

Decadal study of Avifaunal Diversity of Banni Grass land, Katchchh, Gujarat, India

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ABSTRACT

Banni Grass land was one of the largest grasslands of arid systems in India. The region shows extreme climatic conditions with summer temperature hovering around 45° C to 50° C temperature and winter temperature dropping to 2 to 3 ° C and annual rainfall is only 2-3 cm. This type of climatic regime supports specific grasses and other vegetation that in turn sustains avifauna. Over the years, the area has undergone changes in vegetation characteristics and human pressures which has an impact on regional climate affecting the bird diversity. Since, birds are the important indicators of health of ecosystem the present study was undertaken to bring out the decadal changes in the faunal diversity. Study was undertaken in seven villages located within the Banni grasslands and the results show change in avifaunal composition as well as diversity between 2004 and 2014. The paper discusses how the vegetation change coupled with human interference have affected the bird composition and is important finding for long term conservation strategy of this unique grasslands.

Keywords: Birds, Grassland, plants, Desert ecosystem.

INTRODUCTION

Grasslands are important ecosystems and unique in terms of diversity that it harness. Grasslands are wide spread in the world and distributed in each continent. The grasslands of arid ecosystem are different as these are highly depended on the annual rainfall. Any change

food accessibility (Butler and Taylor, 2005). It is a long established fact that availability of food affects the population size (Perrins and Birkhead, 1983; Krebs, 1985; Welty and Baptista, 1988). Grassland birds tend to specialize in different structural characteristics of

vegetation, with vertical heterogeneity important for segregation of species in tall grass prairie (Rotenberry and Wiens, 1980). However, in present year this habitat is changing due to slow and continuous growth of human encroachments. Loss of grassland area reduces the number of native avifauna (Monroe and O'Connell, 2014).

Banni grassland is one of the important grassland of Gujarat state. The Total area of Banni Grassland is 2,617.72 km² and it extent up to Naliya village which has 654 km² area (Koladiya *et al.* 2016). Banni Grass land is one of the unique habitats which always show seasonal changes. It faces extreme climatic conditions during summer, (45° C to 50° C temperature) and in winters the temperature drops to 2° C. The average annual rainfall is restricted to 2-3 cm rainfall. Under these extreme conditions, there are exclusive grass species that grows and Banni Grassland is known for its rich avifaunal diversity. The Banni grassland supports many endemic and endangered birds (Rahmani, 1998). A total of 273 birds species including 100 resident and 107 migratory species recorded from Banni and 50 years old heronary recorded near Luna village which comprised of approximately 7900 nest of species like Egrets,

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in the climatic regimes is reflected in the and growth of the grasses and bird diversity. To understand any changes or variations in climatic conditions birds are one of the important indicators of health of ecosystem as well as part of food change. Further, any changes in climatic conditions affect bird distribution and abundance indirectly through trophic level impacts on

Cormorants, Herons, Spoonbills and Ibis were recorded (Tiwari & Rahmani, 1998). The water bodies of Banni support over 150 species of migratory and resident birds, and are important staging grounds for several thousands of migratory cranes (GEC, 1998). Present study deals with decadal changes in avifaunal diversity of ten villages of Banni grassland. In the last ten years developmental activities, tourism and other infrastructure facilities have come up Banni area fragmenting the continuity of the grasslands. In the present paper we try to make an attempt to show these changes in the system through studying the avifaunal diversity.

MATERIALS AND METHODS

Study areas:

Banni grasslands comprises of 42 small village settlements spread across the terrain. The selected villages include Bhirandiyara, Dhordo, Gorewali, Hodka, Sadai, Mithadi, Nanabhitara and Luna.

Bird survey was restricted to 2 hours from sunrise in the morning when they are more active. Birds were observed using 8x50 or 7x35 binoculars and identified on the basis of standard books by Ali (1996) and Grimmett *et al.*, (1999). The birds were counted using transect method and / or point count method (Rodgers, 1991). The transects were laid down at considerable distance from the village boundary with low human interference. One year seasonal (2004 and repeat in 2014) observation was carried out to know the difference in diversity of avifauna. The transects remained the same during both the set of observations.

Statistical analysis:

The species richness (number of species), diversity indices like Shannon Wiener index and equitability (Krebs, 1985) was calculated. Further, Jaccard's similarity indices between all the study areas are calculated. F-test (Prizm-3 software) was carried out to compared the past and present data.

RESULTS AND DISCUSSION

Species Richness

A total of 121 species representing 47 families was recorded during both the years amongst them 74 are resident, 47 are migratory species of birds was reported. Further, vulnerable species Stoliczka's Bushchat (*Saxicola macrorhycha*), endangered Steppe Eagle (*Aquila nipalensis*), six near threatened species (IUCN 2016) was sighted in 2014 at chharidhand wetland during 2004 (Table-1). Comparative statistical analysis between two years gives highly significant ($F_{0.0006}$, $P \leq 0.001$) values of Species richness.

Decadal difference in the bird richness was observed between 2004 and 2014. The bird richness declined from 92 in 2004 to 79 in 2014 (Fig-1). The rainfall of Banni has drastically altered with low rainfall periods

between 2009 to13. Indiscriminate cutting of *Prosopis juliflora* along with native species like *Capparis* sp. and *Salvadora oleriodes* have altered the vegetation composition of Banni grasslands. Change in any type of habitat can change in pattern of bird diversity as well as its nesting pattern (Henderson *et al.* 2004; Donald *et al.* 2002). Even NRCS (1999) report indicate that grassland birds decreased since decades all over the world. This may be due to climatic conditions and human encroachments. Grassland species birds have been declined recently, sometime gradual declined (Butcher, 2007).

Figure-1. Transect point at Study areas



Figure-2. Transect point at Study areas



In Banni grassland both of this phenomenon was observed in last ten years. For instance Pied wheatear (*Oenanthe pleschanka*) and Himalyan bulbul (*Pycnonotus leucogenys*) were recorded only in 2004. These species are frutivorous and survived on fruits of *Capparis* sp. and *Salvadora oleriodes*. But decline in density of these tree species have affected the habitat and the species was not reported in 2014. Increased drought conditions and invasion of woody shrub leads to unfavorable conditions at winter grounds for many grassland bird species (U.S. committee, 2010) and similar trends was recorded in present study.

The area boosted of 50 years old heronary near Luna village with 7900 nest of species like Egrets,

Cormorants, Herons, Spoonbills and Ibis (Tiwari & Rahmani, 1998). However, in 2014 survey no such record of heronary at such large scale was observed at the same location. The change in vegetation structure and grass species that provided the habitat for nesting and feeding guilds of birds posed a major threat for the loss of heronary. The excess anthropogenic disturbances are a threat to the very existence of the bird populations any habitat like wetland (Singh and Laura, 2012).

Figure-1. Decadal differences in total species richness at study areas

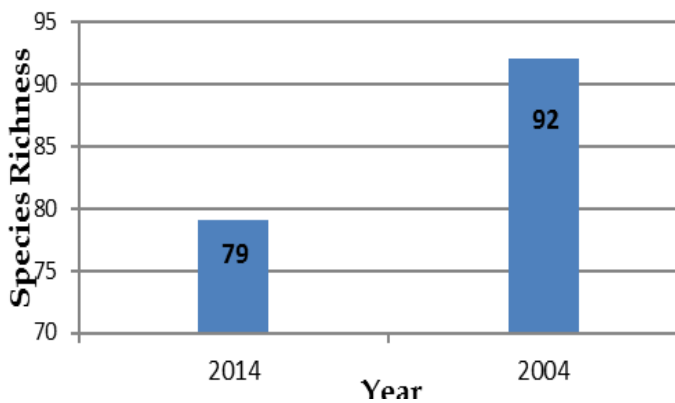


Figure-2. Decadal changes in species richness of birds at 10 different study areas

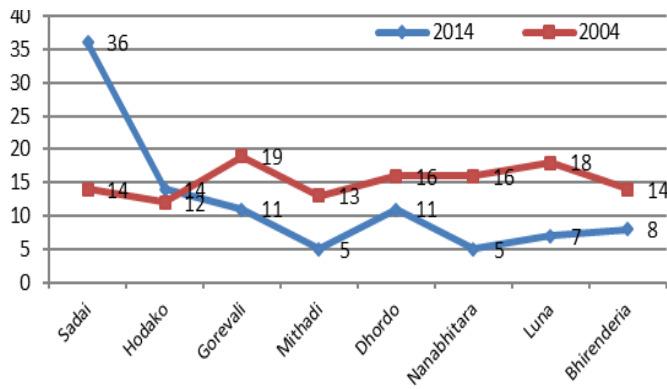
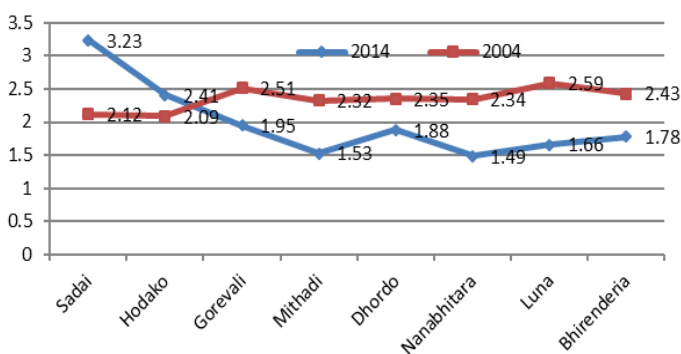
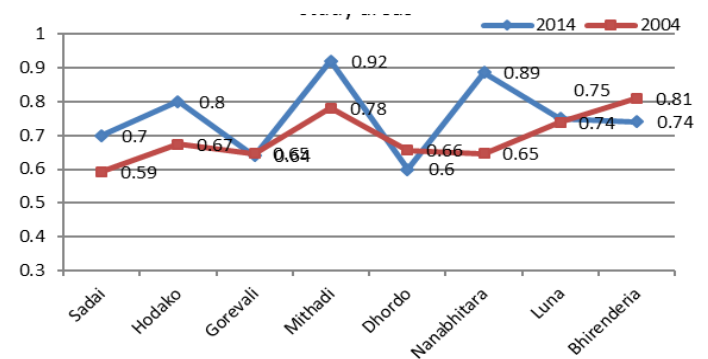


Figure-3. Decadal changes in diversity indices of birds at 10 different study areas



Another important observation is that the Lark species was recorded in 2014, but not recorded in 2004. The food base of larks includes invertebrate, ants, beetles, flies and grass-hoppers. With decline in density of *Prosopis* in 2014, the ground got exposed providing the food for the species, while in 2004 dense *Prosopis* allowed very low ground exposure and the species was not recorded then. Larks are indicative of arid conditions and desertification. A good number arid land birds are adapted to the dry and variable climates in which they live, so it is expected that many will adjust their activities, distribution, or movement patterns in response to climatic alteration (U.S. committee, 2010).

Figure-4. Decadal changes in evenness of birds at 10 different study areas



During 2004, aquatic birds were recorded more as compared to 2014. According to U.S. committee report (2010) predicted changes in temperature and rainfall will probably reduce essential habitats for waterfowl and other aquatic birds. Additionally, these changes will reduce the ability of wetlands to provide functions such as flood control, sediment capture, and ground water replacements. Similar situation has occurred in Banni grasslands with reduction in rainfall and loss of small water bodies in 2014.

During 2004 year highest species richness was recorded at Gorevali village (19), followed by Luna (18), Dhordo and Nanabhitara (16), Bhirenderia, Hodako and Sadai (14), and Mithadi village. In 2014, highest species was recorded at Sadai (36) village and lowest at Nanabhitara and Mithadi (5) (Fig. 2). These differences were recorded may be due to dominance of *Prosopis juliflora* at Mithadi while at Sadai vegetations comprised of *Prosopis juliflora*, *Acacia nilotica* and *Calotropis procera*. Distribution of wintering birds is depends on the suitable vegetation structure because it also affects the predation risk. (Lima, 1990; Watts, 1996).

The species richness in 2004 was uniform at all the sites, but in 2014 high richness was recorded at Sadai village. This indicates that by 2014, there are alterations in the habitat induced by human interventions. Further, vast area of land near Dhordo village was cleared for Rann festival and the size of the festival which was initiated for one week in 2009 stretched to 2 months in 2014. The festival coincided with the wintering grounds

of the migratory birds and could be one of the another reason for the presence of low bird richness in 2014.

Diversity indices is low during 2014 as compared to 2004 (Fig-3). The residential birds like Crows, Asian Koel (*Eudynamys scolopacea*), Blue Rock Pigeon

(*Columba livia*), Black Drongo (*Dicrurus macrocercus*),

Table-1 List of birds during 2004, 2014 and its IUCN status

	List of Avifauna sighted at study areas		Family name	2014	2004	IUCN status (2016)	R/M
No.	Common name	Scientific name					
1	Asian Koel	<i>Eudynamys scolopacea</i>	Cuculidae	√	√	LC	R
2	Ashy Prinia	<i>Prinia Socialis</i>	Monarchinae		√	LC	R
3	Avocet	<i>Recurvirostra avosetta</i>	<i>Recurvirostridae</i>		√	LC	M
4	Ashy crown sparrow lark	<i>Eremopterix grisea</i>	Alaudidae	√		LC	R
5	Barn Swallow	<i>Hirundo rustica</i>	Hirundinidae	√	√	LC	M
6	Black Drongo	<i>Dicrurus macrocercus</i>	Dicruridae	√	√	LC	R
7	Black Ibis	<i>Pseudibis papillosa</i>	Threskiornithidae		√	LC	R
8	Black Redstart	<i>Phoenicurus ochruros</i>	Muscicapidae		√	LC	M
9	Blue Rock Pigeon	<i>Columba livia</i>	Columbidae	√	√	LC	R
10	Blue checked bee-eater	<i>Merops persicus</i>	<i>Meropidae</i>		√	LC	R
11	Bay back shrike	<i>Lanius collurio</i>	<i>Laniidae</i>	√		LC	R
12	Blacktailed Godwit	<i>(Limosa limosa)</i>	Scolopacidae	√	√	NT	M
13	Baya weaver bird	<i>Ploceus philippinus</i>	Ploceidae	√		LC	R
14	Black-winged Stilt	<i>Himantopus himantopus</i>	Recurvirostridae	√	√	LC	R
15	Brahminy Kite	<i>Haliastur Indus</i>	Accipitridae		√	LC	R
16	Brahminy Starling	<i>Sturnus pagodarum</i>	Sturnidae		√	LC	R
17	Cattle Egret	<i>Bubulcus ibis</i>	Ardeidae	√	√	LC	R
18	Common Crane	<i>Grus grus</i>	<i>Gruidae</i>	√	√	LC	M
19	Common Tailor bird	<i>Orthotomus sutorius</i>	<i>Passeriforms</i>	√	√	LC	R
20	Common Teal	<i>Anas crecca</i>	<i>Anatidae</i>		√	LC	M
21	Indian Peafowl (Peacock)	<i>Pavo cristatus</i>	Phasianidae	√	√	LC	R
22	Common kestrel	<i>Falco tinnunculus</i>	<i>Falconidae</i>	√		LC	M
23	Common Myna	<i>Acridotheres tristis</i>	Sturnidae	√	√	LC	R
24	Common Ringed Plover	<i>Charadrius hiaticula</i>	Charadriidae	√	√	LC	M
25	Common Stone Chat	<i>Saxicola torquata</i>	Turdidae	√		LC	M
26	Common Babbler	<i>Turdoides caudatus</i>	Timaliinae	√	√	LC	R
27	Common sandpiper	<i>Actitis hypoleucos</i>	scolopacidae	√	√	LC	M
28	Common Snipe	<i>Gallinago gallinago</i>	<i>Rostratulidae</i>		√	LC	M
29	Cream-Coloured Courser	<i>Cursorius cursor</i>	<i>Glareolidae</i>	√		LC	M
30	Crested Lark	<i>Galerida cristata</i>	Alaudidae	√	√	LC	R
31	Crow Pheasant	<i>Centropus sinensis</i>	Cuculidae	√	√	LC	R
32	Desert Wheatear	<i>(Oenanthe deserti)</i>	<i>Turdinae</i>	√	√	LC	M
33	Demoiselle Crane	<i>Grus virgo</i>	<i>Gruidae</i>	√		LC	M
34	Eurasian collared Dove	<i>Streptopelia decaocto</i>	Columbidae	√	√	LC	R
35	Eurasian Curlew	<i>Numenius arquata</i>	<i>Burhinidae</i>	√	√	NT	M
36	Eurasian Wigeon	<i>Anas Penelope</i>	<i>Anatidae</i>		√	LC	M
37	Greater Flamingo	<i>(Phoenicopterus ruber)</i>	<i>phoenicopteridae</i>	√	√	LC	R
38	Grey Francolin	<i>Francolinus pondicerianus</i>	Phasianidae	√	√	LC	R
39	Grey Heron	<i>Ardea cinerea</i>	<i>Ciconiidae</i>		√	LC	R
40	Greater Hoopoe Lark	<i>Alaemon alaudipes</i>	Alaudidae	√		LC	R
41	Greater sandplover	<i>charadrius ieschenaultii</i>	Charadriidae	√		LC	M
42	Great short-toed lark	<i>Calandrella brachydactyla</i>	Alaudidae	√		LC	R

43	Common Whitethroat	<i>Sylvia communis</i>	Sylviidae	√		LC	M
44	Green Bee-Eater	<i>Merops orientalis</i>	Meropidae	√	√	LC	R
45	Common Greenshank	<i>Tringa nebularia</i>	Scolopacidae	√	√	LC	M
46	Grey-neck Bunting	<i>Emberiza buchanani</i>	Emberizinae		√	LC	M
47	Himalayan Bulbul	<i>Pycnonotus leucogenys</i>	Pycnonotidae		√	LC	M
48	Hopooe	<i>Upupa epops</i>	Upupidae	√	√	LC	M
49	House Crow	<i>Corvus splendens</i>	Corvidae	√	√	LC	R
50	House Sparrow	<i>Passer domesticus</i>	Passerinae	√	√	LC	R
51	House Swift	<i>Apus affinis</i>	Apodidae		√	LC	R
52	Harrier	<i>Circus sp.</i>	Accipitridae		√	LC	M
53	Indian Reef Heron	<i>Egretta gularis</i>	Ardeidae		√	LC	R
54	Chestnut-bellied Sandgrouse	<i>Pterocles exustus</i>	Pteroclididae		√	LC	R
55	Indian Roller	<i>Coracias benghalensis</i>	Coraciidae	√		LC	R
56	Indian Robin	<i>Saxicoloides fulicata</i>	Muscicapidae	√		LC	R
57	Indian Cuckoo	<i>Cuculus micropterus</i>	Cycylidae		√	LC	R
58	Isabelline wheatear	<i>Oenanthe isabellina</i>	Turdinae	√	√	LC	R
59	Jungle Babbler	<i>Turdoides striatus</i>	Timaliinae	√	√	LC	R
60	Larged Billed-Crow	<i>Corvus macrorhynchos</i>	Corvidae	√	√	LC	R
61	Large Egret	<i>Casmerodius albus</i>	Ardeidae	√	√	LC	R
62	Lesser whitethroat	<i>Sylvia curruca</i>	Sylviinae	√	√	LC	M
63	Lesser Whistling-duck	<i>Dendrocygna javanica</i>	Anatidae		√	LC	R
64	Lesser Flamingo	<i>Phoenicopterus minor</i>	phoenicopteridae	√	√	NT	R
65	Lesser White Throat	<i>Sylvia hortensis</i>	Monarchinae		√	LC	M
66	Little Cormorant	<i>Phalacrocorax carbo</i>	Phalacrocoracidae		√	LC	R
67	Little Egret	<i>Egretta garzetta</i>	Ardeidae	√	√	LC	R
68	Little Grebe (Dabchik)	<i>Tachybaptus ruficollis</i>	Podicipedidae		√	LC	R
69	Little Gull	<i>Larus minutus</i>	Laridae	√		LC	M
70	Little Brown Dove	<i>Streptopelia senegalensis</i>	Columbidae	√	√	LC	R
71	Little Stint (Minutus)	<i>Calidris minuta</i>	scolopacidae		√	LC	M
72	Long-legged Buzzard	<i>Buteo rufinus</i>	Accipitridae	√		LC	M
73	Median Egret	<i>Mesophoyx intermedia</i>	Ardeidae	√	√	LC	R
74	Mallard	<i>Anas platyrhynchos</i>	Anatidae	√		LC	M
75	Marsh Sandpiper	<i>Tringa stagnatilis</i>	scolopacidae		√	LC	M
76	Oriental Magpie Robin	<i>Copsychus saularis</i>	Muscicapidae	√	√	LC	R
77	Montagu's Harrier	<i>Circus pygargus</i>	Accipitridae	√		LC	M
78	Oriental skylark	<i>Alauda gulgula</i>	Alaudidae	√	√	LC	R
79	Olive bee-eater	<i>Merops superciliosus</i>	Meropidae		√	LC	R
80	Paddyfield pipit	<i>Anthus rufulus</i>	Motacillidae	√		LC	R
81	Painted Partridge	<i>Francolinus pictus</i>	Phasianidae		√	LC	R
82	Pied Avocet	<i>Recurvirostra avosetta</i>	Recurvirostridae	√	√	LC	M
83	Pied Bush Chat	<i>Saxicola caprata</i>	Turdinae		√	LC	M
84	Pied Kingfisher	<i>Ceryle rudis</i>	Cerylidae	√	√	LC	R
85	Pied Wheather	<i>Oenanthe pleschanka</i>	Turdinae		√	LC	M
86	Painted Stork	<i>Mycteria leucocephala</i>	Ciconiidae		√	NT	R
87	Purple Sunbird	<i>Nectarinia asiatica</i>	Nectariniidae	√	√	LC	R
88	Red Necked Phalarope	<i>Phalaropus lobatus</i>	Phalropidae		√	LC	M
89	Red Rumped Swallow	<i>Hirundo daurica</i>	Hirundinidae	√	√	LC	R
90	Common Redshank	<i>Tringa tetanus</i>	scolopacidae		√	LC	M
91	Red Vented Bulbul	<i>Pycnonotus cafer</i>	Pycnonotidae	√	√	LC	R
92	Red-wattled Lapwing	<i>Vanellus indicus</i>	Charadriidae	√	√	LC	R
93	Indian Bush lark	<i>Mirafra erythroptera</i>	Alaudidae	√		LC	R
94	Ring Dove	<i>Streptopelia decaocto</i>	Columbidae	√	√	LC	R
95	India River Tern	<i>Sterna aurantia</i>	Sternidae	√		NT	R
96	Rufoustailed Finch Lark	<i>Ammomanes phoenicurus</i>	Alaudidae	√		LC	R
97	Rofusbacked Shrike	<i>Lanius cristatus</i>	Laniidae		√	LC	M

98	Rosy starling	<i>Sturnus roseus</i>	Sturnidae	√	√	LC	M
99	Ruff	<i>Philomachus pugnax</i>	scolopacidae	√		LC	M
100	Sand Lark	<i>Calandrella raytal</i>	Alaudidae		√	LC	R
101	Sanderling	<i>Calidris alba</i>	scolopacidae		√	LC	M
102	Shikra	<i>Accipiter badius</i>	Accipitridae	√	√	LC	R
103	Shoveller	<i>(Anas clypeata)</i>	Anatidae	√	√	LC	M
57	Small Bee-eater	<i>Merops orientalis</i>	Meropidae	√		LC	R
105	Small Blue Kingfisher	<i>Alcedo atthis</i>	Halcyonidae		√	LC	R
106	Small Minivet	<i>Pericrocotus cinnamomeus</i>	Campephagdae		√	LC	R
107	Eurasian Spoonbill	<i>Platalea leucordia</i>	Threskiornithidae		√	LC	R
108	Stoliczka's Bushchat	<i>Saxicola macrorhycha</i>	Muscicapidae		√	V	R
109	Spotted Dove	<i>Streptopelia chinensis</i>	Columbidae	√	√	LC	R
110	Steppe Eagle	<i>Aquila nipalensis</i>	Accipitridae	√		EN	M
111	Tawny pipit	<i>Anthus campestris</i>	Motacillidae	√		LC	M
112	Variable wheatear	<i>Oenanthe picata</i>	Turdinae	√		LC	M
113	White Ibis	<i>Threskiornis aethiopica</i>	Threskiornithidae		√	NT	R
114	Western Marsh Harrier	<i>Circus aeruginosus</i>	Accipitridae	√		LC	M
115	White throated kingfisher	<i>Halcyon smyrnensis</i>	Alcedinidae	√		LC	R
116	White-eared bulbul	<i>Pycnonotus leucotis</i>	Pycnonotidae	√	√	LC	R
117	Wire tailed Swallow	<i>Hirundo smithii</i>	Hirundinidae	√	√	LC	R
118	Wood Sandpiper	<i>Tringa glareola</i>	scolopacidae	√		LC	M
119	White Wagtail	<i>Motacilla alba</i>	Motacillidae		√	LC	M
120	White winged Black Tit	<i>Parus nuchalis</i>	Turdinae		√	LC	R
121	Yellow wattled Lapwing	<i>Vanellus malabaricus</i>	Charadriidae		√	LC	R
			Total	79	92		

LC = least concern; NT= near threatened; EN= Endangered; R= Resident; M= Migratory

Bulbul (*Pycnonotus cafer*) have adopted to the change in the habit. These birds have acclimatized to change in habitat as well as vegetation pattern and can be regarded as hardy species or adaptors. Many birds have evolved adaptations in response to climate fluctuations (Butler and Taylor, 2005). Comparative statistical analysis between two years gives highly significant ($F_{0.0026}$, $P \leq 0.001$) values of Diversity indices. Whereas, evenness gives non- significant values.

During 2004 birds are more evenly distributed at all study areas. This reflects the more evenness is due to less diversity of birds. During 2014 birds are not evenly distributed amongst all study areas (Fig-4). Jaccard's similarity indices show only 35 % similarity between 2004 and 2014. This reflects the change in bird composition over the years attributed to alteration in the habitat. This could be due to difference in pattern of vegetations since last 10 years as well as human pressures since last 5 years. Change in vegetation may cause change in climatic conditions. Clearing and removal of native vegetation and introduction of exotic plant species also affect the not only ecology of pond but also change the particular habitat which cause adaptation problems for the birds (Singh and Laura, 2012).

CONCLUSION

Birds are very sensitive to any type of climatic conditions or any disturbances in habitat or ecology.

During present study it is revealed that Banni faced not only climatic change but also face human disturbances which fluctuate the diversity of birds in pockets of the Banni grass land. If we want this unique habitat, we

have to conserve the habitat with respect to climate change which will support the birds. Conservation response to climate change should address means to ensure sufficient habitats are available and justifying against climate change impact on ecological Processes that support birds (Butler and Taylor, 2005).

Conflict of Interests

Authors declare that there is no conflict of interests regarding the publication of this paper.

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