*International Research Journal of Environmental Sciences*_____ ISSN 2319–1414
Vol. **8(3),** 1-11, July **(2019)** *Int. Res. J. Environmental Sci.*

Physico-chemical characteristics of Asan wetland with reference to Avian and Molluscan diversity, Doon Valley (Uttarakhand), India

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Available online at: www.isca.in, www.isca.me
Received 17th October 2018, revised 3rd April 2019, accepted 2nd June 2019

Abstract

The Asan wetland attract very large number of tourists in winter season because Asan wetland derived optimum ecosystem which are responsible to attraction of great number of migratory birds and provide natural habitat of migratory birds as well as residential birds. Since this wetland are located in southern latitudes, so it's attracted great level of birds at winter season that breed in Europe & Northern Asia. Its water is used for irrigation, boating and recreation. In view of these all facts of the Asan wetland, this study has been undertaken to mention attention to the water quality, avifaunal diversity and mollus can diversity of Asan wetland. The physico-chemical characteristics of Asan wetland, as like water temperature recorded in the range of ±0.15 to ±0.11°C, pH ±0.20 to ±0.15, Conductivity ±0.050 to ±0.097µmhocm^{-1}, TDS ±0.57 to ±1.0mg/l, Free CO_2 ±0.05 to ±0.25mg/l, DO ±0.49 to ±0.55mg/l, BOD ±0.49 to ±0.36mg/l, TH ±0.01 to ±0.57mg/l, Calcium ±0.01 to ±0.05mg/l, Magnesium ±0.01 to ±0.06mg/l. The Sodium ±0 to ±0.1mg/l, Potassium ±0.01 to ±0.01mg/l, Nitrate ±0.06 to ±0.02mg/l and Phosphate ±0.03 to ±0.01mg/l were recorded in all zones. The avian diversity of the Asan wetland revealed that a total of 49 species observed at all zones in winter season. The great numbers of birds were recorded in morning time in zone– 4, highbirds' richness observed in Zone- 3. The molluscan fauna of Asan wetland includes 8 families, 8 genera and 9 species recorded at all zones during study period. Significant changes in freshwater snail assemblages were primarily due to changes in the water quality from locality to locality.

Keywords: Asan wetland, natural habitat, avifaunal diversity, physico-chemical characteristic, Mollusca.

Introduction

Those areas which are natural or artificial, annually or seasonal with water that is lentic or lotic, fresh water, marine water, fen, marsh and peatland, low depth and tide does not exceed six meters, that is called wetland[1]. India help diverse and unique wetland habitats because in India various topography and climate condition present[2]. India is provide wintering habitat grounds for migratory birds. In India, wetlands (Manmade and Natural) are attract large number of local and altitudinal migratory birds[3]. Vegetation species richness, in general, increases as water flow-through increases. Spatial heterogeneity (associated with tidal or riparian areas esp.) increases species richness[4]. The natural marsh habitat are very well for water birds species[5]. The species richness in wetlands varies depending upon the period of flooding (hydrology) and transportation of chemicals in the systems. Diversity in Indian wetlands as estimated recently includes 34 groups of animal kingdom, comprising nearly 17,853 species. From the faunal resources point of view, the interest on Indian wetlands is quite recent and in fact very little information is available[6]. In recent years, a monograph on "Asan wetland" is published by the Uttaranchal Govt., which reveals faunal and floral diversity of the wetland. Thought, in the Doon valley, there are studies being conducted on the plant diversity of swamp and in this regard the work conducted by Gupta et al., Manas et al. and Sharma and Joshi can be cited. The physico-chemical characteristics of wetland change the primary and secondary productivity levels of food web structures in wetland ecosystem[7]. The number of ornithological studies carried out on recent and past time particularly on water birds at Asan wetland. Amid the most important being by Mohan, Narang, Lamba, Osmaston, Singh, Tak et al, Gandhi and Singh, etc. to some example. The Trans Himalayan region is known as its scenic beauty, ecological values and biological diversity[8]. Bassi et al., fresh water bodies are change the land use on the basis of catchment leading to reduces in inflows and declining quality of the runoff flow from agriculture fields and urban areas. Different aspects of freshwater molluscs like, habitat, distribution, zoogeographical significance, etc., including their medical and veterinary roles were dealt by Subba Rao. Freshwater molluscs from the state of Uttaranchal have not been worked out separately. Devis et al., made a detailed study of the Asian hill-stream genus Tricula, from Nainital district. In Aquatic ecosystem freshwater molluscs play a very important role. While the smaller species serve as food for many of the birds, fish's etc. majority of the larger species are regularly consumed by people in many parts of the country. Mitra et al., Rai et al., the study involved sampling for a year from water bodies of various localities of Doon valley. Analysis of the data revealed that the physico-chemistry of the stream exercised profound effect on the distribution of the fresh water snails.

Significant changes in freshwater snail assemblages were primarily due to changes in the water quality from locality to locality. Malik. D. S. and Nidhi Joshiin winter season large number of migratory birds observed in Asan wetland, because it provide most suitable habitat for migratory birds. In recent time ornithologist have been worry about highly increasing threat of water birds. The main purpose of this study is to know the water quality of Asan Wetland and interrelationships to avian and molluscan diversity.

Materials and methods

Study area: Asan wetland is also called as Asan barrage bird sanctuary or Asan conservation reservoir. Asan wetland situated in lower Himalayan region at Doon valley. It is located 40km distance from Dehradun (Uttaranchal) on NH 72 (Chakrata road) Figure-1. Asan wetland is a man-made wetland of about 4 km^2 area. It is situated near junction of the river Asan and Yamuna canal at lat/lon 30°26′09″N and 77°39′56″E in Doon valley. A barrage is constructed in western side of the wetland their length is 287.5m long and water level is 403.3m above the sea level.

Methodology: This study data is collected from October 2017 to March 2018. During this study, wetland area are divided into five zones (On the basis of habitat distribution of birds) with 60 –70m intervals (Figure-1b). The physico-chemical characteristics are analysed to standard methodology authorised by APHA[9,10], Trivedi and Goel and NEERI Nagpur will be followed. Water samples will be collected early morning in plastic bottles, on spot test such as Temperature (°C) and pH recorded by using thermometer and digital pH meter. The Free CO_2 (mg/l) and DO (mg/l) will be performed at the selected site during sampling. Other parameter like TDS (mg/l), Total Hardness (mg/l), Ca (mg/l), Mg (mg/l), BOD (mg/l), PO_4(mg/l), No_3(mg/l), Na (mg/l) and K (mg/l) will be analysed in the laboratory. The birds' observation were acquire in the morning (6.30 – 11.00AM) and evening (3.00 – 5.00PM) with the help of 20×50 field binocular at all zones. The birds' observation were carried out to every month on 10 days interval. Field guide book, Fauna of Asan Wetland[11] and The Book of Indian Birds[12] were used to help of documentation and species identification, photography taken by Sony camera with the zoom lenses. Study of freshwater snails were done at different zones of the lake. Freshwater snails were collected from various aquatic habitat like riverbeds, irrigated canals, mudflats and others of the specimens on the spot. The collected speciment were identified using standard keys and catalogues[13,14].

Results and discussion

The Asan wetland provides a wealthy natural habitat with optimum hydrological and ecological characters for migratory birds. In present study the general information of Asan wetland, wetland type (Man-made), altitude (389.4), wetland area (4 km^2), depth of wetland (5–15feet), open water (>60%), vegetation (<40%) number of boats (20), rainfall (14–20mm) and relative humidity (65–80%) recorded during study period (Table-1). Wetlands created specifically to improve water quality are usually referred to as treatment wetland. On the earth, wetland is ultimate productive ecosystem and provide various important services as like tourism and fertile field to human society[15]. The Asan wetland situated at hilly terrain in lesser Himalaya so the present climatic and ecological characteristics are suitable to habitat for migratory birds and other fauna. The all ecological and climatic condition of wetland make good condition for bird's habitat in winter season. The maximum productivity obtained when the physical and chemical parameters are at optimum level**.** The physico-chemical analysis carried out from the different zones during winter seasons has been presented in Table-2 and Figure-2 to 6. Water temperature is important for effects on the chemical and biological parameter of water. Temperature also affects the metabolic activities of the living beings present in water. Temperature of wetland water ranged from a minimum of 14.56±0.15°C to maximum 17.13±0.11°C was related to with observations[16]. pH 7.13±0.20-7.93±0.15 is recorded during study period at different zones. The pH distribution of water showed that the Asan wetland was slightly alkaline. In winters the temperature of water was low and the pH value shifts towards alkalinity while as in summer the pH value moves towards acidity with increase in temperature[17]. Conductivity is measure of the ability of water to pass an electric current. Conductivity of water is affected by the presence of inorganic dissolve solids (ions that carry a negative charge or positive charge). Conductivity minimum 0.203±0.050 to maximum 0.356±0.097µmhocm^{-1} is recorded during study period at different zones. Free CO_2 ranged from minimum 3.16±0.05mg/l to maximum 4.13±0.25 mg/l recorded. The dissolved oxygen is essential component for survival of living organisms. Dissolved oxygen ranges from a minimum of 8.96±0.49mg/l to maximum 10.4±0.55mg/l recorded. In this study dissolved oxygen high in winter. The DO decrease in summer due to the high photosynthetic rate[17]. BOD represents the amount of oxygen (i.e. demanded) that microbes need to stabilize biological oxidizable matters[18]. BOD range varies from minimum 3.85±0.49mg/l to maximum 4.1±0.36mg/l. Total hardness (76±0.01-90.45±0.57mg/l), water hardness, higher in monsoon but it was highest during summer season which might have caused increase concentration of salts by excessive evaporation[17]. Total hardness concentration of metal ions expressed in term of mg/l of equivalent $CaCO_3$.The quantitative values of Calcium hardness were recorded minimum 32.2±0.01 to maximum 42.2±0.05mg/l. The result of Calcium in winter season was related to with observations[19]. Magnesium hardness recorded from minimum 13.44±0.01mg/l to maximum 19.12±0.06mg/l. Sodium is a common element in the natural environment and is often found in water. Sodium (1.1±0-1.5±0.1mg/l) is recorded in winter season was related to with observations[19]. Potassium play a central role of plant growth, it's ranged from minimum 1.01±0.01mg/l to maximum 1.03±0.01mg/l recorded. Nitrate ranged from minimum 0.31±0.06mg/l to maximum 0.37±0.02mg/l is recorded during study period. Nitrate concentration is high can result of algal

blooms and release of toxic substances (cyanotoxins) which will cause the death of fishes[20]. Phosphate is most essential plant nutrient and play a very important role of limiting factors between all other plant nutrients[19] and therefore, its determination in natural water may yield significant conclusions regarding water quality. Phosphate ranged from minimum 0.73±0.03mg/l to maximum 0.89±0.01mg/l recorded in winter season at different zones. On the conservative estimate, during winter season three million of waterfowls migrate to inland wetlands of India from Himalaya and across Eurasia[21]. The monitoring study of avian diversity of the wetland revealed that a total of 49 species and subspecies (Table-3 and 4). The 16 species are winter visitor (WV), and 33 residents (21 R, 8 R/LM, and 4 R/AM). In Asan wetland these birds are found their suitable habitat and fulfilled their basic needs as like feeding, breeding and nesting. At least 10 species (*Tadorna ferruginea*, *Anas acuta*, *Anas crecca crecca*, *Anas platyrhynchos*, *Anas strepera strepera*, *Anas penelope*, *Anas clypeata*, *Netta rufina*, *Aythya ferina* and *Aythya fuligula*) use the wetland as winter home, as they arrive with commencement of water (October), and stay throughout the winter (October – March) at the wetland and depart with onset of summer. Birds are capable to select their habitats on the basis of climatic variations, breeding characters and food spectrum[22]. The birds are observed during morning (6.30–11.00AM) and evening (3.00–5.00PM) in different zones. The zone - 1are covered dense vegetation so in morning time here the maximum number of birds recorded. During study period, minimum number of birds observed in zone - 2. In the zone - 3, moderate number of birds recorded here birds are resting on stone wall. The highly number of birds recorded in zone 4th and 5th during study period because in zone -4 and zone – 5 highly dense vegetation are present so birds found suitable habitat in this area of wetland. The more important study conducted by various ornithologist at few year ago on Asan wetland water birds and their surrounding[23]. The marsh bird like egrets, pond heron, grey heron and avocets etc. wade through the shallow waters and occasionally probe along dry margins of the wetland. The species observed in open water were Gadwall, Redcrested, common and Tufted Pochard. Shallows and shores were usually inhabited by Pintail, Mallard, Wigeon, Greylag Goose, etc. Mudflats were mostly occupied by Brahminy Duck and Common Teal, often accompanied by Barheaded Goose. The ecological characteristics of wetland represent biodiversity richness of wetland if ecosystem is complex biodiversity is well[22]. During study work the molluscan diversity of the all 5th zones there were the following 9 species of molluscs viz., *Bellamya bengalensis*, *Melanaides tuberculate, Lymnaea luteola, Lymnaea acuminate, Annandale Indoplanorbis, Gabbia orcula, Parreysia caerulea, Corbicula striatella* and *Sphaerium indicum* observed showed in Table-5. All these species includes 8 families and 8 genera. All these species usually occur in freshwater bodies with aquatic weeds thought based on minor shell characters, these forms are fairly constant and were recognized by Subba Rao. The species *Bellamya bengalensis* is a genus of fresh water with a gill and an operculum, aquatic gastropod mollusks in the family viviporidae. This is a small, one of the most common molluscs. It is observed in stagnant waters during study period. *Melanaides tuberculata* is a species of freshwater snails with an operculum, a parthenogenetic, aquatic gastropod mollusk in the family Thiridae. *Melanaides tuberculate* it is found in rock or hydrolic soil and grow in wide range of pH[24]. *Lymnaea luteola* is a species of freshwater snails, an aquatic gastropod mollusc in the family Lymnaeidae. *Lymnaea luteola* is widespread species in south Asia and Southeast Asia. *Lymnaea acuminata* is a species of freshwater snail in the family Lymnaeidae. This snail lives in water bodies with thick vegetation when it is observed. It easily survives in polluted waters. *Annandale Indoplanorbis* is a genus of air-breathing freshwater snail. *Gabbia orcula* is found in stagnant waters during study period. *Parreysia caerulea* observed colonizes in gravel, sand and mud substrate in wetland. *Corbicula striatella* it is found in nearby wetland and it prefers fine gravel, sand or mud substratum. It is widely distributed throughout the Indian subcontinent, including most of India confirmed present in Karnataka, Kerala, West Bengal, Bihar, Uttar Pradesh, Orissa, Sikkim[25]. *Sphaerium indicum* Deshayes, the small bivalve usually inhabits stagnant waters, among vegetation[26]. The freshwater molluscs play a very important role in the freshwater ecosystem. While the smaller species serve as food for many of the birds, fishes etc., majority of the larger mollusca species are regularly eat by people in many parts of the country. Shells of some of the species are widely used in lime and button industries and also for manufacturing of poultry feeds. Rai et al., the study involved sampling for a year from water bodies of various localities of Doon valley. Significant changes in freshwater snail assemblages were primarily due to changes in the water quality from locality to locality. Molluscs work as water purifiers. Their filter feeding and algal grazing helps to maintain the quality of water. It is observed that the water quality of the water body housing them is better than others. Molluscs are a favourite food of several predators. Birds like Painted Stork, Asian open bill stork feed on them. Migratory birds like pintail duck also feeds on them during winters. As bivalves feed on organic debris, they absorb heavy metals. By detecting the heavy metals from bivalve species, one can infer the pollution level of water body.

Table- 1: General Information of Asan Wetland.

Parameters	Rang
Type of wetland	Man-made
Altitude	389.4
Wetland area (km)	4 km^2
Depth of wetland	5 – 15 feet
Open water (%)	>60
Vegetation cover (%)	<40
Number of Boats	20
Rainfall (mm)	14 – 20 mm
Relative humidity (%)	65 – 80

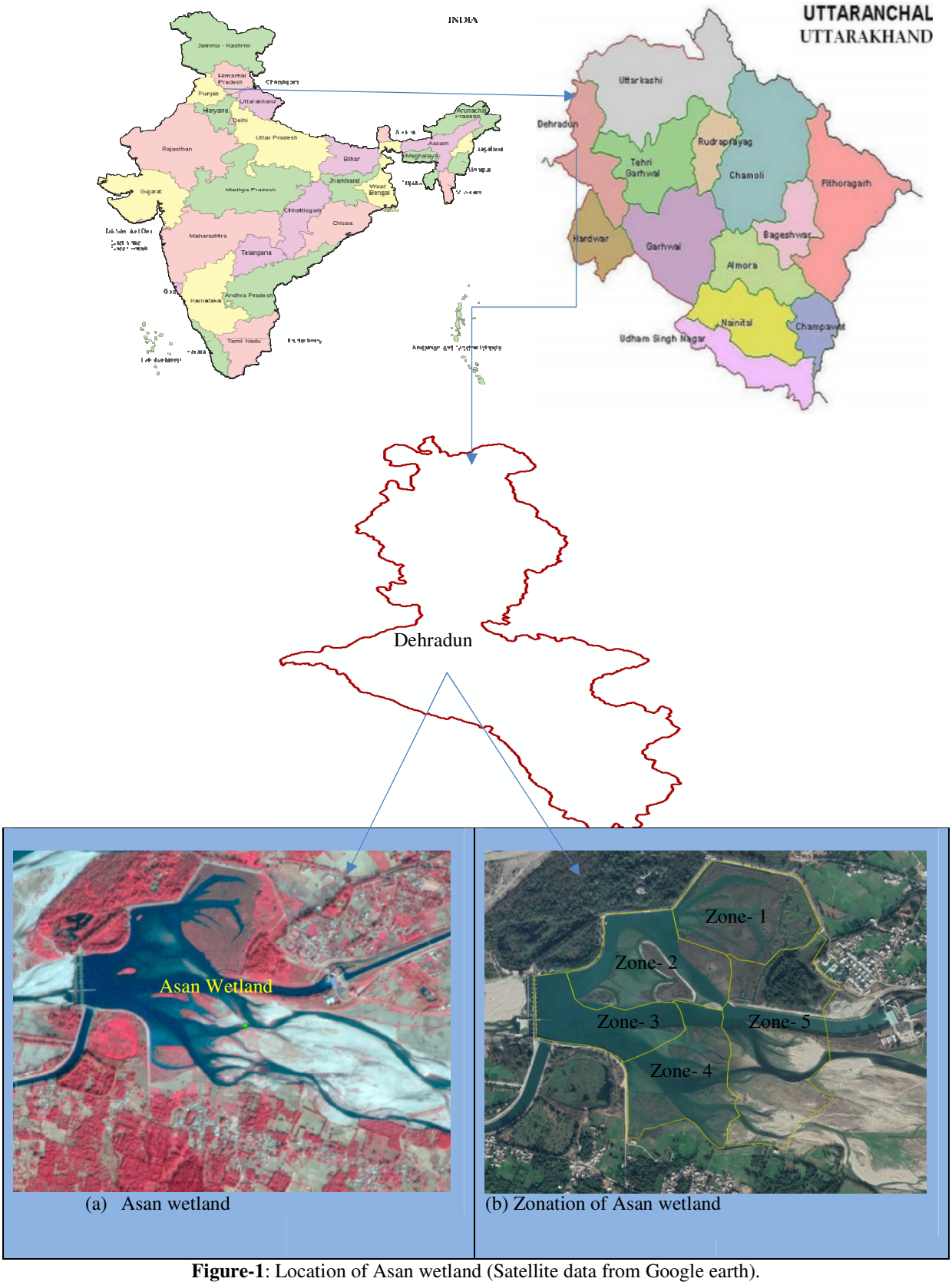

Figure-1: Location of Asan wetland (Satellite data from Google earth).

Table-2: showing average winter season variation in physico-chemical parameter of Asan wetland.

Zone/Perameter	Zone-1	Zone- 2	Zone- 3	Zone- 4	Zone-5
Water Temperature (°C)	15.36±0.15	16.5 ±0.02	17.13±0.11	14.56±0.15	15.5±0.01
pH	7.76±0.66	7.93±0.15	7.7±0.3	7.13±0.20	7.2±0.02
Conductivity (µmhocm^{-1})	0.306±0.041	0.356±0.097	0.203±0.050	0.256±0.025	0.276±0.011
TDS (mg/l)	151±1.00	130±1.00	100.3±0.57	140.6±1.15	152±1.0
Free CO_2 (mg/l)	3.53±0.30	4.13±0.25	3.16±0.05	3.4±0.02	3.5±0.17
DO (mg/l)	10.06±0.75	10.4±0.55	9.4±0.1	9.36±0.41	8.96±0.49
BOD (mg/l)	4.03±0.32	4.1±0.36	3.85±0.49	4.03±0.30	3.93±0.49
Total Hardness (mg/l)	89.66±0.57	77.33±1.15	76±0.01	90.45±0.57	83±0.01
Calcium (mg/l)	32.2±0.01	35.86±0.05	32.3±0.01	36.43±0.01	42.2±0.05
Magnesium (mg/l)	16.22±0.05	17.82±0.01	13.44±0.01	17.27±0.03	19.12±0.06
Sodium (mg/l)	1.1±0	1.1±0	1.3±0.1	1.5±0.1	1.5±0.1
Potassium (mg/l)	1.01±0.01	1.01±0.01	1.03±0.01	1.01±0.01	1.02±0.05
Nitrate (mg/l)	0.31±0.06	0.37±0.02	0.32±0.04	0.33±0.01	0.34±0.01
Phosphate (mg/l)	0.81±0.05	0.83±0.08	0.81±0.03	0.73±0.03	0.89±0.01

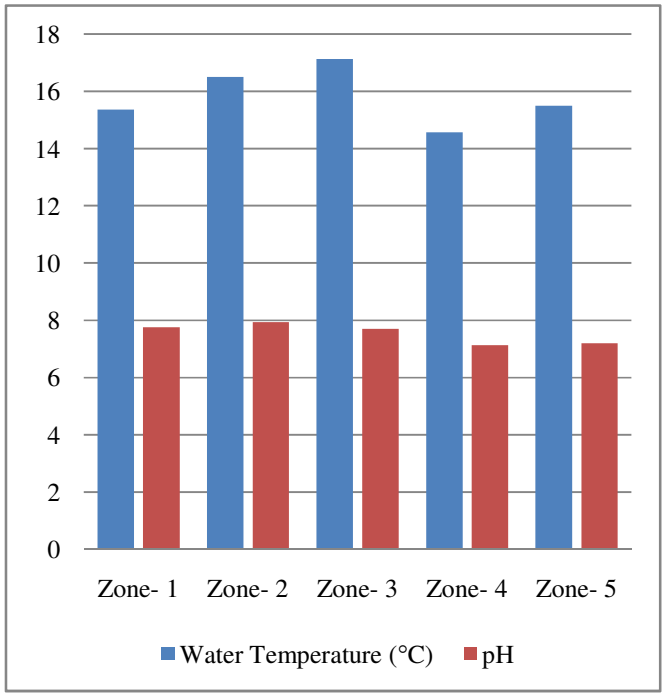

Figure-2: Showing average winter season variation in Water Temperature and pH of Asan wetland.

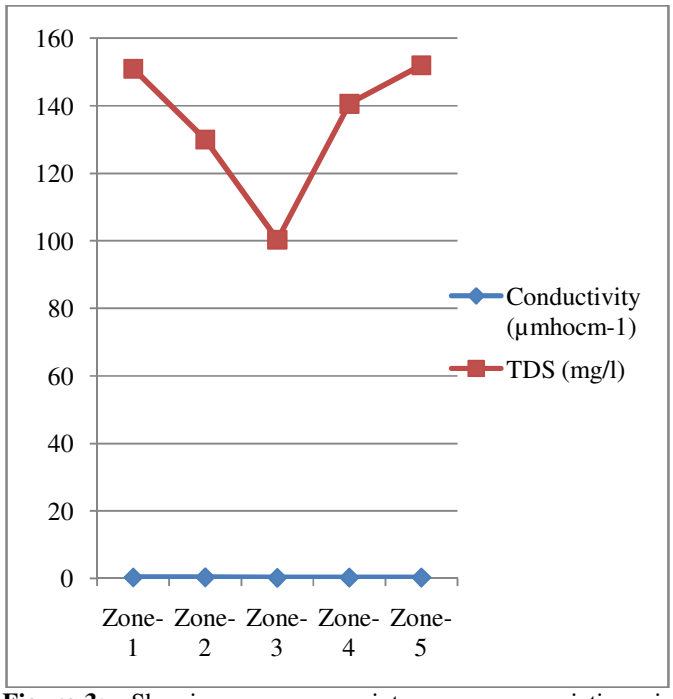

Figure-3: Showing average winter season variation in Conductivity and TDS of Asan wetland.

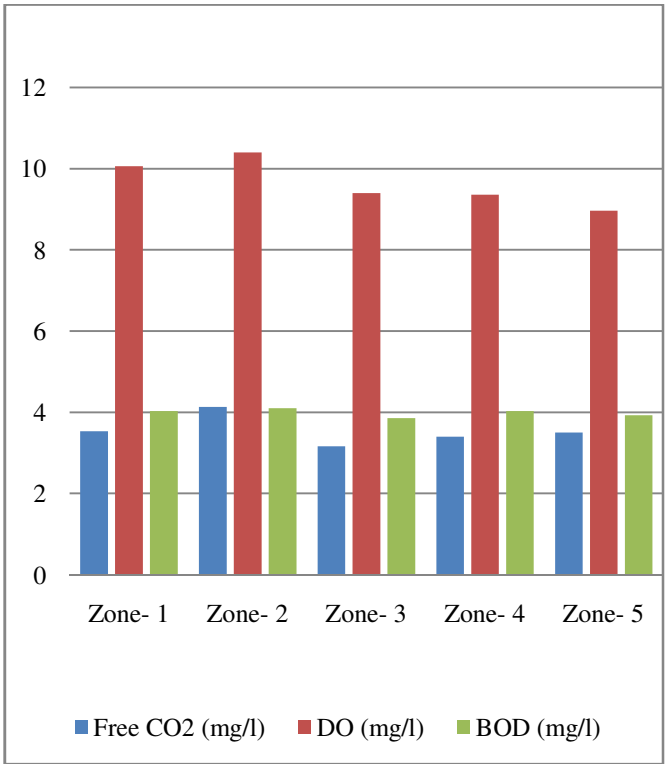

Figure-4: Showing average winter season variation in Free CO_2, DO and BOD of Asan wetland.

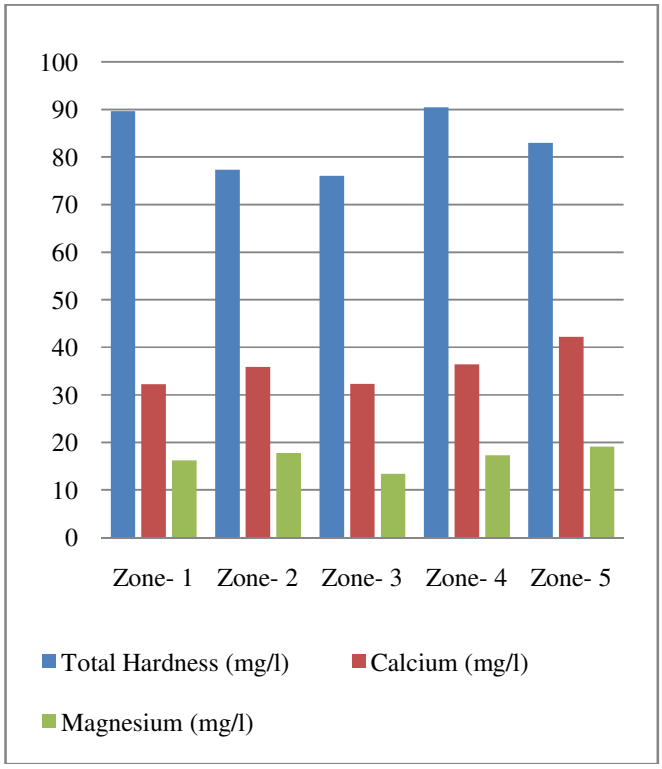

Figure-5: Showing average winter season variation in TH, Calcium and Magnesium of Asan wetland.

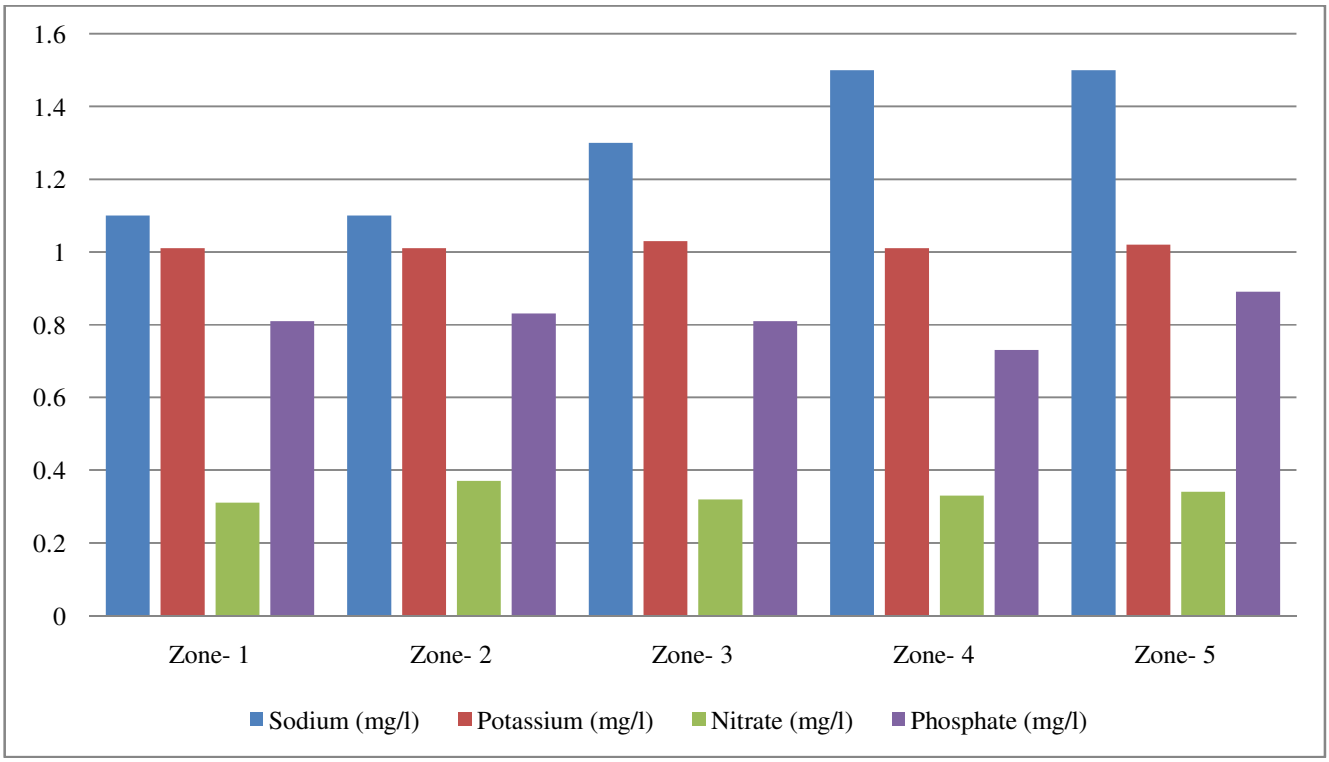

Figure-6: Showing average winter season variation in Sodium, Potassium, Nitrate and Phosphate of Asan wetland.

Table-3: Status of Avian Diversity in Different Zones of Asan Wetland (data collected from October 2017 – March 2018).

Local name of Avian Species	Zoological Name	Status	Zone-1	Zone-2	Zone-3	Zone-4	Zone-5
Large Cormorant	*Phalacrocorax carbo sinensis*	R/LM	Vc	Occ	C	Vc	Vc
Little Cormorant	*Phalacrocorax niger*	R/LM	A	Vc	A	A	A
Eastern Grey Heron	*Ardea cinerea rectirostris*	R	Lc	Occ	Lc	Lc	Lc
Indian Pond Heron	*Ardeola grayii grayii*	R	Lc	Occ	C	C	C
Cattle Egret	*Bubulcus ibis coromandus*	R	C	Lc	C	C	Vc
Eastern Large Egret	*Ardea alba modesta*	R/LM	Lc	Lc	A	A	C
Little Egret	*Egretta garzetta garzetta*	R/LM	Lc	Lc	C	C	Lc
Indian Black Lbis	*Pseudibis papillosa papillosa*	R/LM	Lc	Occ	Occ	Lc	Occ
Indian white Wagtail	*Motacilla alba dukhunensis*	WV	A	C	C	A	Vc
Large Pied Wagtail	*Motacilla maderaspatensis*	R	Vc	Occ	Lc	C	C
River Chat	*Chaimarrornis leucocephalus*	R/AM	Lc	Lc	Occ	Lc	Lc
Barheaded Goose	*Anser indicus*	WV	Occ	Occ	Occ	Occ	Occ
Plumbeous Redstart	*Rhyacornis fuliginosus fuliginosus*	R/AM	Lc	Occ	Occ	Lc	Lc
Brahminy Duck	*Tadorna ferruginea*	WV	A	Vc	A	A	A
Pintail	*Anas acuta*	WV	A	C	A	A	A
Common Teal	*Anas crecca crecca*	WV	C	C	A	A	A
Mallard	*Anas platyrhynchos*	WV	A	Lc	A	C	C
Gadwall	*Anas strepera strepera*	WV	A	Lc	A	A	C
Wigeon	*Anas penelope*	WV	C	Lc	A	A	C
Shoveller	*Anas clypeata*	WV	A	Occ	A	Vc	Vc
Redcrested Pochard	*Netta rufina*	WV	Vc	Lc	A	A	Vc
Common Pochard	*Aythya ferina*	WV	A	C	A	A	A
Tufted Duck	*Aythya fuligula*	WV	Vc	A	C	A	C
Cotton Teal	*Nettapus c. coromandelanus*	R	Occ	Occ	Occ	Lc	Lc
Temminck Stint	*Calidris temminckii*	WV	Lc	Occ	Occ	Lc	Occ
Indian Sarus Crane	*Grus antigone antigone*	R/LM	Occ	Occ	Occ	Occ	Occ
Indian Moorhen	*Gallinula chloropus indica*	R	Vc	Lc	C	Vc	Vc
Common Coot	*Fulica atra atra*	WV	Vc	Lc	A	A	A
Redwattled Lapwing	*Vanellus indicus indicus*	R	Lc	Lc	Lc	Lc	Occ
Spurwinged Lapwing	*Vanellus spinosus duvaucelii*	R	C	Lc	Lc	C	Lc
Spotted Redshank	*Tringa erythropus*	WV	Occ	Occ	Occ	Lc	Occ
Common Sandpiper	*Tringa hypoleucos*	R/LM	Lc	Lc	Lc	Lc	Lc
Indian Blackwinged Stilt	*Himantopus h. himantopus*	R	Lc	Occ	Occ	Lc	Lc
Indian River Tern	*Sterna aurantia*	R	C	Lc	Lc	C	Lc
Spotbill Duck	*Anas p. poecilorhyncha*	R	Vc	Occ	Lc	C	C
Ringtailed or Pallas's Fishing Eagle	*Haliaeetus leucoryphus*	R	Lc	Occ	Lc	Lc	Lc
Osprey	*Pandion haliaetus Haliaetus*	R	Occ	Occ	Occ	Lc	Lc
West Himalayan Pied Kingfisher	*Ceryle lugubris continentalis*	R	Lc	Occ	Occ	Lc	Occ
Indian White breasted Kingfisher	*Halcyon smyrnensis fusca*	R	Lc	Lc	Lc	Lc	Lc
Western Swallow	*Hirundo rustica rustica*	R/AM	A	Lc	Lc	A	C
Plumbeous Redstart	*Rhyacornis fuliginosus fuliginosus*	R/AM	Lc	Occ	Occ	Lc	Lc
Grey Wagtail	*Motacilla caspica caspica*	WV	C	Lc	C	C	C

Note: R = Resident, R/LM = Resident and Local Migrant, R/AM = Resident and Altitudinal Migrant, WV = Winter Visitor, A = Abundant (>100 birds), Vc = Very common (51 – 100), C = Common (11 – 50), Lc = Less common (1 - 10), Occ = Occasional (one or more stray birds spotted once in a while), (Birds counting methodology adopted by Book, Fauna of Asan Wetland, ZSI).

Table-4: Status of Reed Dwellers Birds Observed in Different Zones of Asan Wetland (Data collected from October 2017 – March 2018).

Local name	Zoological Name	Status	Zone-1, Zone-2, Zone-3, Zone-4, Zone-5
			Abundance Status
Streaked Fantail Warbler	*Cisticola jauncidis cursitans*	R/LM	Lc
Northern Ashy-grey Wren Warbler	*Prinia hodgsonii rufula*	R	C
Indian Tailor Bird	*Orthotomus sutorius guzuratus*	R	C
Blyth's Reed Warbler	*Acrocephalus dumetorum*	R	C
Indian Baya	*Ploceus p. philippinus*	R	C
Red Munia or Avadavat	*Estrilda amandava amandava*	R	C
Indian Spotted Munia	*Lonchura punctulata*	R	Lc

Note: R = Resident, R/LM = Resident and Local Migrant, C = Common (11-50), Lc = Less common (1-10), (Birds counting methodology adopted by Book, Fauna of Asan Wetland, ZSI).

Table-5: Status of Molluscan Diversity Observed in Different Zones of Asan Wetland (Data collected from October 2017 – March 2018).

Kingdom	Phylum	Class	Family	Genus	Species	Locality
						Zone-1, Zone-2, Zone-3, Zone-4, Zone-5
Animalia	Mollusaca	Gastropoda	Viviporidae	*Bellamya*	*bengalensis*	+
Animalia	Mollusaca	Gastropoda	Thiridae	*Melanaides*	*M. tuberculata*	+
Animalia	Mollusaca	Gastropoda	Lymnaeidae	*Lymnaea*	*luteola*	+
Animalia	Mollusaca	Gastropoda	Lymnaeidae	*Lymnaea*	*acuminata*	+
Animalia	Mollusaca	Gastropoda	Planorbidae	*Annandale*	*Indoplanorbis*	+
Animalia	Mollusaca	Gastropoda	Bithyniidae	*Gabbia*	*orcula*	+
Animalia	Mollusaca	Bivalvia	Unionidae	*Parreysia*	*caerulea*	+
Animalia	Mollusaca	Bivalvia	Cyrenidae	*Corbicula*	*striatella*	+
Animalia	Mollusaca	Bivalvia	Sphaeriidae	*Sphaerium*	*indicum*	+

Note: + = Present

Conclusion

Wetland have been used to treat a variety of threats to downstream water quality. The Himalayan region is dotted with hundreds of freshwater resources in the form of lakes and wetlands. These freshwaters were affected by an adverse effect of the environment. The present studies indicate to the health of Asan wetland. The relationships between various physico-chemical parameter of were also analysed to ensure the effect of these physiochemical parameters upon biological factors of wetland. The molluscan and bird diversity community relying on avian and faunal substrate of Asan wetland is still moderately, and the water quality was still moderately polluted. Molluscs work as water purifiers. Their filter feeding and algal grazing helps to maintain the quality of water. It is observed that the water quality of the water body housing them is better than others. Molluscs are a favourite food of several predators. Birds

like Painted Stork, Asian open bill stork feed on them. Migratory birds like pintail duck also feeds on them during winters. On the basis of wetland importance, many good approaches are needed for analysis, protection and conservation of Asan wetland.

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