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## RESEARCH ARTICLE

### AVIFAUNA AND ITS CONSERVATION IN DAL LAKE

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#### ABSTRACT

The avifauna of Dal Lake was studied from October 2010- to October 2011. Seventy six species belonging to 34 families were recorded. Of these, 26 were summer visitors, 20 were winter visitors, 9 were local altitudinal migrants and 21 were resident. Family Anatidae showed maximum species diversity. The distribution and abundance of birds varied with season and maximum number of species was recorded during spring. Landscape alteration, poaching, felling of nesting trees were the major threats for the survival of birds. Conservation aspects of birds of this region are discussed.

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#### INTRODUCTION

Wetlands are the most productive and biologically diverse habitat in the world but they are fragile ecosystem (Gibbs, 1993). Wetlands and water birds are inseparable elements and support a rich array of water bird communities (Grimmett and Inskipp 2007). Studies of Emlen, 1974; Donaldson *et al.*, (2007) revealed that depressed abundance of various bird species in most parts of world today, especially in urban areas, were of particular concern as many cities are growing rapidly both in area and in population. In this study, avifauna of Dal lake and its status and occurrence have been studied which will help to understand the threats to avifauna of Dal lake and to propose the action plan for the conservation of birds of Dal lake.

##### Study area

Dal Lake is situated in the State of Jammu and Kashmir (JandK), the northern most state of India, strategically surrounded by four countries, on the east by Tibet, on the North-East by China, on the North by Afghanistan and on the west by Pakistan. Dal Lake is a Himalayan urban lake, located in Srinagar (34° 18' N latitude and 74° 91' E longitude), at an average altitude of 1583 m. The lake covers an area of 11.4 km<sup>2</sup> with the average depth of 5.4 m. The top crust of the lake has also been observed to freeze when the mercury falls to -11°C. Early spring and summers are the wet periods, when maximum rainfall occurs and average annual rainfall recorded is 655 mm. In this season the snow melts in the higher

catchments, and results in increased discharge in Dachigam and Dara Nallah, which flows into the lake. Dal Lake comprises of five basins viz. Hazratbal, Bod-Dal, Gagribal, Nageen and Brari-Nambal. A perennial inflow channel known as Telbal Nallah enters the lake from the north and supplies 80 percent of the water from a high altitude lake called Marsar Lake (Qadri, 1980). Within the lake basin itself there are number of springs (Kundangar *et al.*, 1995) which act as permanent water source to the lake

#### MATERIALS AND METHODS

The study was carried out from Oct 2010 to Oct 2011. Line transect method (Gaston, 1975) and visual counts (Shah, 1984) were used for sampling birds. From November to March, when the lake lacked almost of the emergent vegetation that otherwise conceal the birds, visual counting was very conveniently employed. An estimate was obtained without disturbing the birds, by scanning each part of the study unit from vantage points, with the help of 20×50 x field binoculars. From April to October, line transect method was used for all counts. The method entailed moving along a series of transects to and fro to cover the units, attempting to identify the species and count the number of birds of each species. Observations were carried out mostly in the morning (0700-0900 hrs) and in the evening (1600-1900 hrs). Survey was conducted on foot and by boat. Marginal littoral areas were surveyed by walking on the bundhs where as lake area was surveyed by using wooden boats. Four transects (1 km length and 100 m width) were laid at different locations. Five permanent sampling points were established in each transect and a distance of 50m was maintained between them. Each bird seen was recorded at every point distributed along each transect. Each point was

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sampled three times a season making a total of 240 point counts. Birds were identified with the help of different field guides (Ali 1984; Ali and Ripley 1987; Grimmet *et al.*, 2000; Grewal *et al.*, 2002). As per the occurrence in Dal lake, species were classified as resident (R) found in all suitable habitats through out the year; migrant (M) found only during a specific season. Local migrant (LM) resident to state but found in Dal lake only specific season. The cumulative number of species observed in each site was considered as the species richness for that site. Based on the present investigations, a bird list was compiled. Shannon-Weiner diversity index ( $h' = -\sum P_i \ln P_i$ ) was calculated for each site. Similarity between sites was determined by Sorensen's index of similarity:

$$S = 2j / (a + b)$$

Where j = no. of species common to both sites

A = no. of species in site a

B = no. of species in site b

Bird species were ranked into following categories (Ramirez-Albores and Ramirez 2002) : Abundant (total of 40 or more individuals recorded daily), Common (17 to 39 individuals recorded daily), Scarce (11 to 16 individuals recorded), Irregular (5 to 10 individuals recorded) and Rare (1 to 4 individuals recorded).

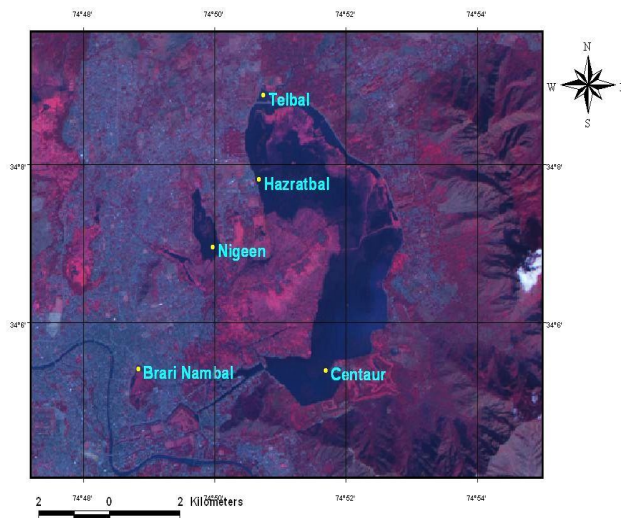


Fig. 1. Map of Dal lake showing different sampling sites and locations of transects (downloaded from Google Earth Year?????)

## RESULTS AND DISCUSSION

A total of 76 species belonging to 34 families were recorded from Dal Lake during study period. Of total diversity 34.2% (26 species) were summer visitors, 26.31% (20 species) were winter visitors : 27.63% (21 species) were residents and 11.84% (9 species) were local altitudinal migrants. Family Anatidae showed the highest species richness within Dal lake (13 species) followed by Muscicapidae (10 species); Ardeidae (6 species). Rallidae, Columbidae, Alcedinidae, Corvidae, Patidae and Motacillidae (3 species each), Scolopacidae, Psittacidae, Picidae, Sturnidae (2 species each), Podicipedae, Phalacrocoridae, Accipitridae, Jacanidae, Charadriidae, Recurvirostridae, Laridae, Cuculidae, Coraciidae, Upupidae, Hirundinidae, Dicruridae, Oriolidae, Lanidae, Pycnonotidae,

Passeridae, Troglodytidae, Sittidae, Certhidae, Corvidae and Fringillidae (1 species each). The species richness of selected sites varied between 30 to 49 (Table 3), while overall diversity ranged from 1.78 to 3.485 (Table 4). Of the total species in the area, 21 species were resident and the remaining species were considered as migratory species. On the basis of relative abundance, 7 species can be considered as rare; 10 as irregular; 25 as scarce; 21 as common and 13 as abundant. The maximum diversity of 3.48 was observed at site 1 and least was recorded at site3 (1.78). The highest diversity at site 1 was probably attributed to its emergent and floating vegetation, as dense vegetation benefitted the nest building and may enhance breeding success of the species (Froneman *et al.*, 2001) and also provides shelter and decreased human disturbance (Hattori and Mae, 2001). The study observed 76 species from Dal Lake, which shows that this lake supports a high diversity of birds. Most of the observed species were breeding residents mainly due to occurrence of various types of microhabitat within the lake. Due to the abundance of endemic species, this lake is very important for bird conservation in this part of the world. Seasonal changes in species richness were observed which was mainly due to changes in weather conditions or fluctuations in food productivity and habitat quality (Loiselle and Blake 1991; Norris and Marra 2007).

Table 1. Sorensen's index representing the similarity values between study sites in Dal lake

	SITE 2	SITE 3	SITE 4
SITE 1	0.96	0.84	0.76
SITE 2		.911	0.761
SITE 3			0.867

Table 2. Relative abundance of bird species in Dal Lake

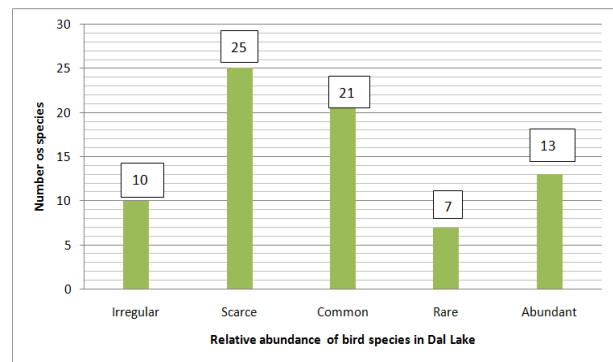


Table 3. Bird species richness for study sites in Dal lake, India

Transects (sites)	Total Richness	Richness (spring)	Richness (summer)	Richness (Autumn)	Richness (winter)
1	49	44	38	34	39
2	45	40	37	35	38
3	30	24	26	21	25
4	35	30	29	31	32

Table 4. Shannon-Weiner index of bird diversity for study sites in Dal lake

Transects (sites)	Total diversity values
1	3.485
2	2.605
3	1.78
4	2.90

Table 5. Check list of birds recorded from Dal lake

S.No.	Common name	Scientific name	Abundance	status
	Family Podicipedidae			
1	Little Grebe	<i>Tachybaptus ruficollis</i>	C	R
	Family: Phalacrocoracidae			
2	Great Cormorant	<i>Phalacrocorax carbo sinensis</i>	A	WM
	Family: Ardeidae			
3	Little Egret	<i>Egretta garzetta garzetta</i>	C	R
4	Cattle Egret	<i>Bubulcus ibis coromandus</i>	R	R
5	Indian Pond Heron	<i>Ardeola grayii</i>	A	R
6	Night Heron	<i>Nycticorax nycticorax</i>	C	R
7	Grey Heron	<i>Ardea cinerea rectirostris</i>	C	R
8	Little Bittern	<i>Ixobrychus minutus minutus</i>	I	SM
	Family Anatidae			
9	Grey Leg Goose	<i>Anser anser</i>	I	WM
10	Mallard	<i>Anas platyrhynchos</i>	A	WM
11	Common Teal	<i>Anas creaca</i>	A	WM
12	Northern Pintail	<i>Anas acuta</i>	A	WM
13	Gad Wall	<i>Anas strepera</i>	A	WM
14	Northern Shoveller	<i>Anas clypeata</i>	A	WM
15	Eurasian Wigeon	<i>Anas penelope</i>	A	WM
16	Garganey	<i>Anas querquedula</i>	A	WM
17	Common Pochard	<i>Aythya ferina</i>	S	WM
18	Red crested Pochard	<i>Aythya rufina</i>	S	WM
19	White Eyed Pochard	<i>Aythya nyroca</i>	R	WM
20	Brahminy Duck	<i>Tadorna ferruginea</i>	R	WM
21	Common Merganser	<i>Mergus merganser</i>	A	WM
	Family Accipitridae			
22	Common Periah Kite	<i>Milvus migrans</i>	S	R
	Family Rallidae			
23	Indian Purple Coot	<i>Porphyrio poliocephalus</i>	R	WM
24	Indian Moore Hen	<i>Gallinule chloropus indicus</i>	C	R
25	Coot	<i>Fulica atra atra</i>	A	WM
	Family Jacanidae			
26	Pheasant Tailed Jacana	<i>Hydrophasianus chirugus</i>	C	SM
	Family Charadriidae			
27	European Little Ringed Plover	<i>Charadrius dubius curonicus</i>	S	SM
	Family Scolopacidae			
28	Common Snipe	<i>Gallinago gallinago</i>	S	SM
29	Common Sand Piper	<i>Actitis hypoleucos</i>	S	SM
	Family Recurvirostridae			
30	Black winged Stilt	<i>Himantopus himantopus</i>	C	SM
	Family Laridae			
31	Indian whiskered Tern	<i>Chlidonias hybrida indica</i>	A	SM
	Family Columbidae			
32	Hume's Blue Rock Pigeon	<i>Columba livia neglecta</i>	C	R
33	Indian Ring Dove	<i>Streptopelia decaota</i>	S	SM
34	Oriental Turtle Dove	<i>Streptopelia chinensis</i>	I	SM
	Family Psittacidae			
35	Himalayan Slaty Headed Parakeet	<i>Psittacula himalayana</i>	S	SM
36	Rose Ringed Parakeet	<i>Psittacula krameri</i>	S	LAM
	Family Cuculidae			
37	Asiatic Cuckoo	<i>Cuculus canorus telephonus</i>	S	SM
	Family Alcedinidae			
38	Central Asian Kingfisher	<i>Alcedo atthis pallasii</i>	C	R
39	White breasted Kingfisher	<i>Halcyon smyrnensis smyrnensis</i>	S	R
40	Indian pied Kingfisher	<i>Ceryle rudis leucomelanura</i>	C	R
	Family Coraciidae			
41	Kashmir Roller	<i>Coracias garrula semenowi</i>	I	SM
	Family Upupidae			
42	European Hoopoe	<i>Upupa epops epops</i>	I	SM
	Family Picidae			
43	Brown Fronted Wood Pecker	<i>Dendrocopos auriceps</i>	R	LAM
44	Grey Headed wood Pecker	<i>Picus canus</i>	R	LAM
	Family Hirundinidae			
45	Common Swallow	<i>Hirundo rustica rustica</i>	A	SM
	Family Dicuridae			
46	Grey Drongo	<i>Dicrurus leucophaeus</i>	C	SM
	Family Oriolidae			
47	Golden Oriole	<i>Oriolus oriolus</i>	C	SM
	Family Lanidae			
48	Long Tailed Shrike	<i>Lanius schach erythronotus</i>	C	SM
	Family Sturnidae			
49	Common Myna	<i>Acridotheres tristis tristis</i>	C	R
50	Himalayan Starling	<i>Sturnus vulgaris humii</i>	C	SM
	Family Corvidae			

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51	House Crow	<i>Corvus splendens</i>	C	R
52	Jungle Crow	<i>Corvus macrorhynchos</i>	S	R
53	Eastern Jackdaw	<i>Corvus monedula</i>	C	R
	Family Pycnonotidae			
54	White Checked Bulbul	<i>Molpastes leucogenys leucogenys</i>	C	R
	Family Muscicapidae			
55	White Caped Redstart	<i>Chaimarrhornis leucocephalus</i>	S	R
56	Plumbeous water Redstart	<i>Rhyacornis fuliginosus</i>	S	R
57	Ruby Throat	<i>Calliope pectoralis pectoralis</i>	R	LAM
58	Himalayan Whistling Thrush	<i>Myiophonus caeruleus temminckii</i>	S	LAM
59	Simla Streaked Laughing Thrush	<i>Trochalopteron lineatum</i>	S	LAM
60	Himalayan Paradise Flycatcher	<i>Tersiphone paradise</i>	I	SM
61	Indian Great Reed Warbler	<i>Acrocephalus stentoreus</i>	C	SM
62	Witherby's Paddy Field Warbler	<i>Acrocephalus concinens</i>	S	SM
63	Western Spotted Forktail	<i>Enicurus maculatus</i>	I	SM
64	Little forktail	<i>Microcichla scouleri</i>	I	LAM
	Family Passeridae			
65	Tree Pipit	<i>Anthus trivalis</i>	I	WM
	Family Paridae			
66	Kashmir Grey Tit	<i>Parus major</i>	I	R
67	Spot Winged Tit	<i>Parus melanolophus</i>	S	WM
68	Green Backed Tit	<i>Parus monticolus</i>	S	WM
	Family Troglodytidae			
69	Kashmir Wren	<i>Troglodytes troglodytes</i>	S	LAM
	Family sittidae			
70	Wall Creeper	<i>Tichodroma muraria</i>	S	WM
	Family Certhidae			
71	Tree Creeper	<i>Certhia himalayana limes</i>	S	LAM
	Family Corvidae			
72	Yellow Bellied Magpie	<i>Urocissa flavirostris</i>	S	SM
	Family Motacillidae			
73	Hodgson's Pied Wagtail	<i>Moticilla alba alboides</i>	S	SM
74	White Wagtail	<i>Moticilla cinerea melanope</i>	C	SM
75	Hodgson's Yellow Headed wagtail	<i>Moticilla citreola calcarata</i>	S	SM
	Family Fringillidae			
76	House sparrow	<i>Passer domesticus</i>	C	R

Status : R – resident; WM –winter migrant; SM – summer migrant; LAM- local altitudinal migrant; Abundance: C- common ; A- abundant ; R- rare ; S – scarce

Species richness of birds in lake becomes maximum during spring season due to greater availability of insects, favorable weather conditions and because on one hand a number of winter visiting waterfowl each with a small population were present and on the other a large number of summer migrants also made their appearance in the lake Status : R – resident; WM –winter migrant; SM – summer migrant; LAM- local altitudinal migrant; Abundance: C- common; A- abundant; R- rare; S – scarce

### Major threats to the avi fauna of this region

- 1 Landscape alteration: The key threat factor is landscape alteration in Dal Lake. Encroachment of lake for the construction of new buildings and settlements are very common in Dal Lake, even though it is legally banned. Large areas of the lake have been filled up and transformed into permanent land masses due to heavy siltation. Some of this area is regularly used for cultivation. This adversely affected migratory birds such as ducks and teals by reducing available roosting place, foraging areas and food in the lake
- 2 Hunting: Hunting pressure is intense in the lake. The main hunting methods involve a combination of shooting (either with air guns or sling shots). The main species hunted are winter migrants like Grey leg goose, Common teal, Pintail, Shoveller, Wigeon, Coot etc., dozens of poachers along with their rifles were seen in lake in wee hours of winter, shooting upon large population of waterfowl.
- 3 Tourism: Amplified promotion of tourism by using boats and speed boats force migratory ducks to desert roosting place in lake. Most of the tourist resort in and around lake and don't have any proper solid waste and waste – water

treatment facilities, therefore all waste material are dumped into lake during night hours. This activity adversely affect self sustaining capacity of the lake, in turn drastically affected nesting habitats of breeding birds.

- 4 Fishing: in Dal Lake, fishing is done in random manner. Although fish is not the major component of food of most of migrants, still mere presence of fishermen in the lake disturbs the breeding summer migrants.
- 5 Felling of nesting and roosting trees: cutting down of tall trees used by colonial nesting water birds is rampant in Dal lake which created trouble in the form of habitat loss for land birds and wetland birds.
- 6 Macrophytic harvesting: Dal lake provides main source of fodder and are greatly exploited for their macrophytes. The harvesting of macrophytes is done either by local people or by contractors. The large scale harvesting poses a serious problem, moreover harvesting is not selective and some of the areas are completely cleared of both floating and emergent vegetation. In doing so the breeding habitats including nest made by birds are completely destroyed

### Conservation action plan

The following action plan is proposed for the conservation of birds of Dal Lake:

- 1 Active patrolling should be carried out by the concerned departments to stop poaching.
- 2 Nature awareness programmes regarding birds and importance of wetland ecosystem for daily sustenance of life should be given to the local people for the conservation of this ecosystem.

- 3 The encroached land must be reclaimed. Encroached land must be identified and help of law be taken to reclaim the same.
- 4 Grazing and harvesting of macro – vegetation should be completely banned to avoid destruction of nesting sites of breeding birds from may to august every year.
- 5 Emergent macrophytes which have been observed more attractive for breeding and feeding of water birds may be encouraged to grow.
- 6 Tree felling in the periphery of the dal lake must be stopped as it results in the habitat destruction of many upland birds.
- 7 Mobile checking facilities should be initiated to seize polluting boats and its license should be withheld
- 8 All tourist establishments must provide a fraction of money from the yearly profit for the restoration activities of Dal lake through government and local NGO,s

While preparing action plan for the conservation of the aquatic biodiversity, there should be collaborative links between the wildlife department and other disciplines and in particular ornithologists, fisheries, biologists, hydrologists, agronomists, economists and water engineers.

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