ISSN Print: 2394-7500
ISSN Online: 2394-5869
Impact Factor: 5.2
IJAR 2018; 4(3): 584-590
www.allresearchjournal.com
Received: 31-01-2018
Accepted: 06-03-2018

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Evaluating the state of the wetlands as habitat for fish

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Abstract
The importance of water to human survival cannot be overstated. Water is stored in wetlands, and they also contain valuable bioresources that keep animal life going. Humans may be able to use fish as a bioresource for food and employment. These models don't rely on causal claims but rather on hypotheses about the interactions between species and their habitats.

Keywords: Wetlands, fish**,** land, bioresource, employment

Introduction
With its numerous distinct habitats and huge variety of globally endangered species, wetland biodiversity is of extraordinary conservation value. Moreover, they are often pivotal to the economics of nearby human groups, whether regional, national, or even global. The poor and the vulnerable, who have fewer options for earning a living and eating, and who have less access to essential services, place a disproportionate value on the benefits provided by wetland areas. Important as they are, wetlands are coming under more and more threat. According to the Millennium Ecosystem Assessment (MEA) 2005, inland waterway biodiversity is in the worst state of any ecosystem worldwide, with a projected loss of 50 percent of inland water area worldwide. Degradation and destruction of wetlands are a major obstacle to achieving conservation and development objectives, and they have a disproportionately negative effect on the world's poorest people.
One of the primary causes of wetland degradation is the lack of thought given to them in decision making. The larger biological, ecological, developmental, and economic aspects of wetlands are seldom taken into account when management choices impacting wetlands are made. As a result, Wetland loss costs and protection benefits are both underestimated. Although development planners often disregard the broader implications of wetland degradation on economic, livelihood, and poverty indices, wetland-managing authorities have seldom been able to show or act on these relationships. In addition, wetland governance has traditionally favored those driven to convert wetlands for the sake of increasing private wealth, rather than communities that rely on wetland resources to provide 'public benefits'.

Literature Review
Priyatharsini P *et al.* (2018) [3] Wetlands may be found in abundance in southern India. It is possible to utilize the characteristics of water quality in these wetlands as an indicator of the biological productivity of the freshwater environment by studying the preferences of the fish that live there. Data on the physicochemical parameters and fish diversity indices of the Theroor wetland ecosystem in Kanyakumari districts were collected over the course of a year (2014-2015) in order to better understand the ecological status of this wetland, which is 80 square kilometres in size and surrounded by agricultural land, small-scale industries, and waterways infested with macrophytes. As a result, it seems that maintaining and monitoring wetlands health requires the careful, scientific management of factors such as temperature, pH, dissolved gases (DO2), hardness, BOD, etc. There was clear evidence of seasonal variation across all of the measured indicators of water quality. Several of the physicochemical characteristics were found to be within acceptable ranges, with the hardness and BOD being the only two notable deviations.

Warish Khan *et al.* (2017) [1] This study aims to identify optimal water quality factors and management strategies for fish farming. Physical, chemical, and biological water characteristics were used to determine water quality standards. The water near Gurgaon Canal in the National Capital Region (NCR) of India is being tested to see whether it falls within New Delhi's jurisdiction, is suitable for use in fish farming, samples of the water were evaluated using the aforementioned criteria. The research determined that the 30.70 degrees Celsius temperature of the river is suitable for fish farming, when compared with worldwide norms and also Indian regulations. Nonetheless, there were several minor deviations from the ideal ranges, with a biological oxygen demand of 36 mg/l and a total dissolved solids concentration of 13.60 mg/l and a total hardness of 470 mg/l. This research will help fish producers determine what kind of treatment is required to utilize this water supply for fish farming.

Zareena Begum Irfan *et al*. (2017) [5] The ecological preservation, environmental enhancement, and human habitat enhancement are all aided by wetlands. Primitive field research, primary survey, and a string of stakeholder meetings were all used to assess the wetland's effectiveness. The Ousteri wetland in Tamil Nadu and Puducherry were compared using a complicated index system that took into account a broad range of factors. Thirty-five potential subindicators were first screened using the Delphi approach. Delphi, the Analytic Hierarchy Process, and the weighted linear combination model were used to identify potential ecological, economic, and social outcomes. The situation in Puducherry and that in Tamil Nadu were each evaluated using these indicators and then applied to the case of the Ousteri wetland. This work's EIS may be used to develop a policy of ecological subsidies that includes incentives and penalties based on evaluations of performance, providing the maximum possible returns on investment in the wetland conservation measure.

Angela H. Arthington, *et al*. (2016) [2] There are about the same number of species of Actinopterygian fish in fresh water as there are in the marine world (14,740), despite the vast differences in the volume and size of the two environments. Several marine and freshwater fishes are in growing danger of local, regional, or global extinction despite widespread recognition of their ecological and social worth. Loss of habitat, introduction of exotic species, pollution, overfishing, and climate change are the most pressing issues affecting aquatic ecosystems today. Unpredictable interactions between climate change and other threats make the effects of extra stresses that threaten many marine and freshwater species far more difficult. Little, specialized freshwater and marine fishes often face the most difficult situations due to isolation and fragmentation of their habitats, whereas bigger marine and freshwater species face the greatest danger due to exploitation. Certain migratory species have a high chance of being caught at predicted bottlenecks in their journeys between freshwater and marine environments, and deterioration of breeding habitat, feeding habitat, or the migratory corridors themselves are further threats.

Subhro Mitra *et al.* (2014) [4] Deepor Beel is a major wetland in the lower Assam portion of India's Brahmaputra Valley and is typical of the wetlands in the Burma Monsoon Forest biome. The Ramsar Convention has recognised Deepor Beel, which is located between the Rani and Garbhanga protected forests, as a Wetland of International Importance. Animals such as the Asian elephant (*Elephas maximus*), which is in risk of extinction, call these woodlands home. The wetland is essential for the elephants, who use it to find food and drink. Indian Railways constructed the Assam State Southern Railway across the wetland in 2001. The wetland-forest ecology has been separated and the wetland has been split into at least two parts due to the railroad. As the train was built across the swamp, elephant habitat has been rapidly deteriorating. In addition, some elephants have been killed after being struck by trains. The current railroad has had severe consequences for the environment of Deepor Beel, especially for Asian elephants, and this research assesses those consequences. Impact quantification makes use of geographic information systems (GIS) and mathematical models. The methods and instruments utilized in this research may be applied to other, comparable ecosystems elsewhere.

Methods

The fish samples were caught using a wide range of fishing gear, including caste nets, gill nets, drag nets, triangular scoop nets, and various traps. When required, camouflage was also utilized to sneak up on the fish and snag them. Preserving fish has progressed from using pure formaldehyde out in the field to using a 10% formalin solution in the lab. Standard references were used to confirm the fish identifications. Using daily catch data reported at the fish landing stations (FAO, 1974), yield statistics were extrapolated, and the trend and cyclic fluctuations were generated using the use of the 12-month moving average approach. Standard techniques were used to make estimates of water's physicochemical qualities (APHA, 1995).

Soil in "wet lands" is saturated with water for at least part of the year, thus the name. Wetlands are defined as places with temporary or permanent marsh, fen, etc.; a body of water, whether natural or manmade, that is often no deeper than six metres (IUCN, 1970). Wetlands are defined as regions with large amounts of stagnant water and low rates of water movement.

Northern India's wetland regions: The North Eastern (NE) region of India is characterised by undulating landscapes and an abundance of water resources, such as a complex network of articulating rivers and associated wetlands, which are home to a bewildering diversity of aquatic biota, perhaps unparalleled in the history of the world. As a result, it has been labelled a "hotspot" of biodiversity (WCMC, 1998). However there is little doubt that the area has significant potential for fish production to meet the region's food needs and address the declining protein supply.

The Assam wetland system. There is a lot of potential for fishing in India's lentic water bodies, which encompass a total area of 0.72 x 106 hectares (ha). There are various lentic systems in Assam, including Beel, Haor, Anua, Hola, Doloni, Jalah, etc., which together make up over 81% of the total lentic area in the NE region. These lentic systems are generally open and shallow, with sizes ranging from 35 ha to 3458.12 ha and depths of 0.25 m to 3 m at maximum storage (FSL). In addition, Assam is home to roughly 1,392 wetland regions and approximately 22,896 fisheries;

however, only 394 wetland areas (30.38%) have been formally recognized, despite these wetland areas comprising an estimated 70,000 hectares. Around 20% are in excellent condition, 15% are in poor condition, and 30% are completely abandoned (Government of Assam, 2006). Wetlands may be found across Assam, many of which are protected as part of national parks, sanctuaries for endangered species, and even Biosphere reserves. There are Ramsar sites that must be attended to.

Assam wetland types described and categorized. Around 6 percent of Earth's surface is made up of wetlands, which may be found in practically every climate zone. IUCN's Ramsar Convention (2004) provides one of the easiest ways to categorize wetland types, which is as follows in a nutshell: reservoirs, ponds, marshes, swamps, bogs, and oxbow lakes and wetlands are all examples of freshwater lakes and wetlands.

Examples of tropical wetland ecosystems can be seen in the Assam region of India and neighbouring Bangladesh. These ecosystems feature shallow depressions in the form of a basin in the centre of hillocks on all sides, an abandoned stretch of river, or a shallow section of river course that becomes disconnected from the main river course during the dry season. North Eastern India's wetlands may trace their genesis all the way back to plate tectonics.

There are three primary types of wetlands that are widespread in the Assam area and its neighboring Tripura and Bangladesh regions. Local names for them include: (a) "Beel": wetlands that stay wet year-round; (b) "Hoar": floodplain wetlands, or seasonal wetlands, that only become wet when it rains; (c) "Anua": Perennial wetlands of the oxbow kind emerge in rivers when the river's original path is altered, and they may or may not remain connected to the river.

Habitat Suitability Index (HSI): As a numerical indicator, the Habitat Suitability Index (HSI) shows the potential of a habitat to sustain a particular species. Instead than relying on declarations of known cause and effect correlations, these models instead rely on postulated species-habitat interactions. The HSI model depicts the interplay of habitat features and the connections between habitat types and species. The river is rated on a few different criteria.

Data Analysis

Many of the most significant lentic systems (wetland ecosystems) in the Barak Valley region of Assam are discussed here.

Geology: These three geological processes morphogeny, lithogeny, and tectonics are said to be occurring here at the same time, making this area special from a geological perspective. The Assam Platform is separated from the severely folded mobile belt to the south by a northern thrust boundary, and both are thought to be covered with sediments of the same age. This area is separated from the Burma Platform by the ophiolite belt. Very likely, the ophiolite marks the edge of the Indian Plate.

Sone Beel

It is in the syncline between 92°24'50" and 92°28'25" East and 24°36'40" and 24°44'30" North in Assam's Karim Ganj District. (Fig. 1). Little hills dot the landscape, with broad, flat valleys in between. In the Barail range, the ridges run NE-SW and NE-SSW, but further south, they go N-S. The largest "Beel" (wetland) in Assam, Sone Beel, can be found between two mountain ranges the Badarpur-Saraspur and the Chowkirmukh-Dohalia. The Badarpur line of folding is an eastern adjacent structure, whereas the Chargola anticline is western. In geomorphology, hillocks with steep dips in the sedimentary strata demonstrate the tightfoldedness of anticlines.

Fish diversity in Chatla Haor of Assam

There are 57 different species of fish in Chatla Haor, spread throughout 28 genera, 17 families, and 9 orders. According to zoogeographic classification, the majority of Chatla Haor's ichthyoses (79.62%) are principal FW fish, while the remaining species (20.38%) are classified as peripheral. Icthyospecies of Chatla Haor also include fish that are classified as either globally spread species (such as Puntius, Ompok, Channa, and Anabas) or as species native to northern India, depending on whether you're looking at the distribution patterns of Indian or non-Indian fish territories (notably, Botiadario, *Lepidocephalichthys guntea*, etc.). According to eco morphology (Dey, 1973), Chatla Haor's fish species fall into two categories: semi-torrental and plainwater.

Fish Diversity in Puneer Haor of Assam

The Puneer Haor is home to 24 different fish species in 8 orders, 22 families, and 15 genera.

Fish diversity in the Anuas of Assam

Rupairbala Anua

Twenty-four fish species, representing 21 genera, 15 families, and 9 orders, have been documented so far this Anua.

Baskandi Anua

A total of 13 fish species from 10 different genera, 6 families, and 4 orders have been seen in Baskandi Anua.

Fulbari Anua

Throughout the course of the pilot research, seven fish species were identified in Fulbari Anua, representing six genera, six families, and six orders.

Sibnarayanpur Anua

Twenty-two fish species from 21 genera, 10 families, and 5 orders have been documented in Sibnarayanpur Anua.

Table 1: Fish diversity in southern Assam Wetlands ("+" Present, "–" Absent)

Fish species	Sone Beel	Sat Beel	Chatla Haor	Puneer Haor	Rupairbala Anua	Baskandi Anua	Fulbari Anua	Sibnarayanpur Anua
Pisodonophis boro (Hamilton)	+	–	–	–	–	–	–	–
Gudusia chapra Hamilton)	+	–	+	–	+	–	+	+
Tenualosa ilisha (Hamilton)	+	–	+	–	–	–	–	–
Chitala chitala (Hamilton	+	–	+	–	–	–	–	–
Notopterus notopterus (Pallas)	+	–	+	+	+	–	–	–
Amblypharyngodon mola (Hamilton)	+	+	+	+	+	+	–	–
Aspidoparia morar (Hamilton)	+	–	–	–	–	–	–	–
Barilius bendelisis (Hamilton)	+	–	–	–	–	–	–	–
Osteobrama cotio (Hamilton)	–	–	–	–	–	–	–	+
Catla catla (Hamilton)	+	–	+	–	–	–	–	+
Cirrhinus mrigala (Hamilton)	+	–	+	–	–	–	–	+
Cirrhinus reba (Hamilton)	+	–	+	+	–	–	–	–
Chela laubuca (Hamilton)	+	–	–	–	–	–	–	+
Cyprinus carpio (Linnaeus)	+	+	+	–	–	–	–	–
Ctenopharyngodon idellus (Valenciennes)	–	–	+	–	–	–	–	–
Hypophthalmichthys molitrix (Valenciennes)	–	–	+	–	–	–	–	–
Devario devario (Hamilton)	+	–	+	–	–	–	–	–
Esomus danricus (Hamilton)	+	–	+	–	–	–	–	+
Labeo bata (Hamilton)	+	–	–	–	–	–	–	–
Labeo calbasu (Hamilton)	+	+	+	+	–	–	–	–
Labeo gonius (Hamilton)	+	–	+	–	+	–	–	+
Labeo nandina (Hamilton)	+	–	–	–	–	–	–	–
Labeo rohita (Hamilton)	+	–	+	–	–	–	–	–

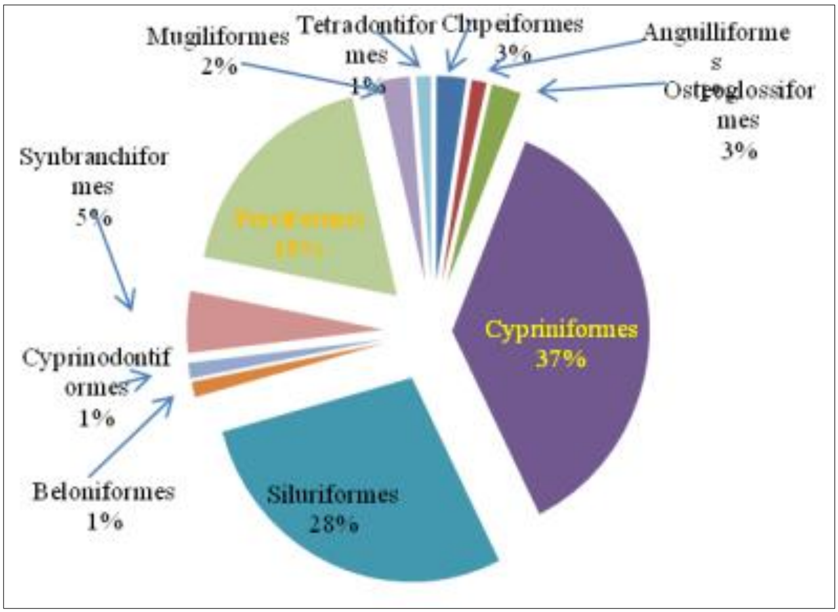

Fig 1: An index ranking the fish populations of Assam's several wetland habitats

Wetland habitat mapping exemplified

Just a small number of Assam's wetland areas have been mapped thus far, but the effort is ongoing. The research shows that siltation has an impact on almost all of Assam's wetlands. Some of them are shallow, while others lack an abundance of macrophytes in the water. During the wet months, the water often becomes rather muddy. Mostly, the land is used for fishing, however paddy is also grown there, especially in the spring.

Epizootic Ulcerative Syndrome (EUS fish disease)

Epizootic ulcerative syndrome (EUS) is a devastating disease that has been spreading rapidly over the world's freshwater fish populations without much resistance. Large numbers of fish have died from this illness since 1988, putting several species in risk of extinction. As a result, the fish-eating public develops an irrational dread of seafood, which has devastating effects on the industry as a whole. The severity of epizootic ulcerative syndrome has been shown to vary across animals. Interesting results, including the isolation of a virus, have emerged from our investigations, which have spanned disciplines as diverse as limnology, chemistry, physics, bacteriology, mycology, and virology and used techniques such as tissue culture and electron microscopy. This unchecked fish sickness has to be managed immediately.

Plate 1: Fish species affected by the epizootic ulcerative syndrome (EUS) fish disease

Habitat Suitability Index

A habitat's ability to sustain a particular species is quantified by a metric called the Habitat Suitability Index (HSI). Instead of using claims of verified cause and effect correlations, these models instead rely on postulated species-habitat interactions. The findings of the HSI model illustrate the interplay between habitat features and the species that use them. The model may be built using a mix of several approaches, including a word model, a mechanical model, a multivariate statistical model, or any of these alone. The benefit is a more solid foundation upon which to build better decisions and a deeper understanding of species-habitat interactions.

Table 2: Physico-Chemical parameters for HSI analysis

Temperature (0C)		pH	Transparency (cm)	Current Speed (s/m)	D.O (mg/l)	FCO2 (mg/l)	TA (mg/l)	PO4
Air	Water							
21.29	20.56	6.7	19.87	8.45	6.78	2.33	49.1	0.21

Table 3: Category of Physico-Chemical parameters for HSI analysis

Category	SI	Criteria
Good	1	Abundant & diverse communities
Moderate	0.67	Moderate invert diversity
Poor	0.33	Low invert diversity.
Bad	0.01	Clearly polluted.

HSI of water quality for Towkak River

$$HSI=sqtroot\ (21.29*20.56*6.7*19.87*8.4*5*6.78*2.33*49.1*0.21)/9 = 0.92$$

Information suggests that the Towkak's water quality has reached its species-limit.

Table 4: No of distribution of fish species various region in the Towkak river

Location	No of Fish Species
Dumukhiya	60
Borahi	56
Dumahi	70
Sonari	42
Santipur	56
Thukubill	38
Sildubi	54
Bordubi	50
Toop	49
Joboka	72
Joboka habi	67
Gutighat	58
Silghat	49
Naganadi	70
Namtola	65
Lapha	34
Tizit	30
Dumahi	32
Camp	25
Sangcha	20

Table 5: Fish Diversity HSI Category

Category	SI	Criteria
Absent	1	Absent
Possible	0.67	Possible
Minor	0.33	Minor
Major	0.01	Major

HSI of fish diversity for Towkak River
HSI=nth sqrroot of no of all fish species/20 = 0.38
It seems that the Towkak River may be home to a wide variety of fish species

Conclusion

The hilsa is a fish that may be found in both Asian and international seas. Its range extends from the Persian Gulf and Pakistan through the Indian subcontinent, Bangladesh, China, and Burma. This makes its discovery in the Sone Beel all the more noteworthy. The relevance of the Chatla Haor wetland in Assam as a potential breeding habitat for Hilsa is further highlighted by the presence of juveniles of this species there. These concerns need to be addressed on a global scale. Epizootic ulcerative syndrome (EUS) is an undiscovered awful, virulent, and puzzling fish illness that has been sweeping the freshwater fish semi-globally without being stopped or contained. So, it is necessary to combat EUS, which is responsible for the widespread destruction of wetland ecosystems and farmed fish, wreaking havoc on economies and threatening people's health. Even a cursory examination of the interaction between fish and their environment reveals a great deal of variability. Long-term goals can only be achieved via sustainable development, which necessitates integrated land and water planning based on the river watershed as the basic unit to accommodate a new environmental demand.

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