state of Bihar, is one of the most unique expressions of the association of people and wetlands. Other examples are Dal Lake in Kashmir, Khajjiar Lake in Himachal Pradesh, Naini Lake in Uttarakhand and Kodaikanal in Tamil Nadu, which are all popular tourist destinations.

SNAPSHOT of WETLAND TYPES in INDIA

Source: Wetlands of India Portal

11,740 **Lakes & Ponds**

3,806 **Mangroves**

2,834 **Riverine**

2,707 **High altitude**

606 **Coral Reefs**

178 **Lagoons**

House boats–originally built as vacation homes for landless British administrators but functioning as tourist stays today–on Dal Lake in Jammu and Kashmir.

Environmental and Economic Importance of Wetlands

Wetlands are frequently overlooked for developmental activities and more often than not, are reduced to becoming dumping grounds for urban or rural waste. If, however, the potential of India's wetlands is correctly harnessed, they can prove to be economic powerhouses. These diverse ecosystems, encompassing marshlands, swamps, bogs, and estuaries, are far from passive landscapes; they function as unacknowledged pillars of the national economy, contributing crores of rupees annually through their invaluable services. Conserving these "green goldmines" is not just an environmental imperative, but also a critical step towards unlocking a sustainable future for generations to come.

Broadly divided, wetlands offer three major services: Environmental or ecological benefits, economic or societal benefits, and cultural and traditional benefits. Ever so often, these benefits can overlap one another. Simply put, the role of wetlands in providing one set of services directly benefits another set; for example, flood and groundwater regulation positively impacts not just the environment, but government expenditure outlay as well. Similarly, cultural services like eco and spiritual-tourism help both human wellness as well as income generation.

Of all water-related ecosystems, wetlands act as the most productive ecosystem that nurtures biodiversity and maintains ecological balance; protects communities from extreme weather events and provides livelihoods. Their ability to act as natural filters in order to cleanse water, regulate floods, sequester carbon and act as nature's shoreline regulators, establishes these ecosystems as essential contributors to environmental health. From time immemorial, communities have depended on wetlands for sustenance. Across geographies, wetlands have been to used in a variety of ways—inundated farming, floodplain fishing, livestock grazing and for the collection of flowers, leaves and reeds.

Ironically, for many of the same reasons, wetlands are prone to major anthropogenic threats or negative externalities such as pollution, encroachment, over-exploitation and environmentally harmful tourism.

Interestingly though, in addition to these very obvious threats, according to the Ramsar Strategic Plan 2009–2015, the scarcity of information on the economic value of Wetland Ecosystem Services (WESs) has proved to be a key driving force for the continued deterioration and loss of wetlands; therefore, "to ensure the wise use of wetlands, it is important to know the values as well as the costs and benefits of wetland resources related to the services that are provided." Thus, going beyond merely their ecological importance, wetlands function as a kind of 'Natural Capital' that contributes substantially to local and national economies through myriad ecosystem services. WESs need to be used "wisely", to make the flow of income more sustainable. In order to determine the tangible value of WESs, and how such values can fluctuate due to changes in the condition of this 'Natural Capital', systematic and scientific assessments need to be regularly conducted.

Most WESs are ‘non-marketed’ commodities by their very nature. WESs are the various goods and services originating from water bodies such as marshes, swamps, bogs, fens etc., which directly and indirectly contribute to human well being. According to WWF's Living Planet Report of 2018, WESs were valued at a staggering USD 47 trillion—This huge economic resource stems from the invaluable role that wetlands play in water management, flood control and biodiversity support.

Provisioning Services:

With the population explosion across the planet, freshwater is a resource that is shrinking at an alarming rate. Wetlands are a principal source of renewable freshwater for both drinking and irrigation, as they purify water by trapping pollutants and heavy metals in their sediments and vegetation, filtering up to 90 per cent of sediments in runoff. An illustrative example is the East Kolkata Wetlands in West Bengal, where urban waste is treated and the resulting water is utilised for fish-farming and agriculture, directly supporting the livelihoods of over 50,000 people.

India's wetlands flourish with diverse life, serving as breeding grounds for fish and crustaceans, while also providing vital havens for countless bird species, reptiles and amphibians. Between 2011 and 2012, fisheries, both marine and inland, contributed approximately USD 10.9 billion to India's GDP. In fact, the majority of India’s fish production—accounting for 61 per cent of the total—originates from inland water bodies. The Indian part of the Sundarbans, the country's largest mangrove forest which lies in the state of West Bengal, contributes over Rs. 1 crore annually, to the national economy through fisheries, honey collection, prawn and grain harvests.

Wetland flora such as reeds and bamboo provide raw materials for handicrafts and construction purposes, generating income for local riparian communities. In Assam for instance, the Brahmaputra floodplain supports a thriving market for bamboo products, highlighting the economic potential of seemingly unproductive ecosystems. Odisha’s Chilika Lake saw an over-all economic contribution of an estimated Rs. 200 crore per annum.

Regulating Services:

Wetlands act as a 'natural storage reservoir' as well as a buffer in times of flood and drought. Wetlands are effective flood mitigators as they absorb excess water during the monsoons and gradually release it back out during the remaining part of the year. This protective function shields vulnerable communities from severe inundations. Using Cyclone Paradip which lashed Orissa back in 1999 as a reference point, a study which focussed on India's second-largest mangrove forest, Bhitarkanika, was conducted in 2005. It demonstrated how oftentimes, various WESs become inter-twined. The study not only came up with physical damage estimates but could also quantify in actual terms the per-household financial losses incurred due the havoc caused by the cyclone: Villages protected by mangrove forests faced the least damage as well as the lowest per-household financial loss—USD 33.31 as opposed to villages without mangrove protection which incurred a per-household loss of up to USD 153.74. Mangroves, coral reefs and sea-grass beds, not only help mitigate the impacts of tropical cyclones and tsunamis, but also help stabilise shorelines. In addition to this vital role, peat lands, mangroves and salt marshes act as natural carbon sinks. Simply put, wetlands store toxic greenhouse gases and prevent them from escaping into the atmosphere, which in turn significantly helps to reduce the impact of ozone depletion and climate change.

Supporting Services:

Wetlands support and help create fertile soils, reduce erosion and retain sediments and nutrients as well as reduce the potential for salinity and acid sulphate soils. Traditional farming communities in Jaisalmer, Rajasthan, have relied on *khadeens* or manmade flooded farmlands for generations. During the desert's short but sharp monsoon showers, rain slowly flows down a barely perceptible slope through the farmland. An earthen embankment is built across the slope to catch the run-off—no matter how little—to trap the precious water in the farmland. During the roughly two months of intermittent rain, the soil slowly absorbs the water and stays saturated long enough to raise one or two crops. Water that would otherwise have been lost as run-off, is now captured by the *khadeen*, or flooded farmland. Layers of gypsum that lie underneath the soil's surface prevent the sweet water from getting tainted by the saline water below. In addition to bringing in water, fine silt also enters these farmlands making them more fertile than the region's non-*khadeen* lands.

Wetlands have historically been a source of livelihood regardless of geography. From the lakes and springs of Kashmir in the north to the 'below-sea-level' rice paddies of Kuttanad in the Vembanad wetland system in Kerala; from the arid western salt-flats and step-wells in Gujarat to the floating *phumdis* of Manipur in the east, dependence on various wetland ecosystems is still a way of life for many traditional communities. This economic spectrum also traverses the realms of biodiversity and conservation.

Wetlands are crucial for supporting 40% of the world's biodiversity, encompassing large predators such as sharks and tigers, as well as migratory birds and fish. These ecosystems are also the exclusive habitats for several endemic species, including mudskippers and the Indian bullfrog. Remarkably, approximately 200 new freshwater species are discovered in wetlands each year.

Cultural Services:

Wetlands in India serve as important landscapes for the conservation. The rich biodiversity and the aesthetic value of these ecosystems attract tourists and avid birders from all over the world. Many of India's wetlands are critically important "stop-overs" for several migratory birds as they fall on the Central Asian Flyway (CAF). This is one of the nine routes that migratory birds including Bar Headed Geese, take from their central Asian breeding grounds to non-breeding or wintering sites in West and South Asia and the Indian Ocean. Harike Barrage in Punjab is one such halting point; while many wetlands in South India and elsewhere also get their fair share of migrant visitors, like the elegant Greater or Pink Flamingo often spotted at Pulicat Lake on the Andhra-Pradesh-Tamil Nadu border. Keoladeo National Park in Rajasthan is a UNESCO World Heritage Site and a Ramsar Site. It showcases vibrant bird aquatic and mammalian life, which in turn supports a flourishing eco-tourism industry.

This is a domino effect that supports an entire network of symbiotic activities—religious, recreational and economic. In India, many wetlands, whether lakes or tanks are often home to temples and other shrines. Renuka Lake in Himachal Pradesh, the Maduranthakam Temple tank near Chennai and the Bonbibi Temple deep in the Sundarbans mangroves, attract pilgrims from all over the country, which in turn creates a religious cottage industry. For example, every part of the lotus flowers growing in the Maduranthakam Temple tank are utilised. The flowers are sold to the temples nearby, and eventually to markets in Chennai. The remaining tubers are sold for their medicinal value; while the stalks are finally dried to extract the fibrous threads, which are then tied together to prepare wicks for the lamps in the temple.

Srinagar's famous Dal, Wular and Nageen lakes have historically been used for boating and other recreational purposes. The famous floating gardens and vegetable patches have always been a part of the traditional Kashmiri water way of life, and even today many households depend upon the lakes' bounty. The Tehri Lake created by the Tehri dam in Uttarakhand has become an extremely popular destination for angling and water sports with the state government putting in place many incentives to promote these activities.

Fig. 2: Floating market on Dal Lake in Srinagar, Kashmir. The floating gardens in the natural wetlands of Srinagar are the prime source of vegetable cultivation and these fresh vegetables are then sold on the floating 'shikara' boats on the lake.

Traditional Wisdom and Cultural Significance of Wetlands in India

From time immemorial, nature has had a huge influence on culture and religion. Most ancient civilisations have left behind evidence of the profound—yet often intangible—connect between humans and the natural world around them. Such connections have stemmed from the historical, cultural and ritualistic significance attributed to natural resources, which has helped traditional societies sustain life through harsh climates and unforgiving landscapes. Across India, immense cultural value is conferred on water-bodies and wetlands, which often also serve as the cradle for traditional ecological wisdom and knowledge. Perhaps this deep bond with this particular natural resource can be attributed to the fact that water features predominantly in every momentous occasion in a person's life—from birth until death. Be they in formal religions like Hinduism, Catholicism or Islam; animist or pagan beliefs, for most traditional societies around the globe, water has a significant role to play. It is the giver of life, a purifier, and a nurturer. Elaborate etiquette and rituals were put in place to ensure that the sanctity of this resource was maintained. These established norms are not only of spiritual significance but also hold high conservation value.

Most of the freshwater swamps that dot the Western Ghats, have presiding deities that are known by different names. The locals of

Fig. 3-4: Vanadevate, the goddess of the forest, is thought to protect those who venture into the forest for their daily labour. Serpent groves line the sides of roads in Uttara Kannada and are tended to by local villagers.

Uttara Kannada district of Karnataka for instance, prioritise the ritual worship of *Vanadevate*, the Mother Goddess of the sacred swamps. The Mother Goddess finds personification in Manipur as well. *Loktak Ima* is considered by the Meitei people to be a spiritual mother who has nurtured their people over the ages.

While such attachment of indigenous communities to their biophysical environment manifests itself in the form of ancestor and spirit worship, mainstream religions took to installing temples, engraving imagery from mythology, and putting in place, elaborate rituals to display their reverence. Step-wells are commonly found across Rajasthan and Gujarat where water is often very scarce. Sculptures of gods, demi-gods, flora, and fauna adorn the pillars and walls of Rani ki Vav, a step-well temple complex in Patan in Gujarat. A UNESCO World Heritage Site—it is depicted on the back of the Indian 100-rupee note. Elaborately carved female deities are located along the corridor at Rani ki Vav,

Fig 5-6: Rani ki Vav or 'The Queen's Stepwell' is located on the banks of the Saraswati River in Gujarat and designed as an inverted temple highlighting the sanctity of water. The first photo is taken above the ground and shows the entrance of the Vav. The second photo is below the ground showing the inside of the well.

personifying the seven most sacred rivers in India—the Ganga, Yamuna, Godavari, Saraswati, Narmada, Sindhu, and Kaveri.

Odisha's Chilika Lake—designated as India's first Ramsar Site in 1981—is many things; it is the country's largest brackish water lagoon with an estuarine character; it is home to the endangered Irrawaddy Dolphin; it is one of the significant wintering grounds for local and trans-boundary migratory birds. It comes as no surprise then, that Chilika is intrinsically woven into the culture and lore of Odisha. One such myth involves Manikapatna, a small estuarine village named after Manika, a curd-seller. Legend has it that Lord Jagannath and his brother Balabhadra set off on a journey, when they stopped on the way to buy curd from Manika for which they gave her a coin. Meanwhile, the reigning king of Puri was waging a war against the southern kingdom of Vijayanagara, and sought the blessings of Lord Jagannath. As the king started to head south with his army, he came across the coin given to Manika and surmised that he had been blessed by the gods to victory, and the town was then named Manikapatna.

In the Sundarbans—a UNESCO Heritage Site and Biosphere Reserve—one of the largest mangrove forests in the world, *Ma Bonbibi* is believed to be the presiding queen of the forest. The *Bonobibir Johuranama*, a literary compilation of texts, describes *Bonbibi's* struggle with *Dakshin Rai*, or the Southern King, who rules over beasts and demons. He is revered as a Forest God and a shape-shifter who is believed to assume the shape of a tiger prowling through the mangrove. The *Johuranama* is widely read and performed in the Sundarbans. It is a legacy that is shared by both Hindu and Muslim devotees of *Bonbibi* who seek her blessings and protection as they navigate the dense mangroves to collect honey or catch fish. Hand in hand with the elaborate myths and

legends is the traditional wisdom and knowledge that has been passed down generations. Even though the modern scientific mind may be sceptical, there is plenty to learn about wetlands and their management through traditional knowledge systems.

Traditional knowledge can sometimes manifest in the form of early warning systems. For instance, in the temple tank of the Thirupudaimaruthur temple in Tirunelveli in Tamil Nadu, there is a figurine of a monkey bowed down as if to drink water. The monkey is not merely an architectural detail, but in fact a flood indicator—if the water level of the tank reaches the monkey's mouth, it indicates an imminent flooding event.

The *khadeens* of Jaisalmer in Rajasthan's Thar Desert are yet another example of putting knowledge born out of decades of observation and years of design refinement to good use. *Khadeens*, not only improve soil quality with the silt that they add to the other-wise pretty barren farming lands. This not only allows for a couple of crop cycles, but also demonstrates water harvesting systems in a topography as exacting as the Thar itself. By virtue of being grounded, quite literally, in local knowledge, these traditions continue to be relevant even today, sustaining lives and livelihoods in this dun-coloured landscape.

Fig 7-8: Khadeens in Rajasthan, are created on slopes of farm lands by building a 'bund' that catches surface run-off after it rains.

The traditional knowledge of indigenous tribal communities manifests in many different ways. It may take the form of utilising the landscape for livelihood, knowledge of local flora and fauna, traditional engineering methods, or early warning systems for disaster management. A key component of traditional knowledge is also the detailed spatial awareness and knowledge of the landscape. For traditional and indigenous communities, this awareness often manifests itself in the form of the supernatural. In many parts of India, supernatural spirits are still revered, worshipped, placated and pacified. In the northeast for example, these spirits take various names and inhabit specific forests entities. For the Kuki tribe of Manipur, the *Thilha* spirits associated with water and springs, are considered to be the most powerful of these spirits that demand the greatest sacrifices.

The significance of traditional knowledge for the conservation of biodiversity and the achievement of sustainable development is globally recognised. Traditional societies take pride in preserving their cultural and environmental stability rather than focussing on 'over-maximising' production. As a result, "exploitation" of nature, which is considered as an abode, a deity, and a giver, rather than merely a collection of commodities, is minimised. This way of life—although dwindling with the push of modernity in the name of progress—is based on a strong sense of human interconnection and interdependence with nature, an obligation to the larger community and future generations.

Asian Small-clawed Otter or Aonyx cinereus shot at Sunderbans, West Bengal
© Soumyajit Nandy

Wetland Rules and Regulations in India

With Honourable Prime Minister Shri Narendra Modi making sustainability a key aspect of development, there has been an overall improvement in how India cares for its wetlands. Wetlands receive protection from several older central rules and regulations as well. The provisions of the Indian Forest Act, 1927, the Wildlife (Protection) Act, 1972, and the Forest (Conservation) Act, 1980, define the regulatory framework for wetlands located within forests and designated protected areas. The Environment (Protection) Act, 1986 is an umbrella Act that was enacted with the objective of protecting and improving the environment and for matters connected to it. 'Environment' as defined under the act, includes water, air and land; and the interrelationships, which exist between water, air and land and human beings and other living creatures, plants and microorganisms and property.

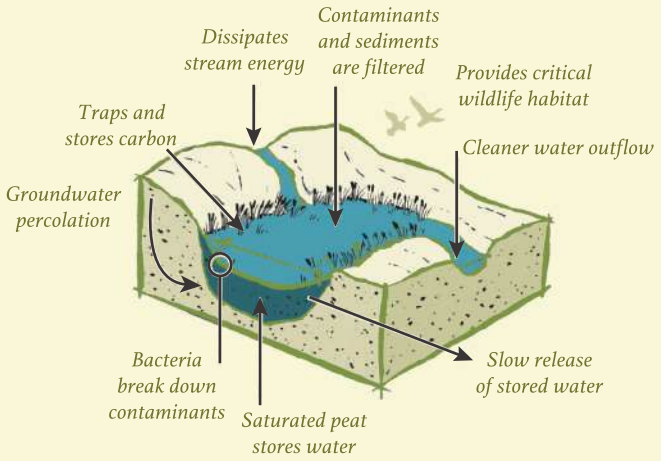
The Environment (Protection) Act, 1986 has been instrumental in protecting wetlands. Several significant regulations have been passed under it for monitoring pollution and safeguarding the environment. The Coastal Regulation Zone Notification for instance, imposes restrictions on industries, operations and processes in some specific coastal zone areas. This Act has also been useful in checking mushrooming aqua-culture in the coastal areas, protecting threatened wetlands such as the Dahanu wetlands in the state of Maharashtra, from environmentally harmful industries and projects.

Fig. 9: A farmer in Dahanu, Maharashtra. This wetland had become threatened due to excessive aqua-culture (breeding, raising and harvesting of fish, shellfish, and aquatic plants). The Environment (Protection) Act 1986 has been instrumental in the conservation of this wetland.

The Wetlands (Conservation and Management) Rules 2017, formulated by the Ministry of Environment, Forest and Climate Change (MoEFCC), prescribes various measures to be adopted by state governments to improve wetlands across India. These measures include preparing 'brief documents', determining their 'wise use', protecting their ecological characteristics, preparing a list of activities for regulation and permission, as well as developing an Integrated Management Plan.

What is a Healthy Wetland?

An aquatic ecosystem that maintains its original ecological character and can withstand disturbances such as growth of exotic species, persistent contaminants, deviations in water quality and anthropogenic interferences.
It has intact living and non-living components.



WETLAND HEALTH CARDS

WHCs are used to assess the health of a wetland ecosystem. They give us information about:

Biodiversity
- Diverse Flora & Fauna (Presence of macrophytes and water birds)
- Presence of 'Indicator Species'–good indicators such as water birds, bad indicators such as invasive species like water hyacinth
- Habitat Quality

Hydrology/Catchment
- Water levels
- Flow patterns - inlets & outlets
- Anthropogenic influence on catchment area

Area
- Size of the wetland
- Land Use
- Habitat Area

Governance
- Policy & Regulations
- Management practices
- Protection status

Benefits of WHCs:

Prioritization of Conservation Efforts

Improved Decision-Making

Public Awareness

Fulvous Whistling Duck or Dendrocygna bicolor shot at Keoladeo National Park, Bharatpur
© Jayanth Sharma

Knob-billed Duck or Sarkidiornis melanotos shot at Keoladeo National Park, Bharatpur
© Jayanth Sharma

Campaigns for Wetland Conservation in India

The Ministry of Environment, Forest and Climate Change (MoEFCC), under the Government of India has initiated a number of campaigns and awareness programmes for wetland conservation in India. Notable among them are Mission LiFE (Lifestyle for Environment), Amrit Dharohar; Amrit Sarovar, and the MISHTI Scheme among others. Several other outreach efforts have also been put into place in order to sensitise and create awareness in not just the immediate stakeholders but amongst the general public at large.

Amrit Dharohar:

Launched in June 2023, by the Central Government, the 'Amrit Dharohar Capacity Building Scheme', is spearheading significant transformation in the area of wetland tourism. The MoEFCC, along with the Ministry of Tourism, aims to revolutionise tourism practices at ecologically sensitive wetlands, particularly Ramsar Sites. The scheme will be implemented over the next three years to encourage the “wise” use of wetlands, thereby enhancing biodiversity and carbon stock. Opportunities for eco-tourism will be optimised through the strategic transition from high-volume tourism to high-value nature tourism at ecologically-sensitive wetlands, generating income for local communities. Multiple pilot sites have been identified like Chilika Lake in Odisha, and Sultanpur Bird Sanctuary in Haryana among others.

Amrit Sarovar:

Mission Amrit Sarovar was launched in April 2022 as part of the year-long celebration of India’s 75th Independence Day or *Azadi Ka Amrit Mahotsav*. With the focus on water conservation for the future, 75 Amrit Sarovars or ponds were to be either developed or rejuvenated in every district of the country, with the ultimate goal of creating about 50,000 Amrit Sarovars across the country. By August 2023, the number of Amrit Sarovars crossed the initial goal, with more than 60,000 projects being completed.

Fig 11: The country's first "Amrit Sarovar" was inaugurated by former Union Minister Mukhtar Abbas Naqvi and Uttar Pradesh Jal Shakti Minister Swatantra Dev Singh at Patwai in Rampur, Uttar Pradesh (May 13, 2022). Originally a pond on the Gram Sabha land, the site had become a garbage dump after it dried-up. The villagers, schools, Gram Panchayat and the District Administration joined hands to transform this water body into a reservoir as well as a tourist attraction.

Mangrove Initiative for Shoreline Habitats & Tangible Incomes (MISHTI):

The Mangrove Initiative for Shoreline Habitats & Tangible Incomes scheme was launched with an implementation period of five years starting from 2023. The acronym MISHTI which means 'sweet' in Bengali is highly appropriate as the scheme has in its inception phase focussed primarily on the Sundarbans Delta, and the Hooghly Estuary in West Bengal, but will gradually also include other wetlands in the country.

MISHTI is a government-led initiative that is aimed at increasing, conserving and restoring the mangrove ecosystem along the coastline and on saltpan lands. Mangroves are critical to mitigating the effects of climate change, by preventing coastal erosion and sustaining local livelihoods. Under the scheme, financial assistance is being provided to encourage mangrove plantation activities. The activities are conducted in a participatory manner involving local communities and NGOs, in order to ensure sustainability and create sense of community ownership of the initiative.

Mission LiFE (Lifestyle for Environment):

The concept of Mission LiFE was introduced by Honourable Prime Minister during the 26th United Nations Climate Change Conference of the Parties (COP26) in Glasgow, Scotland. The idea promotes an environmentally conscious lifestyle that focuses on "mindful and deliberate utilisation" instead of "mindless and wasteful consumption". The LiFE movement aims to utilise the power of collective action and to nudge individuals across the world to undertake simple climate-friendly actions in their daily

Fig. 12: Mangrove Plantation Program organised in Chengalpattu district of Tamil Nadu, led by the Union Minister for Environment, Forest and Climate Change, Shri. Bhupender Yadav.

Fig. 13: Prime Minister Narendra Modi, UN Secretary-General Antonio Guterres (centre), External Affairs Minister Dr. S. Jaishankar and Gujarat C.M. Bhupendra Patel during the global launch of Mission LiFE at the Statue of Unity, Gujarat.

lives. The LiFE movement, additionally, also seeks to leverage the strength of social networks in order to influence the social norms surrounding climate.

Save Wetlands Campaign/ Mission Sahbhagita:

The Mission Sahbhagita Guidelines were created by the MoEFCC to promote a 'whole of society' approach to protect and sustainably manage wetlands with key stakeholders and local communities at the forefront. To take this idea forward, a year-long 'Save Wetlands Campaign' was launched in February 2023 during the celebration of World Wetland Day. Aligning with the Mission LiFE, the objective of this campaign is to create mass awareness about the importance of wetland conservation and management, while actively involving local communities in the integrated management and monitoring of wetlands and getting community-based organisations, businesses, and knowledge partners to join hands to save the wetlands from further degradation.

Wetland Mitras:

The MoEFCC envisaged the concept of 'Wetland Mitra', which literally translates to 'Wetland Friend'. Wetland Mitras are volunteers who play an important role in protecting these valuable ecosystems. At least 20,000 Wetland Mitras are enrolled and connected through a digital network and roughly 10 lakh citizens have been trained to identify and report threats to wetlands and work to further sensitise the public about the importance of wetlands. Mitras are motivated volunteers from diverse stakeholder groups that work together to protect the wetlands and actively engage in conservation initiatives to manage these natural resources. Wetland Mitras achieve this objective through the use of four broad pillars: Communication, Education, Participation and Awareness.

Fig 14: Wetland Mitra teams de-weeding the Kabartal wetland in Bihar.

Fig 15: Wetland Mitras conducting a bird survey in Puttenhalli lake in Karnataka.

Kurur Lake, Tamil Nadu

What We Can Do to Protect Our Wetlands

For Mobius Foundation, the driving ethos behind events like "Wetlands for Wellbeing: Preserving India's Wetlands" is to raise awareness about the environmental dilemmas that challenge each and every one of us across the globe. Through the medium of engaging, interactive sessions, the aim is to start a conversation. Climate Change is a very real phenomenon that directly affects wetlands and therefore needs to be addressed on a war footing. And the soldiers in this war are our youth—children, students, researchers and scholars.

The experts gathered at the event lauded the initiatives taken by the central government. They commended these as vital steps in the right direction towards saving critically endangered wetlands not only in the Indian subcontinent, but also across the globe. At the end of the thought-provoking and insightful panel discussion, the eminent group drew on their vast experience in the diverse areas of their personal expertise and proposed a number of practical suggestions, that if given due consideration can go a long way in conserving not only precious Ramsar Sites but also other wetland ecosystems.

The ways in which ordinary citizens can contribute significantly towards protecting and preserving wetlands are simple and practical. Government-sponsored programmes like Wetland Mitra and Mission LiFE can be easily adopted if there is a wetland present in one's vicinity.
Visiting wetlands in one's own area helps to create a deep personal connect, as well as educates on the types of flora and fauna that thrive there. Exploring these wetlands regularly helps to identify what specific threats they may face. Land use of the wetlands is another key factor to their health. Often, wetlands are seen as wastelands; spaces to be filled in, drained off, cleared by burning or converted for other uses. Any illegal activities such as logging or encroachment in a protected site should be reported immediately to the relevant authorities.

Spreading awareness by disseminating information to others within the community is easy. Making others understand the huge benefits that wetlands bring, both globally and locally is crucial. Volunteering time and labour to organise wetlands clean up is yet another practical solution. Many urban wetlands often become dumping grounds for garbage and other refuse. Working regularly in a group for an hour or two can make all the difference to wetland health. Documentation of the 'before' and 'after' results to highlight the difference, also helps generate awareness and inculcate a sense of ownership within the larger community.

At the Mobius Foundation event, the experts not only discussed these easy solutions, but also referenced their own experiences. As a member of the Delhi Wetlands Authority, *Dr. Suneesh Buxy*, IFS Member Secretary, talked about the practical challenges faced by the capital city's wetlands and how this is compounded by land ownership issues in the fight to restore them. *Mr. Ramveer Tanwar*, Pond Man of India, in his address and through his presentation shared many practical suggestions to save the ponds in and around the Delhi-NCR region. *Mr. Soumitra Dasgupta*, IFS (Retd), former Principal Chief Conservator of Forests and Head of Forest Force, West Bengal, talked about the importance of the Sundarbans and also the challenges faced in protecting them like deforestation, climate change, sea level rise. *Dr. Aditya J*oshi, former PCCF, HOFF, CWLW, Government of Manipur and Advisor, Think Tank, Mobius Foundation, and an expert on Loktak Lake spoke

Dr. Suneesh Buxy - IFS Member Secretary, Wetland Authority of Delhi

Mr. Ramveer Tanwar, Pond Conservationist, Pond Man of India

Mr. Soumitra Dasgupta, IFS (Retd), former Principal Chief Conservator of Forests and Head of Forest Force, West Bengal

Dr. Aditya Joshi, former PCCF, HOFF, CWLW, Government of Manipur and Advisor, Think Tank, Mobius Foundation

Dr. Ritesh Kumar, Director,Wetlands International South Asia

Mr. Suresh Babu, Senior Director, Ecological Footprints, WWF India

about the threats this Ramsar Site in Manipur faces and highlighted a significant step in the right direction for the preservation of Loktak: the proposed decommissioning of the Ithai Barrage. This proposal has already been suggested by the state government to the centre and is currently under serious consideration. This is a historically significant move, as it can potentially become one of the first instances where a multi-national hydro project will have to bow down to pressure from local, conservationist and civil society. *Dr. Ritesh Kumar*, Director, Wetlands International South Asia, observed about the distinction between the European and Indian model of wetlands conservation highlighted the fact that while European models were scientifically-driven, Indian models need to be more people-centric and participatory in nature, given the large number of local communities dependant on these wetlands not only for their livelihood but for their very survival itself. *Mr. Suresh Babu*, Senior Director, Ecological Footprints, WWF India, suggested shared participation by government and civil society to rejuvenate our wetlands. As outlined by Mission LiFE, simple things like changing one's consumption habits, saving water and reducing harmful waste can make a hugely positive difference not just to these ecosystems but also to the larger environment. Encouraging sustainable farming and buying sustainably raised or caught seafood, organic produce and meat can all have a positive effect on wetlands. The ban on single-use plastic has encouraged the use of cloth or reusable bags. Recycling household garbage, and ensuring that batteries and other harmful e-waste do not end up in wetlands or landfills all make for wisdom for our wetlands.

These sessions create a platform to bring together luminaries in the field of conservation, policy makers and the influencers of tomorrow—future conservationists and environmental warriors. In the long run, it will influence policies and act as a push for more comprehensive efforts for the protection and conservation of biodiversity in the wetland ecosystems in India. Furthermore, it will result in a deeper understanding of the conservation of endangered species and the rejuvenation of these vital ecosystems, fostering the aim of a more sustainable and resilient planet.

POLICY-LEVEL ACTIONS

Government

- Delineation of wetland boundaries.
- Establishment and strengthening of robust regulatory mechanism for wetland conservation.
- Implementation of conservation programs for wetlands and coastal areas.
- Monitoring of wetlands.
- Establishing protected areas and enforcing regulations.
- Promoting sustainable tourism practices.
- Monitoring and mitigating development impact.

Mr. Bhupendra Yadav, Union Minister, MoEFCC, launched the 'Save Wetlands Campaign' in Goa

Environmental Awareness Programs at school/college level to NCC students

Institutional

- Exposure and awareness on the importance of wetlands.
- Including wetland visits and rejuvenation activities in curriculum.
- Encouraging students to volunteer in cleanliness drives, plantation efforts, wetland health assessments, creation of Wetland Health Cards.
- Assignment of mandatory projects on wetlands in colleges.
- Encouraging students to explore the importance, threats and potential solutions towards wetland conservation.
- Inform and involve the community, through
- Conducting neighbourhood workshops and seminars with experts, about water conservation.

Wetland Mitras birdwatching at a lake

At Home

Waste Management

- Segregate your waste.
- Compost biodegradable waste.
- Recycle paper and plastic waste.
- Reduce the amount of solid waste disposed into our wetlands.

Save water

- Install water-saving devices like low-flow showerheads, dual-flush toilets in homes.
- Adopt efficient gardening practices like drip irrigation, planting native species.
- Practice mindful habits like turning off taps while brushing teeth, fixing leaks.
- Participate in community-based water conservation initiatives.
- Raise awareness about sustainable water use.
- Install rainwater harvesting systems.
- Reuse grey water.
- Install decentralized waste-water treatment system.

INDIVIDUAL ACTIONS

Around Wetlands

Be Responsible

- Do not disturb or hurt birds and animals in the wetland.
- Do not litter wetlands and other water bodies.
- Plant native species that support local biodiversity.
- Regularly remove weeds and invasive species.
- Ensure all inlets and outlets of the wetlands are intact and functional.
- Promote organic farming and reduction of chemical fertilizers.
- Restrict the flow of untreated sewage into the wetlands.
- Monitor changes in land-use and land cover around wetlands.

Be Pro-Active

- If a wetland near you is at risk due to illegal construction, dumping of untreated waste, or any other threat, report it to the government/local authorities.
- Join water governance meetings in your city. Participate in ward *sabhas*, become a Wetland Mitra or lake warden to actively contribute.
- Pledge to take care of a wetland near you. Volunteer to organize or participate in cleanliness drives, plantation drives, wetland health assessments and awareness programmes over the weekends.

FOUR MAJESTIC WETLANDS IN INDIA - AT A GLANCE

India is home to some breathtaking wetland bodies that are an intrinsic part of the people and cultures that surround them.
This snapshot showcases four such places that are not only important to humans but also home to some seriously endangered species.

Supporting humans...

Loktak

- The largest freshwater lake in Northeastern India.
- Its floating 'Phumdis' provide refuge for the endangered Sangai deer.
- Situated in Manipur
  ~287 km²
- Species Supported:
  116 Birds, 54 Fishes, 22 Mammals, 68 Reptiles & Amphibians, 200+ Plants

Along the coasts...

Sundarbans

- The largest mangrove forest in the world.
- Home of the endangered Royal Bengal Tiger.
- Spans West Bengal in India and Bangladesh.
  ~10,000 km2
- Species Supported:
  356 Birds, 50 Mammals, 72 Reptiles & Amphibians, 350 Fishes, 280+ Plants, 753 Insects

Up in the mountains...

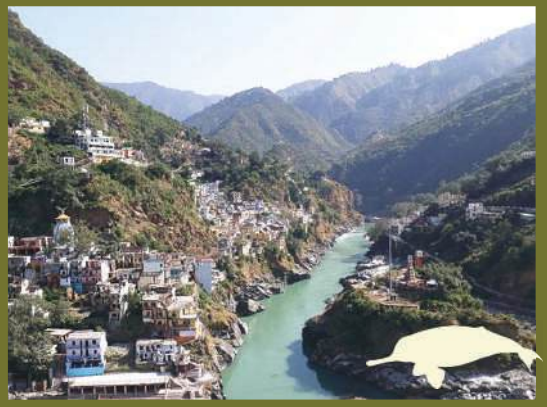
Chandratal

High up in the Himalayas,
a clear blue, moon shaped lake.

Haven for the "ghost of the mountains"
—the Snow Leopard.

In the valleys of Himachal Pradesh
~2.5 km2

Species Supported:
30 Birds, 11 Mammals,
28 Plants



On the floodplains...

The Upper Ganga

Cradle of ancient and modern
Indian civilizations.

Habitat of the endangered Gangetic
River Dolphin.

Coursing through Uttar Pradesh
~266 km2

Species Supported:
102+ Birds, 82 Fishes,
12 Turtles, 450 Plants

Despite their ecological, spiritual and aesthetic wealth, these wetlands are facing a major crisis today. Pollution, deforestation, encroachment, human-wildlife conflict, unregulated tourism, overexploitation of resources are all threats to their survival.

There have been significant efforts and checks put in place by the governement, such as the creation of protected areas, raising awareness about the endagered species inhabiting these waters, anti-poaching and cleanliness drives; The need of the hour still is community participation. Without care from their people, these wetlands cannot hope to survive.

The next chapter gives an in-depth undestanding of each of these case studies, their importance, and the challenges the face today. Panellists at the Mobius event "Wetlands for Wellbeing: Preserving India's Wetlands" event extrapolated on wetlands specific to their own areas of expertise.

Case Studies

LOKTAK LAKE
The Floating Islands of India

Drawing on his long experience of having worked closely at Loktak Lake in Manipur, Dr. Aditya Joshi highlighted the threats to the Loktak Lake and how authorities and local communities have come together to protect this important Ramsar Site. He also shared his insights about this unique ecosystem and how it supports not only the local indigenous community's livelihood but also helps to conserve its most iconic creature—Manipur's state animal, the Sangai or Dancing Deer.

Loktak Lake, the biggest natural wetland in India's north-east, is a large expanse of water west of the River Imphal in Manipur. Locally, *Loktak Ima*, or Mother Loktak, is considered by the indigenous Meitei community to be their spiritual mother, one who has nurtured them over the ages. Around and within Loktak, there are many sacred sites that all contribute to the mystique of this unique wetland.

It boasts a unique ecosystem characterised by an archipelago of 'floating islands' covered with soil, vegetation and biomass called *phumdis*. These *phumdis* are reinforced and thickened to reduce sogginess, with new layers added periodically to expand habitable space. Biomass is manually cut and spread atop existing layers, while older biomass is pushed beneath to establish and maintain a strong foundation. Bamboo and logs are strategically placed around the phumdis to create walkways. Fishermen inhabit these *phumdis* in huts known as *phumsang*, which are built on bamboo bases for stability. Locally crafted wooden boats are used for transportation across the lake. From a vantage point, multiple circular *phumdis* dotted across the lake can be observed—a result of laborious manual work. The largest congregation of *phumdis* is in the Keibul Lamjao National Park, home of the Sangai deer.

This Ramsar Site, is also a livelihood lifeline for the indigenous fishing communities like the Meitei. Fishing, farming, and the collection of aquatic plants are the main income generators. This community possesses a wonderful and rich repertoire of ancient knowledge and skills for the wise use of Loktak. The traditional fishing technique of *phum namba* which literally translates to *phum* pressing, is applied using the *athaphum* technique which basically means using enclosures of *phumdi* strips arranged in circles that use buoyant biomass, anchored to the lake bed and filled with vegetation. These enclosures attract fish but also act as the primary foundation of fish breeding and trapping. *Athaphum*—a technique, that has evolved over time, but now uses more modern techniques like drag nets—presents a challenge to lake management due to its role in promoting over-fishing and proliferation. Addressing this issue requires an understanding of its ecological aspects and sensitivity to its social ones, including its genesis, transformation, and contributing factors. In modern times, *athaphum* fishing occurs throughout the year based on fish availability, contributing approximately 40 per cent of the total lake fish yield. According to 2007-8 surveys, over 5,000 fishing households relied on *athaphum* fishing for their livelihood.

This centuries' old way of life for the Meitei fishing community is being severely challenged by developmental projects and other factors. In 1983, a multipurpose project was commissioned for

The Sendra Tourist Home on a phumdi in the middle of the Loktak Lake, Manipur, is a famous tourist spot.

generation of hydropower and irrigation by construction of a barrage at Ithai in the southern part of the lake. This has brought about drastic changes in hydrological regimes and converted a natural wetland with normally fluctuating water levels into a reservoir with more or less constant water levels. Deforestation and shifting cultivation in the catchment area has promoted soil erosion resulting in increased lake siltation. A staggering 650,000 tonnes of silt gets deposited annually in Loktak. Nutrients from the catchment area, runoff from agricultural pesticides and domestic sewage from Imphal city carried by the Nambul River, all drain into the lake. The rapid proliferation of *phumdis* and excessive growth of aquatic weeds have led to reduced water holding capacity, deterioration of water quality, interference in navigation, and overall reduction in the aesthetic value of the lake. Encroachments through the construction of fishponds, roads and settlements has only compounded the problem. These factors have all lead to a loss in the lake's biodiversity. Populations of both resident and migratory waterfowl have declined during last few decades due to poaching and changes in the ecological character of the lake. The habitat of the Sangai deer in Keibul Lamjao National Park is also under threat. Many species of animals, birds, reptiles and aquatic life that occurred abundantly in the past have either declined or are gradually disappearing.

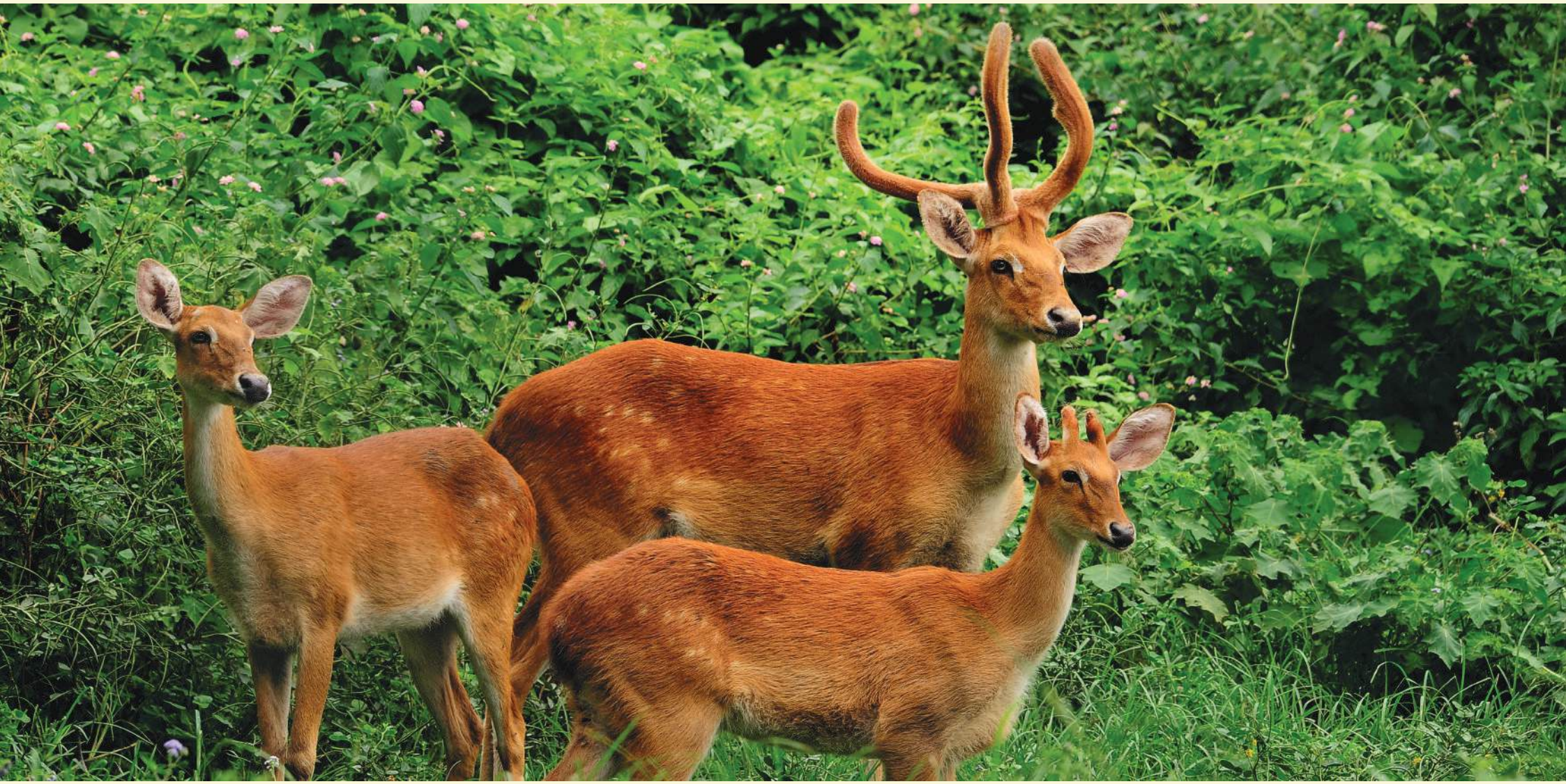
Sangai or Brow-Antlered Deer (Rucervus eldi eldi)

Some facts on the species:
Population: about 200 individuals
Height: 115-130 cm (male), 90-100 cm (female)
Weight: 90-125 kg (male), 60-80 kg (female)
Food: water plants, grass, herbs and shoots
Lifespan: about 10 years

The Sangai or Brow-Antlered Deer, is a Schedule I animal under the Wildlife (Protection) Act, 1972 and is on the endangered list of the International Union for Conservation of Nature (IUCN) Red List. Sangai were believed to be almost extinct soon after Independence; however, six individuals were spotted in 1953. After the State of Manipur declared it a protected species, its population has increased to approximately 204 individuals.

A medium-sized deer, it has uniquely distinctive antlers. The forward protruding beam appears to come out from the eyebrow giving it its name: Brow-Antlered Deer. It is largely seen on the floating biomass, or *phumdis*, located in the south eastern part of Loktak Lake inside the park. While the park covers an area of 40 square kilometres, the home range of the deer within the park is confined to between 15 and 20 square kilometres. These *phumdis* are the most important and unique part of the Sangai's habitat.

The Sangai faces threat from the steadily degeneration of its habitat due to continuous inundation and flooding caused by the artificial reservoir created by the Ithai Barrage. Water quality of the reservoir is being degraded due to pollution and stoppage of nutrient supply. There is also an invasion of non-native plants like Paragrass. The Sangai also faces threats of diseases from domestic livestock, inbreeding and poaching.



Sangai deer or Rucervus eldi eldi shot in Manipur
© Ministry of Tourism, Manipur

SUNDARBANS
The Largest Mangrove Forest

As a former Principal Chief Conservator of Forests and Head of Forest Force, West Bengal, Mr Soumitra Dasgupta talked about the importance of the Sundarbans and also drew attention to the various challenges faced in protecting these wetlands, such as deforestation, climate change and rising sea levels among others.

The Sundarbans wetland, has been a UNESCO World Heritage Site since 1999 and on the Ramsar List since 2019. Covering a sprawling 9630 square kilometres, the Indian part of the Sundarbans comprises of a complex network of mudflats, islands, rivers, channels, and creeks. Its tropical climate—with estuarine water temperatures ranging from between 20 and 35 degrees Celsius—is influenced by monsoon winds, bringing an annual rainfall of between 1500 and 2000 millimetres. Located at the mouths of the Ganges, Brahmaputra, and Meghna rivers, the Sundarbans ecosystem consists of a brackish water environment, the result of the mingling of salt and fresh water. These nutrient-rich waters foster spawning grounds for various fish species; while the forest with its diverse plant and animal life, is home to an apex predator: The Bengal Tiger. Resources like food, fibre, medicinal plants, and wood are the mainstay for the locals.

The Sundarbans also acts as a natural barrier, protecting human settlements from cyclonic disturbances like the storm surges and strong winds that frequently occur; offering a range of WESs vital for both local livelihoods as well as for spiritual well being. Mangroves—transitions between land and sea—have evolved as mechanisms for the exchange of organic and inorganic substances, including nutrients. The Sundarbans ecosystem serves as a significant source and sink of carbon, with substantial primary production from its forests and wetlands. It stores organic carbon in its peat soils and transports it via tides to coastal waters, eventually settling as bottom sediments in the ocean.

Economically, the Sundarbans plays a crucial role for the state of West Bengal, providing precious raw materials for various industries as well as supporting traditional and non-timber forest product harvesting. Of the 100 islands that fall in the Indian part of the Sundarbans, only about 54 are inhabited, while the rest are designated as protected forests. Although agriculture is the traditional livelihood, the brackish nature of the river renders farming difficult and unreliable. Winter cultivation is almost non-existent due to the scarcity of fresh water. Impoverished families, especially those with limited or no land ownership, depend heavily on marine resources such as fish, prawns, and crabs from the waters for their livelihood. The forest also serves as a significant source of income for these families who frequently venture deep inside in order to collect firewood, timber, and honey. Livelihood activities in the Sundarbans are physically very demanding and present various challenges for the local population, resulting in a significantly poor quality of life. The frequent occurrence of cyclones in the region, has led to a decline in agricultural practices, resulting in a high rate of male migration to large cities and other urban centres in search of work.

Royal Bengal Tiger
(Panthera tigris tigris)

Some facts on the species:
Population: about 3700 individuals

Saltwater Crocodile or Crocodylus porosus shot at Sunderbans, West Bengal

Height: 275-290 cm (male), 260 cm (female)
Weight: 150-170 kg
Food: deer, monkeys, buffaloes, hare etc.
Lifespan: about 15 years

The Bengal Tiger is the most numerous of the six-tiger subspecies, and accounts for about half the world's population of wild tigers. Despite their iconic status in both India and Bangladesh, Bengal tigers are a highly endangered species. The Sundarbans National Park, in West Bengal, provides a safe haven to is home to about 101 of these majestic felines.

Tigers occupy an important place in Indian culture finding significant place in Hindu mythology as the vehicle or *vaahan* of the Goddess *Durga*. Since time immemorial, while the tiger has been a symbol of magnificence, power, beauty and ferocity, it has also been associated with the virtues of bravery, nobility and valour. In fact, historically, hunting tigers was considered to be one of the highest acts of bravery by kings and noblemen; and it is this "act of valour" that prompted the competitively self-indulgent hunting expeditions or *shikaar* during the British Raj, leading to the near decimation in tiger numbers. The tiger is a unique animal, which plays a pivotal role in the health and diversity of an ecosystem. It is an apex predator and is at the top of the food chain. As an "umbrella" species, tiger presence in the forest is an excellent indicator of the well being of the ecosystem. The Bengal Tiger is found mainly in India, Nepal, Bhutan and Bangladesh. Tigers are found in a variety of habitats, including tropical and sub-tropical forests, evergreen forests, mangrove swamps like the Sundarbans, and grasslands. Tiger population in India is currently pegged at about 3700 individuals living mostly in National Parks, Tiger Reserves and Wildlife Sanctuaries, also known as Protected Areas.

With its distinctive orange and black striped coat, the Bengal Tiger is instantly recognisable. Its black ears, each with a winking white spot at the back is another dead giveaway. Tigers can measure between 2.6 and 3 meters from the nose tip to its tail end, and can weigh anywhere between 135 and 280 kilograms. The average life span of a tiger in the wild is between 14 and 16 years. Due to their large body size, tigers unlike leopards, are not good tree climbers. They can only climb along large leaning trees. Tigers however, are excellent swimmers and love water. Sundarbans tigers unlike their counterparts on mainland habitats, can not only drink saline water and swim between islands, but can hunt in these tidal waters as effectively as they do on land. The diet of an Indian tiger mainly consists of large deer such as *Chital (Axis axis), Sambar (Cervus unicolor), Barasingha (Cervus duvacelii), Nilgai (Boselaphus tragocamelus)* and other animals such as Wild Boar *(Sus scrofa)*. It is an opportunistic feeder and can at times also kill large prey such as elephant calves (*Elephas maximus), Gaur (Bos gaurus)* and Wild Buffalo *(Bubalis arnee)*. Tigers may occasionally also kill sloth bear and leopards as well as smaller prey such as peafowl, *langur* monkeys, jungle fowl, hare etc.

The increase in human populations has caused the incidence of man-animal conflict to rise as well. This has been observed as particularly true in the Indian part of the Sundarbans. Development, deforestation and poaching have also contributed to a reduction of the tiger's natural prey base. As a result, human settlers who rely on the forest for their livelihood often end up falling prey to these apex predators.

Royal Bengal Tiger or Panthera tigris tigris in the Sunderbans Mangrove, West Bengal
© Soumyajit Nandy

CHANDRATAL
The Lake Of The Moon

Chandratal Lake is a naturally occurring high altitude wetland situated in the Lahaul and Spiti district of Himachal Pradesh. Nestled high in the Western Himalayas, near the Kunzum pass, which connects the Greater Himalayas and Pir Panjal ranges, Chandratal sits at an elevation of 4337 metres above sea level. Located in the upper Chandra River valley, the lake is embedded in a large alpine meadow that supports a variety of animal and plant life. This lake is also one of two high-altitude wetlands in India that have been designated as Ramsar Sites—the other being Tso Morari in Ladakh, which is the highest in the world. Historically, Chandratal Lake was used as campsite for traders who travelled down the ancient Silk Route. Today it is a destination for adventure enthusiasts and nature lovers alike. Shaped like a crescent moon, this beautiful lake changes colour throughout the day giving it a magically surreal quality.

Chandratal Lake falls in the higher Himalayas, which is covered by perennial snow and the Barashigri glacier for the most of the part of the year. This high-altitude zone is a region of oxygen deficiency, low atmospheric pressure, excessive cold, aridity and intense radiation. The flora and fauna of this region have developed particular physiological and morphological features that allow them to counteract or withstand the unfavourable effects of these extreme environmental conditions.

These wetlands are a repository of the unique biological diversity of this ecological zone—reflective of other alpine areas of the Western Himalayan ecosystem. A large number of mammals are present in the lake's catchment area. The most important of Chandratal's residents is the highly endangered Snow Leopard *(Panthera uncia)*. Other prominent species are the Red Fox *(Vulpes vulpes)*, Bobak Marmot *(Marmota bobak)*, Royal's Vole (*Alticola roylei)*, Himalayan Ibex *(Capra sibirica hemalayanus)*, Blue Sheep or *Bharal* as it is known locally *(Pseudois nayaur)* all of which are categorised as endangered on the International Union for Conservation of Nature (IUCN) Red List.

Chandratal is also an important site for a host of migratory birds using the Central Asian Flyway (CAF), during the summer months. Many different species are found in these wetlands, including the Snow Cock *(Tetraogallus himalayensis)*, Barbary Partridge or *Chukor (Alectoris Barbara)*, Black Ring Stilt *(Himantopus mexicanus)*, *Brahmi* Duck *(Tadorna ferruginea)*, Kestrels *(Falco tinnunculus)*, Golden Eagle *(Aquila chrysaetos)* and Chough *(Pyrrhocorax pyrrhocorax)*

Chandratal Lake is of special value for not only for maintaining the genetic and ecological diversity of the region, but also for its endemic plant and animal communities. In addition to mammals and birds, the region abounds in various insects during the summer season. The insect fauna consists of spiders, beetles, wingless grasshoppers, butterflies and bugs. The margins of the lake abound in larvae of mayflies, stoneflies and caddis flies.

The lake is fed by glacier melt water from the catchment area especially on its left bank. There is a regular out flow of water, which varies depending on the season. Outflow from the Chandratal Lake meets the Chandra River. With generally very little human activity in the immediate vicinity, this fresh water lake is free from eutrophication. Since the Chandratal area falls in the rain-shadow areas of the Himalayas, the monsoon hardly

Lake Chandratal, Himachal Pradesh

Fig 16: Sheep grazing around and drinking water from Lake Chandratal.

penetrates the valley; and if and when it does, it takes on the form of a misty drizzle. During the winter season, precipitation occurs in the form of snowfall, creating extreme climate with temperatures dipping to between -37 and - 40 degrees Celsius.

Over the last couple of decades, Chandratal is witnessing some level of anthropogenic interference to the lake ecosystem. However this is seasonal—limited to the summer months—caused by trekkers and tourist traffic from the nearby settlement of Batal, and the high mountain passes of Kunzum and Baralacha that allow tourists to travel over. During the peak summer tourist season, a large number of visitors pollute the lake by leaving behind garbage after camping, thereby affecting the water quality of the lake. Most of the camping spots on this alpine meadow are at the northern end, which drains into the lake. This adds toxicity to not just the marine life but to the surrounding areas as well. Nomadic herdsmen that pass through the Chandra valley each year, with huge flocks of sheep and goats that graze in the meadows, also contribute in degrading the entire Chandratal ecosystem and its catchment area. The combined effect of seasonal visitors and migratory herdsmen contributes to increased siltation and organic influx into the lake.

Modern day seasonal visitors travel to Chandratal for its mystical beauty; this aura is only enhanced by the legends and myths with which the lake is awash. In a folk tale about Chandratal Lake, it is believed by local communities, that it is home to a mermaid. The story has it that there was once a shepherd who came to check on his livestock near the shores of the lake, when he came upon a beautiful mermaid in the water. The two fell in love immediately, but there was a catch: The shepherd was married, but did not disclose this fact for fear that he would lose the love of his life. One day the secret was revealed to the mermaid. Heartbroken, she vanished and the shepherd never saw her again. People believe that the mermaid in search of love, still lives by the lake and steals things from unmarried men and is visible to only single men.

There is also a myth from Hindu mythology, which goes back to the *Mahabharata*. It is believed that after defeating the *Kauravas* in the great battle at *Kurukshetra*, the five *Pandava* brothers embarked on their final journey towards heaven. As they undertook the arduous walk, they died one by one until only the eldest brother *Yudhishtir* remained. Legend has it that Lord *Indra* descended to Chandratal in his chariot and carried *Yudhishtir* away with him to heaven. Due to this legend, local villagers view Chandratal Lake as a sacred space and even compare it to the River Ganga. Many Hindus, even today make the pilgrimage to Chandratal Lake in order to bathe in its holy water.

Lake Chandratal, Himachal Pradesh

Snow Leopard (Panthera uncia)

Some facts on the species:
Population: 400-700 individuals
Height: 60 cm
Weight: 35-40 kg (female), 45-55 kg (male)
Food: sheep, deer, other small mammals
Lifespan: about 18 years

Snow leopards play a key role as a top predator, an indicator of the health of their high-altitude habitat, and increasingly, an important indicator of the impacts of climate change on mountain environments. If snow leopards thrive, so will countless other species and many of the planet's important freshwater reservoirs. Snow leopards have evolved in order to live in some of the harshest conditions on earth. Their thick whitish-grey coat spotted with large black rosettes blends in perfectly with the Himalaya's steep and rocky mountains. Their incredible natural camouflage, which renders them almost invisible in their surroundings, causes snow leopards to often be referred to as "ghost of the mountains." The snow leopard's powerful build and hind legs allows it to scale steep slopes with utter ease. Its long tail enables agility, provides balance and wraps around the resting snow leopard much like a scarf, acting as protection from the cold.

For millennia, this magnificent cat was the king of the mountains that were once abundant with their natural prey such as blue sheep, Argali wild sheep, ibex, marmots, pikas and hares. The snow leopard's habitat range spans the mountainous regions of 12 countries across Asia: Afghanistan, Bhutan, China, India, Kazakhstan, Kyrgyz Republic, Mongolia, Nepal, Pakistan, Russia, Tajikistan, and Uzbekistan; with the majority of its habitat found in China. Current snow leopard population is pegged at between 4,400 and 6,000 individuals, with strong indications that it is very likely declining.

Humans are the sole predator of snow leopards. Across most ranges, population densities have been declining due to illegal wildlife trade. For generations, these creatures have been killed not only for their beautiful fur, but also for their bones and other body parts, which are used in some traditional medicine. Snow leopards are also often killed in retaliation by local farmers and herders as a result of human-wildlife conflict. The snow leopard's usual prey—the Argali and blue sheep or *Bharal*—are animals that are also hunted by local communities. As their natural prey becomes harder to find, snow leopards are forced to kill domestic livestock for their own survival.

The snow leopard's habitat range continues to decline due to fragmentation caused by the impacts of climate change and human disturbance. Rising global temperatures can severely impact alpine habitat productivity, which in turn can impact prey and freshwater availability in the harsh mountainous environment. Climate crisis poses perhaps the greatest long-term threat to the snow leopard. A warming planet could result in the snow leopard losing up to 30 per cent of its habitat in the Himalayas alone. To compound this, the increased use of this space by domestic livestock for grazing, has resulted in the further loss of habitat and food sources.

Snow Leopard or Panthera uncia, also called the 'Ghost of the Mountains', shot in the Himalayas
© Ismail Shariff for the Indian Minitry of Tourism

THE UPPER GANGA RIVER
The Cradle Of Civilisation

In 2005, the 265.90 square kilometre-area of the Upper Ganga River that spans 85 kilometres and stretches from Brijghat in Garh Mukteshwar district to Narora in Bulandshahr district, was declared Uttar Pradesh's first Ramsar Site. This stretch of the Upper Ganga along with the 2,073 square kilometres of the Hastinapur Wildlife Sanctuary, spread over five districts of Uttar Pradesh, with its rich biodiversity, forms an important habitat for the Gangetic River Dolphin *(Platanista gangetica)* population.

Within this Ramsar Site are three major bathing ghats or jetties of religious significance: Brijghat, Anoopshahr Ghat and Rajghat. The Ganga becomes the final resting place for thousands of Hindus, whose cremated ashes or partially burnt corpses are immersed in its waters. From the spiritual standpoint as well, this river plays a pivotal role. According to Hindu mythology, the Ganga River came down to earth from the heavens; today, it symbolises purification to millions of Hindus who believe that drinking or bathing in its waters will lead to *moksha*, or salvation from the endless cycle of rebirth.

The entire stretch from Brijghat to Narora, is sandy, muddy and shallow with only intermittent small stretches of deep-water pools and reservoirs upstream of the numerous barrages. The depth of the water varies between 300 and 362 centimetres with transparency ranges of between 3 and 5 centimetres during the peak monsoon season. A large number of factories involved in small-scale engineering, tanneries, and others in the production of sugar, chemicals, fertilisers and cotton are also situated along the banks of the river. The discharge from these industries enters the Ganga, polluting the river to a considerable extent.

For most part of the year, the this stretch of the river, largely witnesses the prevalence of dry air and extreme temperatures in both summer and winter. It is only during the monsoon months that breezes of oceanic origins arrive, bringing with them increased humidity, cloudiness and eventually rain. This Upper Ganga Ramsar Site is an inland river-stream wetland which experiences water surging recurrently, during flooding from the Ganga river during the monsoons, and then receding during the dry summer months.

The Ganga and its tributaries drain a large—almost one million square kilometres—fertile basin that supports one of the world's highest human population densities. Almost half of India's population lives on one-third of this landscape within a 500-kilometre range of the Himalayas along the Gangetic plain. As a result, there is strong demand and competition for natural resources, especially water for domestic use and irrigation, and most of the basin's tributaries are regulated by barrages. Fisheries along the river are of high economic value and their output makes a major contribution to the region's nutritional needs.

The Ganga is inarguably one of the hardest working rivers, hosting countless dams, barrages and sluice gates that not only help in irrigation, water flow regulation but also in power generation. A quantification of the Upper Ganga River System reveals multiple WESs: Drinking Water is the most cited ecosystem service pegged at over 60 per cent, followed by water for irrigation at 56.41 per cent and religious and spiritual services at 44.87 per cent. In addition to

Farmers engaged in activity in the Upper Ganga Ramsar Site.
© Sandeep Behera

this, the Upper Ganga River System is an important ecosphere that supports numerous fisheries—56 fish different species were recorded from all five zones of the upper stretch of the Ganga. Like most wetland ecosystems, the Upper Ganga River System also acts as a carbon sink storing toxic greenhouse gases and preventing them from escaping into the atmosphere, which in turn significantly helps to reduce the impact of ozone depletion and climate change.

This area serves as important landscapes for the conservation of flora and fauna. The rich biodiversity and the aesthetic value of these ecosystems attracts tourists and avid birders from all over the world. In addition to providing premium ringside seats for viewing these seasonal avian visitors, the backwaters near Brijghat, for instance, also play host to eco-tourists visiting to witness the *Barasingha (Rucervus duvaucelii)* in its natural habitat.

These wetlands like many others across the country, face almost the same sort of challenges; those of anthropogenic interference, pollution, siltation, human interference in the form of encroachment, mining, over-fishing and the over-exploitation of its natural resources. The main eco-hydrological alterations in wetland and river systems are caused by the construction of dams and barrages on the river. This results in loss of wetlands and floodplain habitat as well as habitat fragmentation. This especially affects aquatic mammals like the Gangetic River Dolphin—an apex predator in these waters. Alterations of water quantity, seasonal flows and patterns of variability caused by damming have substantial and negative consequences for the maintenance of biodiversity in many rivers, including the Ganga. A series of barrages and dams have been commissioned in the Upper Ganga River System from Rishikesh to Narora. The Tehri dam constructed in the hills of Uttarakhand has considerably reduced water flow and has shown detrimental effects on the physical attributes and destruction of the feeding, spawning, and migration routes of endemic fish like the Mahseer *(Tor putitora)* etc.

Human beings have been encroaching upon rivers since time immemorial, especially by occupying much of the flood plains and parts of river banks for their activities. In modern times however, the encroachments have become extensive with widespread construction activities on the floodplains and even farming on river beds during lean flow seasons. While on the one hand, the increased construction on flood plains has led to altered runoff patterns into rivers, increased pollution inflows with runoff, reduced groundwater recharge and, hence, decreased base flows in rivers, and curtailed ecological linkages between the river, its floodplains, and floodplain wetlands; on the other hand, river bed farming together with modern chemical pesticides such as DDT and HCH, have polluted the river bed, thus affecting the health of aquatic creatures and disturbing the breeding sites of apex aquatic animals like the Gangetic River Dolphin.

Gangetic River Dolphin (Platanista gangetica)

Some facts on the species:
Population: 1200-1800 individuals

A group of Brown Roof Turtles or Pangushera smithi, and Indian Tent Turtles or Pangushera tecta hatchlings on the sandbars of the Upper Ganga River stretch.

Height: 270 cm (female), 212 cm (male)
Weight: 135-230 kg
Food: prawns, fish, other crustaceans
Lifespan: about 30 years

The Gangetic River Dolphin is one of the oldest surviving cetaceans in the world having evolved over 20 million years ago. It has the largest territory inhabiting the Ganges - Brahmaputra - Meghna river basin that spans India, Nepal and Bangladesh. WWF estimates peg their total population to be between 3000 and 5000 individuals.

The Ganga, which originates in Gangotri at a height of 4000 metres above sea level, in the Himalayan state of Uttarakhand, flows through five Indian states—Uttarakhand, Uttar Pradesh, Bihar, Jharkhand and West Bengal—covering a total distance of 2510 kilometres before entering Bangladesh to finally empty into the Bay of Bengal. The Gangetic River Dolphin is found across these states, albeit in varying numbers. The Himalayan region is the youngest mountain eco-system on earth and is quite appropriately called “the water tower of Asia”. Traversing 33,000 square kilometres of glaciers, it is the source of many major river systems including the Ganga, Indus and Brahmaputra.

Gangetic River Dolphins prefer deep waters, in and around the confluence of rivers. The distribution range of the Gangetic River Dolphin in India covers seven states namely, Assam, Uttar Pradesh, Madhya Pradesh, Bihar, Jharkhand and West Bengal. The upper Ganga River (in Uttar Pradesh), Chambal River (Madhya Pradesh and Uttar Pradesh), Ghaghra and Gandak Rivers (Bihar and Uttar Pradesh), Ganga River, from Varanasi to Patna (Uttar Pradesh and Bihar), Son and Kosi rivers (Bihar), Brahmaputra from Sadia (in the foothills of Arunachal Pradesh) up to Dhubri (on the Bangladesh border) and the Kulsi River, a tributary of the Brahmaputra River, all form ideal habitat.

The Gangetic River Dolphin has a sturdy, yet flexible body with large flippers and a low triangular dorsal fin. It can weigh up to 150 kilograms, and is usually a greyish-brown in colour. Females of the species tend to be larger than males and can measure around 2.67 metres while males can measure about 2.12 metres. These cetaceans have relatively low birth rate. Females give birth to only one calf, once every 2 or 3 years, after a long gestation period of 9 to 11 months. The species is functionally blind, so it navigates and hunts by emitting an ultrasonic sound called echolocation. Gangetic River Dolphins rely heavily on echolocation in order to navigate the river waters and hunt for food.

Once present in tens of thousands of numbers, the Gangetic River Dolphin has dwindled abysmally during the last century owing to direct killing, habitat fragmentation due to dams and barrages and indiscriminate fishing causing loss of prey base. It is for these reasons that despite a high level of protection, its numbers continue to decline. The absence of a coordinated conservation plan, lack of awareness and continuing anthropogenic pressures are posing incessant threats to the existing dolphin population.

Gangetic River Dolphin or Platanista gangetica shot at the Upper Ganga River stretch
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