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RESEARCH ARTICLE

HABITAT SELECTION PATTERN OF MIGRATORY AVIFAUNA IN RELATION TO NUTRIENTS IN ASAN WETLAND AT DOON VALLEY (GARHWAL HIMALAYA), INDIA

Malik.D.S and Nidhi Joshi

Department of Zoology and Environmental Science, Gurukula Kangri University, Haridwar (India)

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ABSTRACT

Asan wetland is a rich, diverse and a well notified conservation reserve for sustaining a large migratory avian diversity. Migratory birds are an important biotic component of the wetland ecosystem as they occupy several trophic levels in the food web of wetland. Habitat ecological study of migratory and local birds in Asan wetland has been done during the winter season. The Asan wetland provides an optimum suitability of natural habitats for breeding, roosting, feeding etc. to rich repository migratory avifaunal population and supports them for their annual migratory behaviour. The 21 migratory species in different flocks from four zones of wetland were observed during the study period. The maximum number of flocks were recorded in morning in Zone I but the high abundance was observed in Zone IV. Mostly the birds are carnivorous and feed mainly on Insects, Zooplanktons, Crustaceans, Water bugs, flies etc. The wetland is quite rich in nutrients and contributed significantly to enhancement of ecosystem productivity as a distinct food web cycle provides a substantial food spectrum to the avian fauna. The ecological characteristics of wetland were studied as dissolved oxygen in the range of (5.6-7.2 mg/l), Sulphate (1.32-1.36 mg/l), Calcium (24.17-25.43mg/l), Magnesium (12.83-13.27mg/l). The nitrate (0.29 mg/l -0.33 mg/l) and the phosphate (0.659-0.76 mg/l) were recorded in all zones. The nitrate and phosphate are the limiting factor to denote the present trophic status of wetland in relation to productivity and status of species richness of biotic communities. The present study revealed that the availability of nutrients in wetland play a significant role in the selection of particular ecological niche by the migratory avifauna.

INTRODUCTION

Wetlands are the most valuable ecosystem on the earth as it supports a rich and diverse biodiversity of the flora as well as fauna. A large number of migratory birds have visited during in winter periods in the wetland due to climate variations and availability of feeding resources. Wetlands are contributed as natural habitats for feeding, roosting, nesting and breeding of birds (Weller, 1999; Stewart, 2001). The relationship between habitat structure and wetland assemblages is centered on habitat extension effects on community structure (Froneman *et al*, 2001; Riffell *et al.*, 2001). Bird Species richness and their abundance guild have been positively correlated with wetland area and water surface area (Babbitt, 2000). According to their habitat suitability, the migrant birds are selected different natural sites for their diurnal activities. The physical and chemical attributes alters the corresponding food web structures at the primary and secondary production levels in the wetland ecosystem (Wrona *et al*, 2006).In winter, the productivity of the ecosystem is stabilized and food is easily accessible by migratory species of wading birds are attracted increasing the species richness of migratory birds. According to Paszkowski and Tonn (2000), larger wetlands can provide more natural microhabitats, thereby attracting a greater number of species. However, Hudson (1983) and Garay e*t al* (1991) emphasized that smaller wetlands maintained higher waterbird density and diversity than larger ones. Considering that wetlands differ in their biological potential to provide a habitat for wetland birds, because species have contrasting life histories that influence the way that each interacts with the selective landscape (Naugale *et al.*2001). There are many ecological and climatic factors, which are mainly, contributed for the disturbance of the habitat one is mainly the anthropogenic pressure affects the habitat of water birds (Bharatha lakshmi, 2006). Human activities threatened the existence of many birds by destroying their habitat or directly affecting their survival and reproductive success (Green and Hirons, 1991). The mesotrophic status of wetland carried good food web as feeding habits and selective micro-habitat could also increase diversity, evenness and species richness in the wetland (Smith, 1992). The distribution and abundance of many bird species are determined by the composition of the vegetation that forms a major element of their natural habitats. Asan wetland considered as an important aquatic habitat for migratory birds due the high productivity and nutrients enrichment. This paper evaluates the micro-habitat that is selected by the winter migratory birds and different attributes which are responsible for present status of nutrients present in particular habitat. The main aims of present study were to quantify the nutrient characteristics and their interrelationships as food resources and selective habitats preference for migratory and local birds. The present results will be contributed to the ecological management and restoration of natural habitat in the wetland.

* Corresponding author: **Malik.D.S**
Department of Zoology and Environmental Science, Gurukula Kangri University, Haridwar (India)

MATERIALS AND METHODS

Study area

Asan wetland is now known as Asan conservation reserve, geographically situated between latitude 30° 24' – 30° 28'N and Longitude 77 ° 40' – 77 °44' E, near the confluence of river Asan and Yamuna Hydel Canal at Doon valley of Garhwal Himalaya in Indian sub-continent. Asan wetland is located in the foot hills of lesser Himalayan zone at Doon valley, consisting both shallow and deep water areas with large catchment basin surrounded by forest, agricultural pastures, river basin, and village inhabitants. In the western side of wetland, a barrage (water regulator) is constructed as 287.5 m long and river bed is 389.4 m above the sea level with the water level of 403.3 m above sea level. The maximum rainfall was received about 250-275 cm. during rainy seasons. Asan wetland attracts large number migratory as well as local aquatic birds as waterfowl, both waders and divers in winter seasons for the breeding due to the availability of food resources and suitable natural habitats. (Fig. 1)

Methodology

The study area is categorized into four different zones on the basis of habitat preferences by migratory and local birds. The hydrological and biological parameters were analysed for the study of habitat ecology. The physico-chemical characteristics and nutrients were analyzed by the standard methodology prescribed by APHA (1998). Plankton samples were preserved by adding 5 ml of 40 % formalin and identification was done with help of standard works and Plankton net was used for collection made up of silk cloth No.25(mesh size 0.064mm) described by Edmondson(1965),Needham and Needham (1966). The birds count percentage was recorded between the sunrise and sunset with the help of binoculars (10×50). To avoid the repeated counting of birds, routes were seasonally spaced out in enclosed habitats by 50-100m and in the open wetland habitat by 100-150m.Bird watching and recording has been done for the period of one year and the photography was done with the help of Sony camera with the zoom lenses. The birds were identified with help of different field guides (Ali 1984; Ali and Ripley 1987; Grimmet *et al.,* 2000; and Grewal *et al.,* 2002).

RESULTS

The Asan wetland provides a rich natural habitats for migratory birds as well as consisting of optimum hydrological and ecological characteristics. The selective ecological parameters, rainfall (15-25mm), relative humidity (65-80%), water temperature (2.5-27.0°C) and dissolved oxygen (5.6-7.2 mg/l) were recorded during the study periods in and around Asan wetland (Table .1). The wetland is quite rich in nutrients contributed significantly to develop a food web spectrum and selective ecological niche for migratory birds. The quantitative values of these nutrients were recorded as Ca (24.17- 25.43), Mg (12.83-13.27 mg/l), K (1.09 -1.12 mg/l), $S0_4$ (1.32-1.36 mg/l), Po_4 (0.65-0.76 mg/l), No_3^{2-} (0.295-0.331 mg/l), No^-_2 (0.159-0.21mg/l), and Cl (27.35-28.13 mg/l) from different zones of wetland and showed in Table 2. The present food spectrum in Asan wetland has been determined by the composition of biotic organisms as plankton (Phytoplankton and Zooplankton), benthos, and small fish species for the migratory birds. The phytoplankton were denoted as members belongs to Chlorophyceae (18.6- 20.1), Bacillariophyceae (32.1-33.5), Euglenophyceae (13.6-14.9) and Cyanophyceae (24.4 -25.5) were recorded. The species observed as Chlorophyceae was *Spirogyra sp, Chlorella sp, Hydrodictyon sp, Cladiphora sp,* Bacillariophyceae viz, *Diatoms sp, Synedra* sp, *Flagillaria sp, Navicula sp, Cymbella* sp and Euglenophyceae as Phacus sp, *Euglenomultiformis.* and two Species was reported under Cyanophyceae order was *Oscillatoria sp, Anabaena sp* and the surface and bottom water quality of wetland were exerted a selective magnitude on distribution, their abundance of zooplanktons and other animal groups . The zooplanktons were fairly evidenced as distribution patterns belonging to Protozoa (25.6- 26.9 %), Rotifers (21.3-21.7 %), Cladoceran (19.3-20.1%), and Copepods (21.3-21.8%) in Asan wetland. The species recorded in different groups are Protozoa viz, *Volvox sp,Ceratium sp, Euglena sp,* Rotifera includes *Notholoca sp, Rotifera sp, Monostyla sp, Trichotoria sp,* Cladoceran as *Daphnia sp,Moina sp, Cyorus sp,* Copepods as Cyclops, Diaptomus sp, Mesocyclopus sp. The insects recorded as abundant group of Odonata with (28.2-32.1%), Trichoptera (23.1-24.5%), Coleoptera (17.2-18.2%), Ephemeroptera (11.3-13.3 %). Macrobenthos recorded as Gastropods as (46-58%), Annelids (37-47%). (Table 3).

Table 1 Hydrological Characteristic in Asan Wetland

S.No.	Parameters	Range
1	Year Declared as a Conservation reserved	2005
2	Surface area	4 Km^2
3	Rainfall(mm)	15 - 25 mm
4	Relative Humidity(%)	65-80
5	Water Temperature (°C)	2.5-20°C
6	Sunlight radiations (Lux)	180-195
7	Dissolved Oxygen(mg/l)	5.6 – 7.2

Asan wetland provides most suitable ecological habitats for winter migratory birds during the winter season. The 21 birds species are observed in various flocks at different zones of wetland during the migration period. The birds required a specific habitat niche to satisfy their primary needs. The migratory birds were arrived in different time intervals at Asan wetland during winter months i.e. October to January. The particular bird species abundance and their flocks also showed their selective habitat preferences on diurnal scales depicted in Table 4. Birds species like *Podiceps cristatus, Anas falcata, Nycticorax nycticora*x, *Tadorna ferruginea, Tadorna tadorna, Clangula hyemalis* found in clean water habitat with abundant aquatic plants, Fulica atra, *Anas acuta, Anas clypeata* rested in open with submerged macrophytic wetlands and *Podiceps* cristatus, Nycticorax nycticorax,*Ardea cineria*, Tadorna *tadorn*a,*Anas clypeate, Clangula hyemalis*, Tringa *ochropus*, Tringa *erythropu*s, Larus *ridibundus* were found mostly carnivorous and feeds mainly on small Fishes, aquatic invertebrates, insects, crustaceans etc. and occurred in dense macrophytic zones of wetland (Table 5).

Table 2 Nutrient Characteristics in different Zones

S.No	Parameters (mg/l)	Zone I	Zone II	Zone III	Zone IV
1	Calcium	24.17	24.52	24.35	25.43
2	Magnesium	12.83	13.025	13.16	13.27
3	Potassium	1.09	1.09	1.10	1.12
4	Sulphate	1.33	1.32	1.34	1.36
5	Phosphate	0.659	0.70	0.74	0.76
6	Nitrate	0.295	0.307	0.323	0.331
7	Nitrite	0.159	0.173	0.207	0.215
8	Chloride	27.35	27.50	27.62	28.13

Table 3 Composition (%) of biotic organisms of Asan wetland

S.No.		Zone I				Zone II				Zone III				Zone IV			
		Chl	Bac	Eug	Cya	Chl	Bac	Eug	Cya	Chl	Bac	Eug	Cya	Chl	Bac	Eug	Cya
1.	Phytoplankton	18.6-32.1 Prt	32.1-38.2 Rot	13.6-23.5 Cla	24.4-32.1 Cop	19.2-33.1 Prt	32.4-38.7 Rot	14.6-24.5 Clad	25.1-33.2 Cop	19.4-33.6 Prt	32.5-38.8 Rot	14.7-24.7 Cla	25.3-33.5 Cop	20.1-33.8 Prt	33.5-38.9 Rot	14.9-24.8 Cla	25.5-34.3 COP
2	Zooplankton	25.6-29.5 Odo	21.3-31.2 Tric	19.3-22.1 Cole	21.3-29.2 Ephe	25.7-29.6 Odo	21.5-31.4 Tric	19.4-24.1 Cole	21.4-29.5 Ephe	26.1-29.5 Odo	26.1-31.7 Tric	19.7-24.4 Cole	21.5-30.1 Ephe	26.9-30.1 Odo	21.7-31.8 Tric	20.1-24.8 Cole	21.8-24.7 Ephe
3	Insects	28.2-31.2	23.1-29.3	17.2-17.9	11.3-12.4	29.3-32.3	23.7-29.5	17.5-18.2	12.3-13.5	31.2-34.2	21.2-27.1	17.9-18.5	12.4-13.7	32.1-34.5	24.5-28.2	18.2-19.9	13.3-15.2
4.	Macro invertebrates	Annelids 37-39		Gastropods 46-52		Annelids 41-45		Gastropods 55-58		Annelids 43-46		Gastropods 59-62		Annelids 47-51		Gastropods 58-71	

Chl: Chlorophyceae, Bac: Bacillariophyceae, Eug: Euglenophyceae , Cya: Cyanophyceae:Prt : Protozoa, Rot: Rotifera,Clad: Cladocera,Cop:Copepoda,
Odo: Odonata, Tric: Trichoptera,Cole:Coleoptera,Ephe:Ephemeroptera

Table 4 Birds abundance (No. of Flocks in different zones) in Asan Wetland during the Winter Season

S.No.	Birds	Status	Zone I			Zone II			Zone III			Zone IV		
	Nomenclature		8-10	10-12	2-4	8-10	10-12	2-4	8-10	10-12	2-4	8-10	10-12	2-4
1.	*Podiceps cristatus*	wv	2					4		3		5		
2.	*Phalocrocorax carbo*	wv		8		10				11			13	
3.	*Anas falcata*	wv												
4.	*Nycticorax nycticorax*	lm	4				5				3	2		
5.	*Ardea cinerea*	wv		6				8	5					6
6.	*Anser indicus*	wv												
7.	*Anser anser*	wv	1			4				3				4
8.	*Tadorna ferruginea*	wv		2			3		4				3	
9.	*Tadorna tadorna*	wv			3			2		4				5
10.	*Anas strepera*	wv	1					2	3			2		
11	*Anas platyrhynchos*	wv		4		2			3				5	
12	*Anas penelop*	wv	3			3			2					5
13.	*Anas acuta*	wv		2			4			5		2		
14	*Anas clypeata*	wv	2			3			1				4	
15.	*Aythya fuligula*	wv	1				2			2		1		
16.	*Clangula hyemalis*	wv		3				2	1					2
17.	*Gallinula chloropus*	wv	3			2			1			3		
18.	*Fulica atra*	wv		2		1				3			2	
19.	*Tringa erythropus*	wv	4				3				2	1		
20.	*Tringa ochropus*	wv	1				1						2	
21.	*Larus ridibundus*	wv		3				2	1					2

Table 5 Selected habitat niche and dietary pattern of migratory avifauna

S.No.	Birds Nomenclature	Habitat Niche	Feeding habit
1	*Podiceps cristatus*	Species breed on fresh water with submerged and abundant emergent vegetation	Large fish as well as insects, crustaceans, mollusks, amphibians etc.
2	*Phalocrocorax carbo*		Fishes mainly, Sculpins, Capelin.Gaddis, Flatfish, Molluscs
3	*Anas falcata*	Fresh water habitat	Diet based on wheat and pellets is suggested
4	*Nycticorax nycticorax*	Fresh and salt water marshes, swamps, lakes etc.	Feeds on amphibians, crustaceans, insects and small mammals.
5	*Ardea cinerea*	Shallow water or saline show preferences with trees	Predominantly eat fish, eels, amphibians, crabs, aquatic insects etc.
6	*Anser indicus*	Lowland swamps and with short grasses	Feeds on grass , occasionally feeds on crustaceans and invertebrates
7	*Anser anser*	Lowland marshy area and have fens with a lot of vegetation	Herbivore, plants like Eleocharis sp., Scirpus sp are mostly preffered .
8	*Tadorna ferruginea*	Freshwater habitat	Omnivorous, diet consist of often tender green shoots
9	*Tadorna tadorna*	Saline habitat, Fresh water habitat on migration	Aquatic invertebrates(insects, crustaceans small fish etc)
10	*Anas strepera*	Open water Habitat	Abundant aquatic plant, mainly leaves, stems of pondweed.
11	*Anas platyrhynchos*	Preferred marshy area	Eat seeds of grasses ,Sedges, Leaves, stem and seeds of Aquatic plants
12	*Anas penelope*	Species breed in lowland freshwater marshes with emergent submerged vegetation	Vegetarian consumes leaves, seeds stems, and roots of pond weeds, fine grasses
13	*Anas acuta*	Bird of Open wetland , nests on ground	Winter diet includes, plant material including seeds, rhizome of aquatic plants.
14	*Anas clypeata*	Open wetlands, wet grasses,marshes with emergent vegetation	Aquatic plants, insects, molluscs and seeds from water that it filters with its bill.
15	*Aythya fuligula*	Open water marshes	Omnivorous, feeds on plants while floating on water.
16	*Clangula hyemalis*	Breeds on marshes, freshwater habitat	Marine foods, crustaceans, cladocerans, freshwater insects
17	*Gallinula chloropus*	Fresh water habitat, aquatic vegetative habitat	Omnivorous, feeds on plants while Floating on water
18	*Fulica atra*	Open water marshes	Insects,Aquatic plants, amphibians, fishes
19	*Tringa erythropus*	Freshwater area	Terrestrial lying insects, crustaceans, fish and amphibians
20	*Tringa ochropus*	Inland freshwater, and marshes	Aquatic and terrestrial insects, mainly beetles, ants water bugs fishes and crustaceans.
21	*Larus ridibundus*	Temporaray flooded wetland with lush vegetation form nesting colonies on the margin.	Aquatic & terrestrial insects and marine invertebrates fishes .

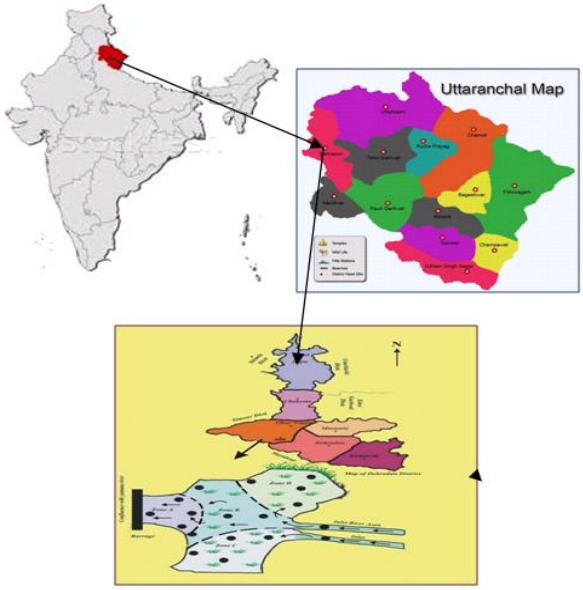

Fig. 1 Showing the Map of Asan Wetland and the Sampling sites

Fig 2 Flocks of migratory birds in Zone I during morning period at Asan wetland

Fig 3 Flocks of migratory birds in Zone IV during evening period at Asan Wetland

Fig 4 Flocks of migratory birds searching feeding materials in Zone III of Asan Wetland

DISCUSSION

Wetlands is considered as an important nutritive natural aquatic habitats for migratory birds for its specific characteristics like rich in biodiversity, vegetation cover, nutrient enrichment and water quality. The ecological dynamics conducted in wetland ecosystems have demonstrated the importance of habitat area and habitat heterogeneity for the existing biodiversity (Svingen and Anderson, 1998; Fairbairn and Dinsmore 2001; Riffel *et al.*, 2001). The present hydrological and ecological conditions of wetland are contributed significantly for the assemblages of birds in particular habitats for their activities like feeding, resting, breeding, roosting etc. The migratory bird species also shift their feeding and breeding habits between seasons in temperate area (Ward, 1969). The present geo-graphical and climatic characteristics of Asan wetland provides a best natural ecological home for attracting the migratory birds from Eurassia, Ukraine, Mangolia and other parts of north arctic regions. The metereological parameters as rainfall (15 to 25 mm), water temperature (2.5.-20° C) relative humidity (65-80) and light intensity (180- 195 Lux) recorded during the migratory periods of birds in the Asan wetland correlated positively with birds diversity and their species richness and assemblages. The migratory birds are selecting their natural aquatic habitats according to their feeding and breeding demands for maintain their physiological requirements. The physico-chemical and biological characteristics of Asan wetland are determined its trophic status and potential of biological productivity to maintain a suitable food spectrum and successive biotic communities. The selective zones of Asan wetland were also classified on the basis of open water, confluence of canal water, shallow, macrophyte vegetative area and determined the nutrients in four zones. The nutrients as Ca (24.17- 25.43 mg/l). Mg (12.83-13.27 mg/l), potassium (1.09-1.12 mg/l), Sulphate (1.32-1.36 mg/l), Phosphate (0.65-0.76 mg/l), Nitrate (0.295-0.331 mg/l), Nitrite (0.15-0.21 mg/l), Chloride (27.3-28.1 mg/l) played a vital role to enhance the growth of plankton,benthos and other aquatic biotic communities. The present nutrients in the wetland have created a significant foodweb structure and responsible for increasing the infestation of aquatic macrophytes on the shallow zones of wetland. The dissolved oxygen (6.8-7.2 mg/l) indicated its high mesotrophic conditions due to rich zooplankton, aquatic insects and aquatic vegetations in the wetland. The higher water temperature, pH, Total solids, Total hardness, Phosphates, Nitrates favour the optimum growth and production of phytoplankton and it occurs commonly in all types of water (Hosetti *et al*, 1994, Goel *et al*, 1992). The percentage chlorophyceae (18.6- 20.1), Bacillariophyceae (32.1-33.5), Euglenophyceae (13.6-14.9) and Cyanophyceae (24.4 -25.5) were recorded in Asan wetland. Shen (2002) found that the algal growth was directly related to the concentration of phosphorus and nitrogen in aquatic ecosystem.

Most of the migratory birds are carnivorous and feeds on the aquatic insects, fishes, crustaceans etc.The biological species recorded in the present study were recorded as Protozoa (25.6-26.9 %), Rotifers (21.3-21.7 %), Cladoceran (19.3-20.1%), Copepods (21.3-21.8%). Sunkad and patil (2004) also reported 4 groups, which include rotifers (52.38%), Copepods (26.5%), Cladocerans (16.45 %), Ostracods (4.67%). The ecological distribution of Euglenoids has been studied by Munawar(1970) and Singh & Swarup (1979) have been advocated that more amount of nitrate , phosphate and low content of dissolved oxygen favoured the growth of Euglenoids. The insects recorded in Asan

wetland as abundant group of Odonata with (28.2-32.1%),Trichoptera (23.1-24.5%), Coleoptera(17.2-18.2%), Ephemeroptera (11.3-13.3 %). Macrobenthos recorded as Gastropods as (46-58%), Annelids (37- 47%). (Table 3).The insect was found as the dominant group in the study by Akbulut *et al* (2002). Mishra (1996) recorded the average ranged (690-250 ind./ m^{-2}) density of Gastropoda due to high concentrations of nutrients in riverine ecosystem. Zooplankton not only regulate the aquatic productivity by occupying the intermediate position in food chain, but also by indicating environmental status in a given time (Xie *et al.,* 2008).Zooplankton organism contribute significantly to the recycling of nutrients and provide a food base for predatory invertebrates and vertebrates (Sautaur and Castel, 1997; Bedir, 2004) . Zafar (1964) and Singh & Swarup (1979) reported that higher concentrations of calcium promote the growth of diatoms. The planktons on which whole aquatic biotic population depends have influenced by interaction of number of hydrochemical factors like low dissolved oxygen, moderate sulphate, nitrate, phosphate and others parameters.

The geo-graphical characteristics of Asan wetland is quite important due to its peculiar location on the foot hills of lesser Himalaya and situated on the confluences of river Asan and Yamuna water canal,damming with a barrage and created a reservoir in upstream as Asan wetland, surrounded by hilly terrains.The present climatic, hydrological, ecological and biological characteristics have contributed significantly to provide a winter home for migratory birds. These migratory birds have visited during the starting month of winter (November) and their numbers increased during December and January. The 21water bird species belongs to fifteen genera are recorded in the study period. These birds mainly have the selective tendency for suitable natural habitats and fulfilled their basic physiological requirement i.e. feeding, nesting, hiding and breeding. The aquatic birds have the tendencies to select their habitats as per seasonal and climatic variations, food spectrum and breeding characteristics in response to their physiological requirement (Riffel *et.al*, 2001 and Du Bowy, 1988) .The total birds abundance may be counted on the numbers of flocks formed by particular birds species. The flocks of different species are observed during the different zones in different time intervals as morning (8.00-10.00AM) to evening (2.00- 4.00PM). The maximum no. of flocks were recorded in morning time at zone I and preferred sitting on stone wall for sun bath and roosting activities. (Fig.2)Some scattered groups of bird species also preferred to paddling near the shore line of wetland in morning periods. During mid day periods(10.00-2.00PM), the bird flocks preferred to swims, roasting for feeding and dubbling activities in zone III. The high abundance of birds occurred in zone IV during the evening time for maximum suitable habitats to get food, shelter, hiding, breeding and nesting habits due to maximum quantitatively nutrients and highly dense vegetative area of wetland. Bird species also shift their feeding habits between seasons in temperate areas (Ward, 1969). Differences in feeding habits and habitats could also increase diversity, evenness and species richness (Smith, 1992).Mostly the migratory birds in Asan wetland feeds mainly on aquatic insects, crustaceans, fishes etc. except few which are herbivorous viz, Anas *acuta*,Anser *anser*, Anas *falcate*, *Anas Penelope*. (Fig. 4)The aquatic habitat is selected by the migratory birds according to their demand like *Podiceps cristatus, Anas falcate, Nycticorax nycticorax, Tadorna ferruginea, Tadorna tadorna,Gallinula chloropus, Tringa ochropu*s preferred the fresh water habitat. Most of the aquatic birds in wetland have preferred shallow marshy habitats in Zone III and IV for breeding activities and laid their eggs in peculiar types of nests, hided by bushes or grasses for protection from prey and predators. The migratory birds species richness,abundances and their migratory schedule or behavior depends upon the shore line area,ecological and biological characteristics and particular micro-habitats (Ringerlman and Longcore, 1982; Froneman *et al*,2001).

Froneman *et al*. (2001) recorded differences in relationships between habitat and community structure among seasons. According to Patterson (1976), Elmberg *et al*. (1993), the local abundance of food, water levels and habitat structure, are the most important factors associated to the spatio-temporal dynamics in many aquatic birds. The Asan wetland is a known tourist centre and attracts the great numbers of visitors for scenic beauty and rich migratory birds. In natural habitats, where interventions of humans is less and minimum, the diversity as well as the evenness of species is higher than the fragmented ones (Rana, 2005).The Asan wetland, a notified conservation reserve provide most suitable natural habitats for migratory birds and attracts a lot of tourists, however they create some anthropogenic negative impacts on sustainable conservation practices adopted to develop more microhabitats for the better survival and protection of migratory birds in Asan wetland. The most comprehensive conservation policy for restoration of natural habitats in relation to migratory birds in Asan wetland is urgently required by the support of ministry of Forest and Environment, New Delhi and Govt. of Uttarakhand.

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