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Assessment of habitat and hydrological parameters of the lotic and lentic wetlands of the Sonitpur district, Assam, India

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ABSTRACT

This paper represents the riparian zone and water parameters in twelve selected sampling sites of both lotic and lentic wetlands of Sonitpur district. The study has been carried out from January 2021 to February 2023. Data were collected representing all the four seasons of the year. Physical Characteristics viz; soil colour, soil moisture, soil texture, vegetation coverage, canopy coverage and litter depth were assessed during the survey period. Vegetation and canopy coverage of the riparian zone adjacent to the lotic wetlands were found to be the highest. Litter depth (3.1cm) was found to be recorded at a single sampling site S_4. Water quality assessment recorded that Water temperature was found to be one of the major factors having the most intense direct and indirect effect on the riverine system ranged from 4.85±0.02 to 27.60±0.10 in the lotic wetlands and between 11.15±0.02 to 27.44±0.05 in the lentic wetlands. The overall pH value ranged from 6.09±0.05 to 7.24±0.32 in the lotic wetlands and between 6.44±0.02 to 7.52±0.08 in the lentic wetlands which is a convenient zone. DO values ranged from 6.01±0.32 to 7.37±0.22 in the lotic wetlands and between 6.39±0.30 to 7.63±0.30 in the lentic wetlands. Maximum DO value was recorded in the monsoon period. Water velocity was observed to vary from 0.20±0.03 to 1.30±0.28 in the lotic wetlands. Highest water velocity was recorded during the monsoon period and lowest in the winter period.

Key words : *Riparian zone, water parameters, pH, vegetation, lotic wetlands*

Introduction

Riparian cover plays a very important role in the aquatic ecosystem. It is the area where terrestrial and aquatic ecosystems converge. The riparian zone is the area between the stream channels or near shore portion of a lake or pond and the furthest upland extent of the aquatic system's influence. Riparian zones may buffer streams from adjacent lands by trapping sediment, nutrients and other contaminants (Carothers, 1977). Aquatic organisms like fish, which form the biotic factor of lotic ecosystems are greatly dependent on the large wood provided by forests for their survival. The two major effects of large wood debris on fish are food and shelter. Large wood and different types of habitats together

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provide important sites for invertebrates which serve as excellent sources of fish-food organisms. Most importantly, log serves as an important diversifier habitat and creator of riparian zone for fish habitat selection. However, the fish species diversity greatly depends on the characteristics of habitats. The relationship between fish and the habitat are major concerns of the fishery biologist, habitat features like stream temperature, stream bed composition (e.g. sand, clay, gravel, boulders etc.), depth, flow, substrate type etc., are generally considered as major determinants in distribution and abundances of fishes from earlier times (Shelford, 1911).

The existing resources of particular freshwater ecosytstem can be detected by the water quality of that habitat, which depends immensely on the influences of both biological and physico-chemical parameter (Kather *et al*., 2015). Moreover, for controlling the productivity of water bodies, water parameters such as water pH, temperature, dissolved oxygen (DO), water current and turbidity plays a very important role.

Studies revealed that, very little information is available on the habitat and water parameters of the lotic and lentic wetlands of Sonitpur district. Keeping in view of the importance of the habitat and water parameters in the aquatic ecosystem, the present study has been proposed.

Materials and Methods

Study area

An extensive survey has been carried out from Jan 2021 to Feb 2023 to collect the habitat and hydrological parameters in the twelve selected sampling sites of both lotic and lentic wetlands of sonitpur district. Data were collected representing all the four seasons of the year viz. pre-monsoon (March to May), monsoon (June to August), retreating monsoon (September to November) and winter (December to February).

Study design

To the convenience of the data collection, the entire study area has been divided into twelve different sampling sites. Among all the twelve selected sampling sites, six sampling sites (S_1, S_2, S_3, S_4, S_5 and S_6) were rivers, two streams (S_7 and S_8), and four were beels (S_9, S_{10}, S_{11} and S_{12}). Sites were selected depending on the accessibility and similarity of physical habitat. The locations of the study sites were taken using GPS (Model, Garmin etrax-30).

Data Collection

Habitat characteristics (Riparian zone)

To study the habitat characteristics of riparian zones quadrate method (Kent & Coker, 1992) was used. Quadrat were established in each study sites at 100m intervals. Different habitat characteristics viz: length, width, litter depth, soil composition, soil type, canopy coverage and vegetation coverage of each riparian zone were studied and recorded. The riparian zone vegetation was usually targeted for detailed surveys. GPS location of each sampling sites were recorded by using Standard Digital GPS Reader (Garmin etrax30x).

Physico-Chemical Parameters of water

For physico-chemical parameter analysis, all the four Parameters viz. Water current, Dissolved Oxygen (DO), Water temperature (WT) and pH were recorded at the spot. Analysis of water parameters were done during four seasons of the year followed after Barthakur (1986), viz. pre-monsoon (March to May), monsoon (June to August), retreating monsoon (September to November) and winter (December to February). Surface water velocity was measured by using a measuring tape, a float and a stop watch, DO was recorded by using a digital DO meter (Lutron-5509), Water Temperature (^{0}C) was measured by using Mercury Thermometer (Readings in degree Celsius) at the time of sample collection and pH was recorded at the sampling site by using a digital pH meter (Testo-206) immediately after collection of the water sample.

Results and Discussion

Riparian areas serve a wide variety of functions that help protect lakes, streams, rivers and other waterways from environmental degradation. However, differences in riparian vegetation between the lotic and lentic wetlands were observed during the survey period. Riparian vegetation of lotic wetlands sampling sites was dominated by herbs and shrubs with a mature forest canopy (Table 1). On the other hand, lentic wealnds sampling sites are non-forest land where tea plantation and agriculture cultivation are carried out. Riparian canopy plays a large role in regulating the transfer of thermal energy to stream ecosystems and is important in determining

the thermal aspect of water quality in lotic environments. Reduced riparian cover has been shown to result in decreased winter water temperatures (Lynch *et al*., 1984; Amour *et al*., 1994) and increased average summer water temperatures (Lynch *et al*., 1984; Pearson & Penridge, 1992; Quinn *et al*., 1992).

Studies on water parameters showed a good quality of water. Study revealed that, physicochemical characteristics of water varied seasonally. Among the habitat attributes, water temperature (WT), pH, dissolve oxygen (DO) and water velocity are assessed. Their values outside the tolerable range can directly affect the abundance of aquatic organisms including fish species of that particular aquatic ecosystem (Imam, 2012). In the present study, while assessing water quality, Water temperature was found to be one of the major factors having the most intense direct and indirect effect on the riverine system. Water temperature showed a definite seasonal trend of increased during monsoon and decreased during the winter seasons. However, in the present survey, the highest water temperature of lotic wetlands was at S_4 recorded during the monsoon period might be because this site is located at the lower reaches of the selected sampling sites. Similar trend of temperature fluctuation was observed by Sharma *et al*. (2016) in a head water stream of Garhwal and Jabeen (2017) on the Manas river system. Moreover, literature study revealed that, temperature ranges of 10°C to 15°C for cold water fishes, 20°C to 25°C for cool water fishes and 25°C to 30°C for warm water fishes were considered suitable as stated by Magnusson *et al*. (1979). Hence, the water temperature which ranged from 4.85±0.02 to 27.60±0.10 in the lotic wetlands and between 19.03±0.01 to 27.44±0.05 in the lentic wetlands in the present study was in the tolerable range (Table 2 & 3).

Table 1. Physical Characteristics of the riparian zone adjacent to the 12 selected sampling sites of the lotic and lentic wetlands of Sonitpur district.

Sites	Latitude/Longitude	Soil colour	Soil moisture	Soil Texture	Vegetation coverage(%)	Canopy coverage(%)	Litter depth
S_1	N27.017° E92.651°	Brownish	dry	sandy	50	30	0
S_2	N26.994° E92.741°	Brownish	dry	sandy	90	70	0
S_3	N26.927° E92.846°	Brownish	dry	sandy	80	70	0
S_4	N26.860° E92.747°	Whitish brown	loamy	clayey	90	05	3.1cm
S_5	N26.860° E92.783°	Reddish, greenish, whitish black	moist	sandy+ clayey	60	10	0
S_6	N26.866° E92.790°	Red	moist	sandy+ clayey	90	40	0
S_7	N26.915° E92.820°	brownish	dry	clayey	60	10	0
S_8	N26.914° E92.825°	blakish brown	wet	clayey	80	80	0
S_9	N26.820° E92.817°	Blackish brown	moist	clayey	10	5	0
S_{10}	N26.825° E92.811°	Brownish	loamy	clayey	10	5	0
S_{11}	N26.821° E92.858°	Brownish	moist	clayey	40	5	0
S_{12}	N26.807° E92.863°	Brown	moist	Sandy+ clayey	90	10	0

Table 2. Average values of Temperature on seasonal basis in the lotic wetlands of the sampling sites

	Temp. (°C)			
Stations	Pre monsoon (Mean±SD)	Monsoon (Mean±SD)	Retreating Monsoon (Mean±SD)	Winter (Mean±SD)
S_1	11.70±0.08	13.37±0.05	10.24±0.03	4.85±0.02
S_2	12.91±0.05	14.14±0.02	9.54±0.06	4.91±0.09
S_3	15.56±0.19	16.19±0.06	12.06±0.03	6.52±0.01
S_4	24.61±0.10	27.60±0.10	21.33±0.03	20.32±0.03
S_5	19.06±0.04	23.08±0.04	18.63±0.02	17.64±0.02
S_6	16.06±0.04	25.35±0.03	21.90±0.06	19.91±0.01
S_7	16.85±0.05	17.66±0.02	14.67±0.02	0
S_8	14.45±0.04	15.85±0.03	11.71±0.05	10.14±0.02

Aquatic organisms are also sensitive to pH fluctuations. Very high and very low pH values are unsuitable for most aquatic organisms. However, the overall pH value which ranges from 6.09±0.05 to 7.24±0.32 in the lotic wetlands and between 6.44±0.02 to 7.52±0.08 in the lentic wetlands which are a convenient zone (Table 4 & 5). Dissolved Oxygen (DO) is one of the most important factors for maintaining aquatic life and is susceptible to slight environmental changes. It is essential for respiration and plays an important role in regulating certain metabolic as well as physiological processes (Khoa & Bai, 1999; Rand *et al*., 1995). Dissolved Oxygen (DO) is an important limnological parameter indicating level of water quality and organic pollution in the water body (Wetzel and Likens, 2000). In the present investigation, DO values fluctuated from 6.01±0.32 to 7.37±0.22 in the lotic wetlands and between 6.39±0.30 to 7.63±0.30 in the lentic wetlands (Table 6 & 7). However, maximum DO value recorded from the lotic wetlands in the monsoon sea-

Table 3. Average values of Temperature (^{0}C) on seasonal basis in the lentic wetlands of the study sites

S_9	21.16±0.19	27.44±0.05	19.52±0.04	14.34±0.02
S_{10}	20.70±0.16	23.88±0.04	17.21±0.05	13.03±0.01
S_{11}	21.04±0.06	25.55±0.06	14.73±0.04	11.15±0.02
S_{12}	22.74±0.03	24.32±0.02	18.16±0.01	15.76±0.02

Table 7. Average values of DO on seasonal basis in the lentic wetlands of the study sites

S_9	7.54±0.27	6.64±0.29	6.43±0.30	7.46±0.31
S_{10}	6.63±0.19	7.74±0.14	6.60±0.27	7.45±0.18
S_{11}	7.31±0.18	6.46±0.31	6.39±0.30	7.63±0.30
S_{12}	7.58±0.24	6.68±0.15	6.55±0.22	7.50±0.24

Table 4. Average values of pH on seasonal basis in the lotic wetlands of sampling sites

	pH			
Stations	Pre monsoon (Mean±SD)	Monsoon (Mean±SD)	Retreating Monsoon (Mean±SD)	Winter (Mean±SD)
S_1	6.93±0.02	6.46±0.05	6.84±0.02	7.01±0.02
S_2	6.81±0.03	7.15±0.03	6.92±0.03	6.95±0.02
S_3	7.01±0.24	7.05±0.03	6.09±0.05	7.14±0.03
S_4	7.24±0.32	7.13±0.16	7.07±0.03	7.04±0.03
S_5	7.01±0.17	7.22±0.03	7.22±0.03	6.26±0.02
S_6	7.23±0.02	7.07±0.02	7.18±0.01	7.23±0.01
S_7	6.94±0.01	7.10±0.02	6.71±0.05	0
S_8	6.95±0.15	6.64±0.03	6.82±0.04	7.04±0.03

Table 5. Average values of pH on seasonal basis in the lentic wetlands of the study sites

S_9	7.52±0.08	7.43±0.03	6.44±0.02	7.47±0.01
S_{10}	7.08±0.00	7.05±0.02	7.06±0.01	7.07±0.02
S_{11}	7.17±0.03	6.83±0.03	7.14±0.03	7.14±0.01
S_{12}	6.46±0.04	7.51±0.09	7.49±0.02	7.07±0.03

Table 6. Average values of DO on seasonal basis in the lotic wetlands of the sampling sites

	DO (mg/l)			
Stations	Pre monsoon (Mean±SD)	Monsoon (Mean±SD) Retreating	Monsoon (Mean±SD)	Winter (Mean±SD)
S_1	6.96±0.34	6.56±0.25	6.01±0.32	6.18±0.30
S_2	6.72±0.21	7.00±0.29	6.35±0.32	6.12±0.05
S_3	7.01±0.27	7.02±0.24	7.07±0.21	7.11±0.20
S_4	7.11±0.31	6.71±0.31	7.10±0.22	6.94±0.35
S_5	6.06±0.16	7.37±0.22	6.47±0.35	7.14±0.27
S_6	7.19±0.24	6.56±0.26	6.96±0.26	7.04±0.07
S_7	6.72±0.20	7.09±0.12	7.15±0.36	0
S_8	6.45±0.26	6.70±0.12	6.55±0.27	6.65±0.23

Table 8. Average values of Water velocity (m/s) on seasonal basis in the lotic wetlands of the selected sampling sites

	Water velocity (m/s)			
Stations	Pre monsoon (Mean±SD)	Monsoon (Mean±SD)	Retreating Monsoon (Mean±SD)	Winter (Mean±SD)
S_1	0.99±0.04	1.30±0.28	0.95±0.03	0.80±0.04
S_2	0.93±0.04	1.21±0.21	0.85±0.04	0.78±0.03
S_3	0.92±0.18	1.01±0.04	0.86±0.04	0.76±0.03
S_4	0.60±0.11	0.72±0.10	0.66±0.05	0.22±0.04
S_5	0.74±0.02	0.86±0.03	0.76±0.04	0.25±0.03
S_6	0.52±0.01	0.64±0.04	0.43±0.01	0.20±0.03
S_7	0.53±0.02	0.79±0.01	0.44±0.03	0
S_8	0.67±0.05	0.74±0.03	0.55±0.03	0.38±0.04

son during the survey period might be because of the bright sunlight as it influences the percentage of soluble gases. Study revealed that, high intensity of sunlight during the daytime accelerated photosynthesis, which resulted in the increase of DO in pre monsoon period. These findings are in accordance with the studies conducted by Das *et al*. (2015), in the Siang River of Arunachal Pradesh. Moreover, the DO value of the twelve sampling sites in the present survey period indicated that it was suitable for aquatic organisms.

Water current, another important physical parameter of river water was also recorded during the study period. It was found that the velocity of water greatly depends on the nature of the gradient and water velocity values progressively decreased from upstream to the downstream. The values of water current were observed to vary from from 0.20±0.03 to 1.30±0.28 in the lotic water body. Water velocity were recorded to be highest during the monsoon season and lower in winter season in eight sites of the total twelve selected sampling sites (four sites were lentic) (Table 8). Similar findings were reported by Basistha (2006) from the Manas River system who recorded water velocity values ranging from 0.2 ms-1 to 1.3 ms-1. Singh *et al*. (2012) also found similar results from the hill stream Sidzii, a tributary of the Doyang River. 2

Conclusion

The present study on the habitat and hydrological parameters in the lotic and lentic wetlands of the Sonitpur district revealed that, riparian areas serve a wide variety of functions that help protect lakes, streams, rivers and other waterways from environmental degradation. Study also revealed that, water parameters plays an important role in determining the water quality of an aquatic ecosystem. However, in the present survey the habitat attributes viz; water temperature (WT), pH, dissolve oxygen (DO) and water velocity that are assessed showed a good quality of water and the physico-chemical characteristics of water varied seasonally.

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Conflict of interest

The author has no conflict of interest.

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