

See discussions, stats, and author profiles for this publication at: <https://www.researchgate.net/publication/313656681>

Assessment of Population Trends of Birds at Taunsa Barrage Wildlife Sanctuary, Pakistan

Article · January 2016

CITATIONS

2

READS

381

5 authors, including:



Fehmeeda Bibi

Bahauddin Zakariya University

36 PUBLICATIONS 150 CITATIONS

[SEE PROFILE](#)



Shafqat N. Qaisrani

University of Veterinary and Animal Sciences

18 PUBLICATIONS 119 CITATIONS

[SEE PROFILE](#)



Masood Akhtar

Bahauddin Zakariya University

132 PUBLICATIONS 1,091 CITATIONS

[SEE PROFILE](#)



Zulfiqar Ali

University of the Punjab

154 PUBLICATIONS 744 CITATIONS

[SEE PROFILE](#)

Some of the authors of this publication are also working on these related projects:



Wetland Management [View project](#)



Effecet of Urban Congestion on Avian Diversity in Lahore [View project](#)

Assessment of Population Trends of Birds at Taunsa Barrage Wildlife Sanctuary, Pakistan

*FEHMEEDA BIBI¹, SHAFQAT NAWAZ QAISRANI², MASOOD AKHTAR¹,
ZULFIQAR ALI³, & BUSHRA NISAR KHAN³

¹Faculty of Veterinary Sciences, Bahauddin Zakariya University, Multan, Pakistan

²Department of Animal Nutrition, University of Veterinary and Animal Sciences, Lahore, Pakistan

³Department of Zoology, University of the Punjab, Lahore, Pakistan

ABSTRACT

Population trends learning is an important tool for conservation of birds, both rare as well as common species. A study was conducted to assess annual decline in species of birds and to identify the causes of this decline at Taunsa Barrage wildlife Sanctuary, Punjab, Pakistan. Data were collected by direct census method during wintering and breeding periods from 2008 to 2014. The results indicated an increasing trend in 157, whereas a decreasing trend in 14 species of birds. Among the species with declining trend, there was a 92% decrease in White-backed Vulture (*Gyps bengalensis*), 60% in Greater Painted Snipe (*Rostratula benghalensis*), 57% in Garganey (*Anas querquedula*), 50% each in Pallas's Fish Eagle and Long-legged Buzzard (*Buteo rufinus*) 50% each, 41% in Grey Heron (*Ardea cinerea*), 39% in Little Cormorant (*Phalacrocorax niger*), 37% in Gadwall (*Anas strepera*), 33% in Marsh Harrier (*Circus aeruginosus*), 30% in Black Drongo (*Dicrurus macrocercus*) and 26% in Red-crested Pochard (*Netta rufina*) population. Habitat exploitation, hunting and grazing were found to be the main causes of this decline in birds species population. In conclusion, conservation and management of the study area is most important to study declining bird. It is suggested, therefore, to take immediate steps for the protection of the sanctuary to conserve the declining population of birds.

Key Words: population trends, wildlife sanctuary, bird, habitat exploitation.

INTRODUCTION

Population trends learning, which also identifies potential threats, is an important tool for conservation programs of rare as well as common bird species. Pakistan harbors a wide range of ecosystems which in turn host a diverse avifauna to exploit their resources (Khan *et al.*, 1996). The occurrence of more than 650 species of birds in three zoogeographical zones of Pakistan is unique in the world (Mirza & Wasiq, 2007). Water birds are important indicators for a healthier environment (Abdullah & Cheng, 2001) as they are one of the food chain connections in ecological units (Thomas *et al.*, 2004). Sparrows, Flycatchers and Green Bee-eaters, for example, eradicate insect species which may adversely affect agriculture and human health. Land birds provide billions of dollars in ecosystem services as consumers of pest insects, dispersers, pollinators and predators of native seeds (Butchart *et al.*, 2010). The presences of these aerial acrobats in sufficient number are, therefore, essential for healthy wetland environment.

Populations of numerous species of birds, however, are declining throughout the world and some of these becoming locally extinct owing to the loss, fragmentation and degradation of their habitats (Hewson *et al.*, 2007). This decline in bird populations over a long period of time may indicate changes, for instance, global warming, pollution,

food supply and inter-specific interactions (Kushlan, 1993; Hetrick & Sieving, 2012). To establish current status, identifying threats and monitoring future changes in population of birds are essential for minimizing the risk in their population (Amano *et al.*, 2010b). In the near future, climate changes, widespread habitat loss (Yasué & Dearden, 2006), increasing numbers of invasive species and extinction may cause decline in bird population (Birdlife International, 2004). Bird extinctions and population reductions during the 21st century may potentially disturb ecosystem processes and services (Luck *et al.*, 2003).

The divergent ecosystems, such as wetlands and forests, are fading away and that's why the ecological roles of birds often disappear with them (Şekercioğlu *et al.*, 2004). The birds population decline in many cases, however, occur independent of habitat exploitation, habitat loss, fragmentation, invasive species, pathogens and other factors (Birdlife International, 2004) and eliminate birds and their services from ecosystems (Redford, 1992). Important avian guilds are in rapid decline and resultantly reductions in ecosystem processes are assessed. The decline in birds' population can disrupt dynamic ecological processes for instance pollination, seed dispersal leading to continuous losses, ecosystem collapse, and over all higher extinction rate (Sodhi *et al.*, 2009).

The present study was conducted to assess annual decline in birds' species at the study site and to identify causes of this decline and suggest necessary actions for conservation and protection of bird population at Taunsa Barrage Wildlife Sanctuary (TBWS) of the Punjab, Pakistan.

MATERIALS AND METHODS

Description of the study site

Taunsa Barrage is situated on the Indus River in Southern Punjab that falls between 30° 30' N latitudes and 70° 50' E longitudes about 20 km northwest of Kot Addu, District Muzaffargarh, with an altitude of 137 m (Bibi & Ali, 2013). Indus River is one of the major routes of migratory birds in Pakistan (Bibi & Ali, 2013). Due to the presence of endemic fauna (Indus dolphin), Taunsa Barrage has been declared as a wildlife sanctuary. This sanctuary forms an important wintering area for migratory water birds (PWP, 2011). It is one of the most important wetland sites in this region and one of the 42 wildlife sanctuaries in the Punjab, Pakistan. Within the sanctuary, an island, referred as "Baila" in the local language, is present and has importance due to its rich fauna. It is also called green reservoir where large numbers of breeding egrets and other animals were observed (Bibi & Ali, 2013). Areas on both sides of the reservoir, up to 9 km upstream and 3 km downstream of the barrage are included in the sanctuary (Scott, 1989). Cotton, wheat, and fodder crops are cultivated on land adjacent to the reservoir. *Delbergia sisso* and *Populus euphratica* in association with *Tamarix dioica* are dominant in the riverine forest along the Indus. However, natural vegetation of the area also comprises of *Acacia nilotica*, *Prosopis cineraria*, *Pisum arvense*, *Salsolabarysoma*, *Cynodon dactyl*, *Eleusine compressa* and *Panicum antidotale* (Scott, 1989). The foremost climate (subtropical) factor that influences biodiversity is annual rainfall 100-400 mm, with relative humidity 25-85%. The average lowest temperature in January remains 4.5°C-6.0°C, whereas the average highest temperature recorded in June was 41.5°C-43°C.

Methodology

Data were collected during wintering and breeding period of birds by direct census method as described by Bibi & Ali (2013). The study was carried out during 2002 and 2008 to 2011. The survey points included island, river banks, surrounding fields and villages. For data collection, 28 visits were made (at a strip of 9 km) upstream and downstream (3 km) of the barrage area (Annexure I). The observer walked quietly at a moderate pace, stopping at predetermined distance to listen birds' calls/sounds and record observations

as described by Bibby & Burgess (2000). Birds were counted accurately in the field by using binoculars with magnification of 10 × 50 and spotting scope of magnification 20 × 30 × 60 with a tripod. Surveys were carried out early in the morning (06:00 to 10:00 hrs) and late afternoon to sunset (16:00 to 18:30 hrs (winter and summer). Nocturnal birds were observed during the night surveys (00:00 to 04:00 hrs) by using hearing senses and search lights. To avoid missing of species during the survey period, unscrupulous observations were also included in the data. Surveys were conducted on foot and by boat. Local occurrence status of birds was measured by a method described by Bull (1974) and also given in detail by Bibi & Ali (2013). The human impact and threats to bird population was assessed by participatory human resource interaction appraisal proforma.

Data Analysis

A series of simple linear regression trend line was run by using birds density as the dependent variable, whereas the time (year) as an independent variable. The correlation between species and years was described by Schork & Remington (2010) as;

$$Y = \beta_0 + \beta_1 x$$

Where; β_0 =the intercept (constant)

β_1 =the x coefficient, denotes the slope of the straight line described by the equation.

RESULTS

During the present study, 171 species of birds were identified. The results indicated that out of 171 species of birds, the populations of 14 species were found declining. As the population of 157 species of birds was stable, population of 14 species, however, namely, Little Cormorant (*Microcarbo niger*), Grey Heron (*Ardea cinerea*), Gadwall (*Anas strepera*), Garganey (*Anas querquedula*), Red-crested Pochard (*Netta rufina*), White-backed Vulture (*Gyps africanus*), Marsh Harrier (*Circus aeruginosus*), Common Buzzard (*Buteo buteo*), Long-legged Buzzard (*Buteo rufinus*), Merlin (*Falco columbarius*), Greater Painted-snipe (*Rostratula benghalensis*) and Black Drongo (*Dicrurus macrocercus*) was found in a significant decreasing trend. Maximum individual count was detected during 2001-2002 and minimum bird population was recorded during 2010-2011. Some species such as Greater Painted Snipe, Merlin, and Imperial Eagle were assessed as very rare, whereas Common Buzzard and Long-legged Buzzard were recorded as rare (Table I). During the present study (2008 to 2014), 100% decline in White-backed Vulture (*Gyps bengalensis*) and

Imperial Eagle (*Aquila heliaca*), 92.3% in Common Buzzard (*Buteo buteo*), 88.5% in Garganey (*Anas querquedula*), 85.7% in Long-legged Buzzard (*Buteo rufinus*), 77.8% in Marsh Harrier (*Circus aeruginosus*), 77% in Grey Heron (*Ardea cinerea*), 75% each in Pallas's Fish Eagle and Greater Painted Snipe (*Rostratula benghalensis*), 68% in Gadwall (*Anas strepera*), 60% in Merlin (*Falco*

columbarius), 56.8% in Red-crested Pochard (*Netta rufina*), 51% in Little Cormorant (*Phalacrocorax niger*) and 50.6% in Black Drongo (*Dicrurus macrocercus*) (Table 1). A decline in trend line and a relation between species of birds with years is shown in figures below (Fig. 1 to 14).

Table 1: Assessing birds population trend at Taunsa Barrage Wildlife sanctuary.

S. #	Species	Count							Decline (%)	Distr. Status	Cons. Status
		(n) 2007-08	(n) 2008-09	(n) 2009-10	(n) 2010-11	(n) 2011-12	(n) 2012-13	(n) 2013-14			
1	Little Cormorant (<i>Phalacrocorax niger</i>)	894	712	661	542	513	493	445	51	R	A
2	Grey Heron (<i>Ardeacinerea</i>)	82	74	69	48	39	28	19	77	WM	VC
3	Gadwall (<i>Anas strepera</i>)	1101	989	756	490	432	394	354	68	WM	VA
4	Garganey (<i>Anas querquedula</i>)	26	20	17	11	9	7	3	88.5	WM	FC
5	Red-crested Pochard (<i>Nettarufina</i>)	97	88	84	71	62	59	42	56.8	WM	VC
6	White-backed Vulture (<i>Gyps bengalensis</i>)	51	5	2	0	0	0	0	100	R	UC
7	Marsh Harrier (<i>Circus aeruginosus</i>)	9	7	5	5	3	2	2	77.8	WM	UC
8	Imperial Eagle (<i>Aquila heliaca</i>)	8	6	5	3	2	1	0	100	WM	VR
9	Common Buzzard (<i>Buteobuteo</i>)	13	8	5	3	2	2	1	92.3	YRV	R
10	Long-legged Buzzard (<i>Buteorufinus</i>)	7	6	4	4	2	2	1	85.7	WM	R
11	Merlin (<i>Falco columbarius</i>)	5	5	4	3	3	2	2	60	SB	VR
12	Pallas's Fish Eagle (<i>Haliaeetus leucorhynchus</i>)	12	9	7	5	4	3	3	75	R	R
13	Greater Painted Snipe (<i>Rostratula benghalensis</i>)	28	23	21	18	14	10	7	75	R	VR
14	Black Drongo (<i>Dicrurus macrocercus</i>)	160	153	146	123	111	98	79	50.6	R	VC

Note: Status: Distribution status was calculated by following Mirza and Wasiq (2007); R= resident, WM= winter migrant, YRR= Year round resident, SB= Summer breeders. Local occurrence status calculated by following Bull, 1974. VA=very abundant; A=abundant; VC=very common; C=common; FC=fairly common; UC=uncommon; R=rare; VR=very rare.

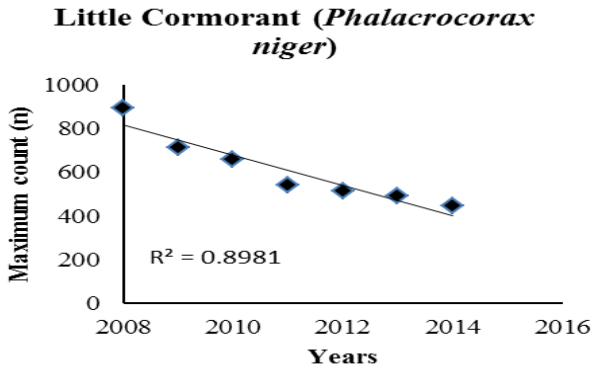


Fig., 1: Observation of population decline in Little Cormorant.

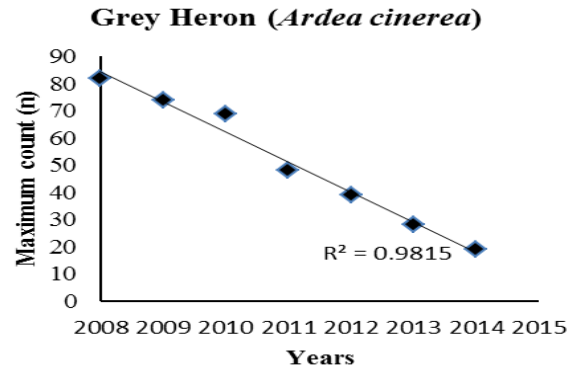


Fig., 2: Observation of population decline in Grey Heron.

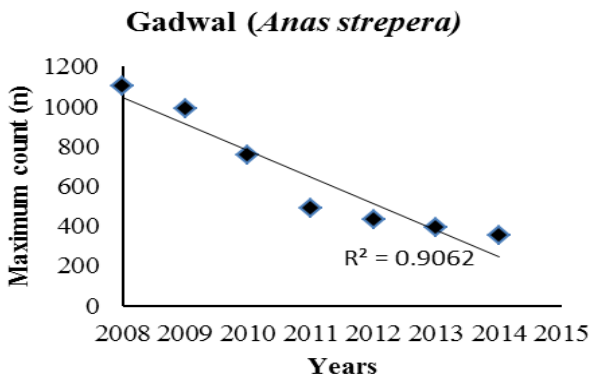


Fig., 3: Observation of population decline in Gadwal

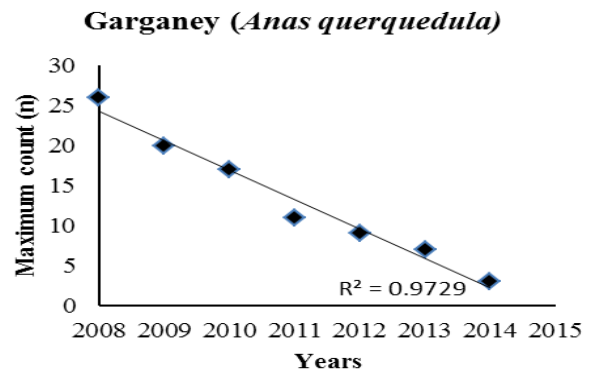


Fig., 4: Observation of population decline in Garganey.

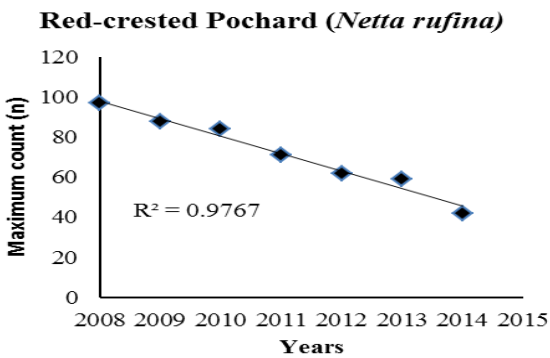


Fig., 5: Observation of population decline in Red-crested Pochard.

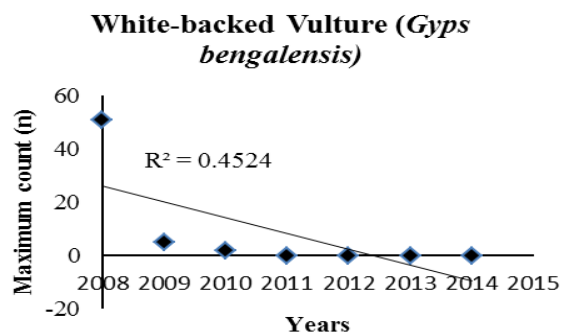


Fig., 6: Observation of population decline in White-backed Vulture.

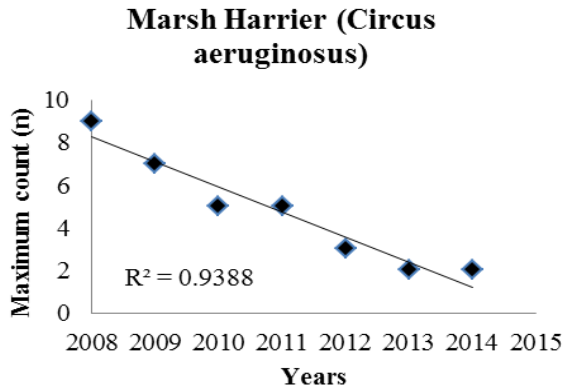


Fig., 7: Observation of population decline in Marsh Harrier.

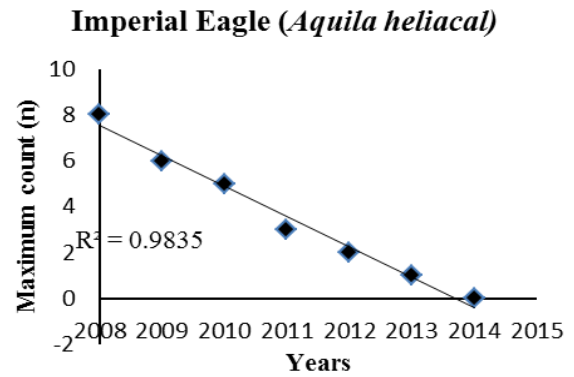


Fig., 8: Observation of population decline in Imperial Eagle.

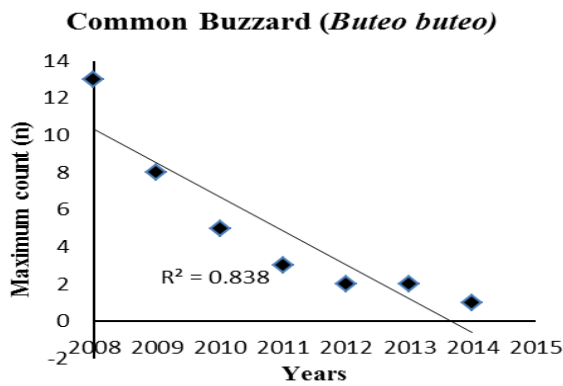


Fig., 9: Observation of population decline in Common Buzzard.

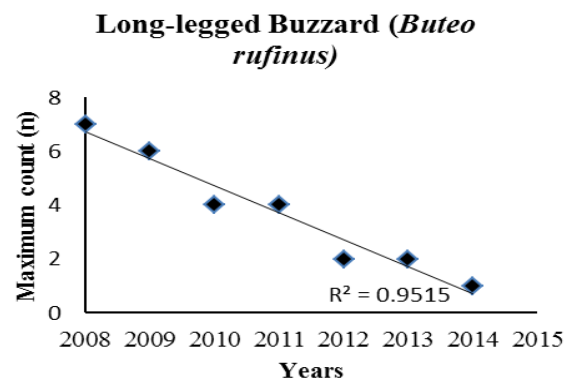


Fig., 10: Observation of population decline in Lon-legged Buzzard.

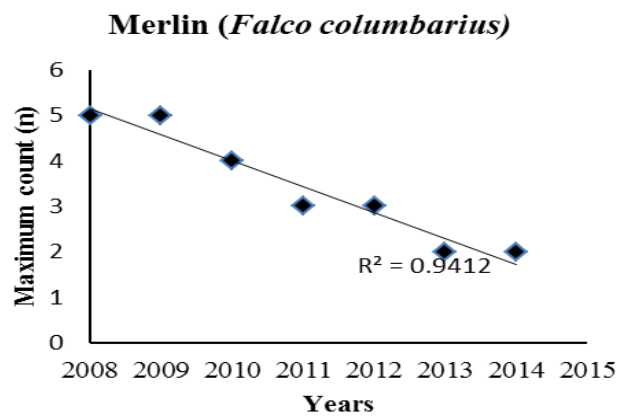


Fig., 11: Observation of population decline in Merlin.

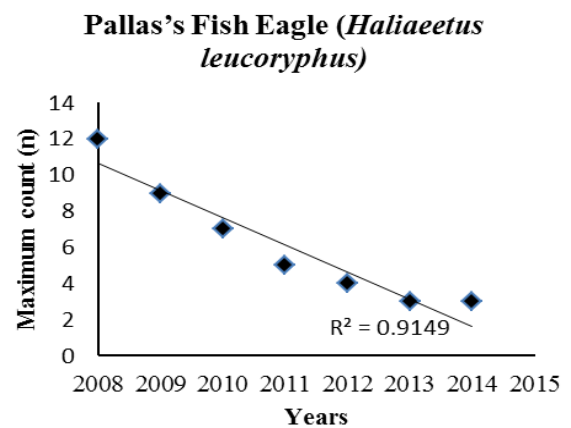


Fig., 12: Observation of population decline in Pallas's Fish Eagle.

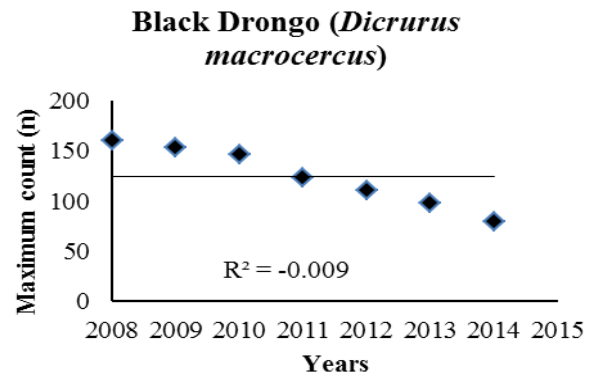
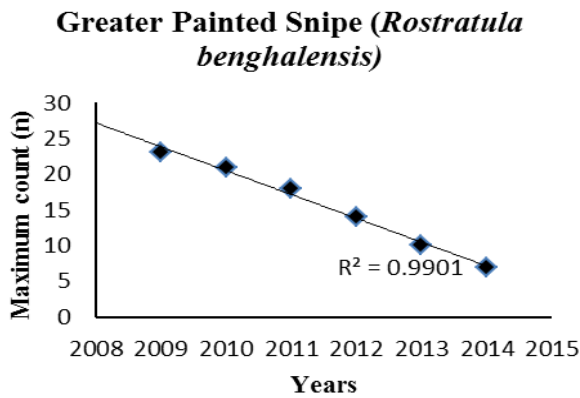


Fig., 13: Observation of population decline in Greater Painted Snipe.

Fig., 14: Observation of population decline in Black Drongo.

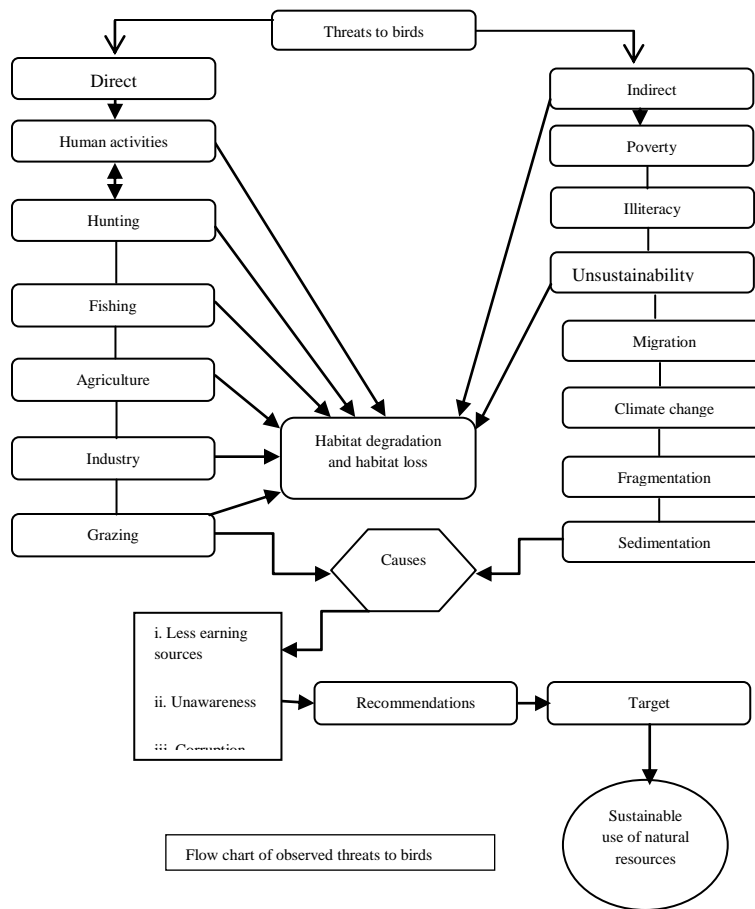


Fig., 15: Flow chart of observed threats to birds at study site.

DISCUSSION

The present study was conducted to assess the trends in population of birds at Taunsa Barrage Wildlife Sanctuary. The objectives of the study were to assess annual decline in species of birds and to identify the causes of this decline at the study site.

In total, 58,598 birds belonging to 53 families and 171 species were recorded, as reported earlier (Bibi & Ali, 2013). The observed decreasing trend in 14 species of birds at TBWS is in accordance with some other studies as well (Begum *et al.*, 2013). A decline in population of waterfowl, in the present study, is in a fair agreement with those reported by Akbar *et al.* (2009). The latter authors observed a reduction in population of waterfowl from 15340 to 2263 during 1997 to 2003. Likewise Mahmood-ul-Hassan (2011) and Sandilyan *et al.* (2010) reported a 92% and 40% decline in Black Coot and waterbirds species, respectively. The observed decline (92%) in Vulture population, habitat specialist birds (forest birds, wetland birds) and shorebirds population, during the present study, has also been assessed worldwide (Butchart *et al.*, 2010; Virani *et al.*, 2011; Ogada *et al.*, 2012, Galligan *et al.*, 2014). In Pakistan, generally the population of migratory birds has been decreasing at wildlife protected areas (Khan, 2005), such as Hub Dam (Begum *et al.*, 2013). The decline in wild birds population of UK was reported 6% between 2008-2013 (Wild Bird Populations in the UK, 1970 to 2014 annual statistical release, 2015). The population decreasing trend in Garganey was also observed by Pöysä & Väänänen (2014).

The decreasing trend in population of birds, in the sanctuary is really alarming and threatening to local community and to the environment, which may be attributed to an increase in local population, illegal hunting, trapping of birds (Begum *et al.*, 2013), habitat exploitation and climate changes (Jiguet *et al.*, 2010). Tamada *et al.* (2014) observed the continuing decline in occupied breeding and in the population.

Since initial declines may be difficult to detect, yet even relatively small proportional declines equate to losses of individuals with a consequential alteration in ecosystem structure, function and services (Elliott *et al.*, 2010). There are various reasons for this population decline for various birds, for instance, the major cause of vulture population decline is attributed to poison including residues of veterinary diclofenac, habitat

loss and unsustainable harvesting of crops (Botha *et al.*, 2012; Thakur and Narang, 2012). The decline in population of water birds species occur due to human detrimental activities (Sandilyan *et al.*, 2010). Accelerated climate change, furthermore, may also lead to a significant decreasing trend and species extinctions (La Sorte & Jetz, 2010).

Threats to bird's diversity of TBWS may be mainly categorized into natural and anthropogenic threats (PWP, 2011). The main human induced factors may include grazing of livestock, hunting, clearance of native forest for agriculture, and use of pesticides for crops (Mineau & Whiteside, 2013), unsustainable fishing, and encroachment of land near the sanctuary area. It was assessed that more than 90% of globally threatened birds and 86% of other birds' species are facing a serious threat primarily due to habitat destruction (Kideghesho *et al.*, 2006; Sandilyan, 2014).

Hunting of birds causes a great deal of disturbance in wildfowl which may disturb other bird species, especially, ducks shift their feeding and resting places or times. Declining birds population at TBWS may be attributed to the threats, for instance, illegal hunting of waterfowls. Deforestation for fuel may be another reason for decline in the bird's population. The major source of fuel wood for TBWS community is *Acacia carechu*, *Acacia nilitica*, *Tamarix dioca*, cotton stalks and crop residues. Men collect tamarix, typha and sacchrum species for use in basket weaving, broom and fan making. These people have sufficient influence on biodiversity (Bibi *et al.*, 2013). Similarly, a reduction in the area of flooded fallow fields with short vegetation at both breeding and wintering sites may be another cause of decrease in bird's species (Amano *et al.*, 2010a). The habitat of birds at protected sites is seriously degraded, when land is given to the farmers on lease, for cultivation of crops, by the Government (Yasué & Dearden, 2006). The livestock grazing was being practiced in the study area, which always disturbed the birds feeding and breeding. The mobility and grazing of livestock on upstream (green reservoir) allowed birds to move somewhere else since grazing degraded the habitat. The ground nested birds, furthermore, are exposed by livestock concentration during grazing that may leads to trampling effects.

In order to conserve and protect population of birds, strict control may be enforced on illegal hunting and netting through Wildlife

Department. The awareness about conservation of the study site through educating the indigenous community, because of low (19%) literacy rate of the study area (Bibi *et al.*, 2013), may reduce this decline in birds population. Habitat of the wetlands may also be protected through controlled livestock grazing and vegetation exploitation with the help of local community.

In conclusion, conservation and management of declining population of birds are of foremost importance for the interests of the indigenous community as well as for the environment. The bird species, however, having abundant and common local occurrence status during the study, may also have threats for their population in future. For this purpose, public awareness programs may be arranged. For a successful conservation approach, it is essential to establish an outline for influential conservation

status, categorizing threats and to keep an eye on future population changes. It is suggested, therefore, that immediate steps be taken including conservation goal, improved environmental education, establishing community co-management, and launching substitute sources for the protection of the sanctuary and to conserve the declining population of birds.

ACKNOWLEDGEMENT

The authors gratefully acknowledge the financial support of British Council DFID-UK under DeIPHE (Developing Partnership for Higher Education) project from 2008 to 2012 and also Higher Education Commission of Pakistan for providing funds for this study under the Startup Research Grant Program 2013-2015.

Annexure-I

Details of field surveys.

No.	Survey dates	Purpose of survey
1	03/2002	Birds diversity survey
2	11/2008	Biodiversity survey
3	10-14/4/2009	Preliminary survey
4	16-18/05/2009	Biodiversity survey
5	4-6/06/2009	Biodiversity survey
6	2-4/07/2009	Biodiversity survey
7	2-4/08/2009	Biodiversity survey
8	4-6/09/2009	Biodiversity survey
9	2-4/10/2009	Biodiversity survey
10	6-8/11/2009	Biodiversity survey
11	4-6/12/2009	Biodiversity Survey; assessment of threats
12	1-3/01/2010	Biodiversity Survey; meetings with the local's
13	11-16/02/2010	Workshop and training ; biodiversity survey
14	5-7/03/2010	Biodiversity Survey; meetings with the local's
15	3-4/04/2010	Biodiversity Survey; meetings with the local's
16	7-8/05/2010	Biodiversity survey; assessment of threats
17	4-6/06/2010	Biodiversity survey and meetings with the Department of Fishries and Wildlife
18	10-11/07/2010	Biodiversity Survey; meetings with the local's
19	4-6/08/2010	Biodiversity survey
20	11-12/09/2010	Biodiversity survey
21	7-9/10/2010	Biodiversity survey and meetings with the villagers of Jannu village
22	5-7/11/2010	Biodiversity Survey; meetings with the locals of Bait Qaimwala
23	4-5/12/2010	Biodiversity Survey
24	13-15/01/2011	Biodiversity Survey
25	6-7/02/2011	Biodiversity Survey
26	12-13/03/2011	Biodiversity Survey; meetings with the local's
27	10-12/11/2011	Biodiversity survey, meetings with the locals of Basti Allahwali
28	13-15/02/2012	Biodiversity survey; threats assessment

REFERENCES

- Abdullah, A. & Cheng, T.C., 2001. Optimization of reduced calorie tropical mixed fruits jam. *Food Qual. prefer.*, **12(1)**: 63-68.
- Akbar, M., Mushtaq-Ul-Hassan, M., Mahmood-Ul-Hassan, M. & Hassan, M., 2009. Waterfowl diversity at Chashma barrage (Wildlife Sanctuary Mianwali) and Marala headworks (Game Reserve Sialkot), Pakistan during 1996-2005. *Int. J. Agri. Biol.*, **11(2)**: 188-192.
- Amano, T., Li, M. H. & Yoshida, H., 2010a. Silent night in Japanese rice fields? A population decline in the Greater Painted Snipe. *Ornith. Sci.*, **9(1)**: 49-53.
- Amano, T., Székely, T., Koyama, K., Amano, H. & Sutherland, W. J., 2010b. A framework for monitoring the status of populations: An example from wader populations in the East Asian-Australasian flyway. *Biol. Conserv.*, **143(9)**: 2238-2247.
- Begum, A., Zubair, A., Hussain, S. E. & Khan, A. R., 2013. Waterbirds diversity and conservation at Hub Dam Lasbella, Karachi, Pakistan. *Afr. J. Sci. Res.*, **2(3)**: 22-26.
- Bibby, C., Burgess, N., Hill, D. A. & Mustoe, S., 2000. Bird census techniques. Academic Press, London. 302 pp.
- Bibi, F. & Ali, Z., 2013. Measurement of diversity indices of avian communities at Taunsa Barrage Wildlife Sanctuary, Pakistan. *J. Anim. Plant Sci.*, **23(2)**: 469-474.
- BirdLife International, 2000. Threatened Birds of the World (Lynx Edicions and BirdLife International, Barcelona and Cambridge, U.K.).
- BirdLife International, 2004. State of the World's Birds 2004: Indicators for our changing world. BirdLife International Cambridge, UK. 28 pp.
- Botha, A. J., Ogada, D. L. & Virani, M. Z., 2012. Vulture Summit 2012.
- Bull, J., 1974. Birds of New York State. Published by Doubleday/Natural History Press. Edited by Emanuel Levine (1985). Cornell University Press. 622 pp.
- Butchart, S. H., Walpole, M., Collen, B., van Strien, A., Scharlemann, J. P., Almond, R. E., Baillie, J. E., Bomhard, B., Brown, C. & Bruno, J., 2010. Global biodiversity: indicators of recent declines. *Sci.*, **328(5982)**: 1164-1168.
- Elliott, G. P., Wilson, P. R., Taylor, R. H. & Beggs, J. R., 2010. Declines in common, widespread native birds in a mature temperate forest. *Biol. Conserv.*, **143(9)**: 2119-2126.
- Galligan, T. H., Amano, T., Prakash, V. M., Kulkarni, M., Shringarpure, R., Prakash, N., Rande, S., Green, R. E. & Cuthbert, R. J., 2014. Have population declines in Egyptian Vulture and Red-headed Vulture in India slowed since the 2006 ban on veterinary diclofenac? *Bird Conserv. Intern.* 1-10. DOI:10.1017/S0959270913000580
- Hetrick, S. A. & Sieving, K. E., 2012. Antipredator calls of tufted titmice and interspecific transfer of encoded threat information. *Behav. Ecol.*, **23(1)**: 83-92.
- Hewson, C. M., Amar, A., Lindsell, J. A., Thewlis, R. M., Butler, S., Smith, K. & Fuller, R. J., 2007. Recent changes in bird populations in British broadleaved woodland. *Ibis*, **149(s2)**: 14-28.
- Jiguet, F., Gregory, R. D., Devictor, V., Green, R. E., VOŘÍSEK, P., Van Strien, A. & Couvet, D., 2010. Population trends of European common birds are predicted by characteristics of their climatic niche. *Global Change Biol.*, **16(2)**: 497-505.
- Khan, M. Z., 2005. Current status of International important wetlands in Pakistan. *J. Basic and Appl. Sci.*, **1(2)**: 1-9.
- Khan, A., Khan, R., Ullah, A., Ali, M., Mahmood, J. & Sheikh, K., 1996. Conservation perspectives of the Imperial *Aquila heliaca* and Steppe Eagle *Aquila nipalensis* in Pakistan. Eagle Studies, WWGBP, Berlin, London and Paris. pp: 459-461.
- Kideghesho, J. R., Nyahongo, J. W., Hassan, S. M., Tarimo, T. C. & Mbije, N. E., 2006. Factors and ecological impacts of wildlife habitat destruction in the Serengeti ecosystem in Northern Tanzania. *Aajeam-Ragee.*, **11**: 917-932.
- Kushlan, J. A., 1993. Colonial waterbirds as bioindicators of environmental change. *Coloni. Waterbir.*, **16(2)**: 223-251.
- La Sorte, F. & Jetz, W., 2010. Avian distributions under climate change: towards improved projections. *J. Exp. Biol.*, **213(6)**: 862-869.
- Luck, G. W., Daily, G. C. & Ehrlich, P. R., 2003. Population diversity and ecosystem services. *Tren. Ecol. Evol.*, **18(7)**: 331-336.

- Mahmood-ul-Hassan, M., 2011. Population trend of the Black Coot (*Fulica atra*) in the Punjab, Pakistan during 1989 through 2008. *Pak. J. Zool.*, **43(4)**: 665-671.
- Mineau, P. & Whiteside, M., 2013. Pesticide acute toxicity is a better correlate of US grassland bird declines than agricultural intensification. *PLoS one*, **8(2)**: e57457.
- Mirza, Z. & Wasiq, H., 2007. A field guide to the birds of Pakistan. Bookland, Lahore. 365 pp.
- Ogada, D. L., F. Keesing, M. Z. & Virani, 2012. Dropping dead: causes and consequences of vulture population declines worldwide. *Ann. New York Acad. Sci.*, **1249(1)**: 57-71.
- Pöysä, H. & Väänänen, V. M., 2014. Drivers of breeding numbers in a long-distance migrant, the Garganey (*Anas querquedula*): effects of climate and hunting pressure. *J. Ornithol.*, **155**: 679-687.
- PWP 2011. Site Management Plan Taunsa Barrage Wildlife Sanctuary. The Ministry of Environment's Pakistan Wetlands Programme. 60 pp.
- Redford, K. H., 1992. The empty forest. *Biosci.*, **42**: 412-422.
- Sandilyan, S., Thiyagesan, K. & Nagarajan, R., 2010. Major decline in species-richness of waterbirds in the Pichavaram mangrove wetlands, southern India. *Wader Study Group Bull.*, **117(2)**: 91-98.
- Sandilyan, S., 2014. Adjacent Agricultural Lands of Pichavaram Mangroves-Vital Alternative Habitat for Waterbirds in Southern India. *Global J. Environ. Res.*, **8(2)**: 21-25.
- Schork, M. A. & Remington, R. D., 2010. Statistic with application to the biological and health sciences. Eds.3rd. Made in the USA Lexington, KY. ISBN: 1449945929; ISBN: 13:9781449945923.
- Scott, D. A., 1989. A directory of Asian wetlands. IUCN, The World Conservation Union Gland, Switzerland. 1181 pp.
- Şekercioğlu, Ç. H., Daily, G. C. & Ehrlich, P. R., 2004. Ecosystem consequences of bird declines. *Proc. Nat. Acad. Sci.*, **101(52)**: 18042-18047.
- Sodhi, N. S., Brook, B. W. & Bradshaw, C. J., 2009. Causes and consequences of species extinctions. *The Princeton guide to ecol.*, **1**: 514-520.
- Tamada, K., Tomizawa, M., Umeki, M. & Takada, M., 2014. Population trends of grassland birds in Hokkaido, focussing on the drastic decline of the Yellow-breasted Bunting. *Ornithological Sci.*, **13(1)**: 29-40.
- Thakur, M. & Narang, S., 2012. Population status and habitat-use pattern of Indian white-backed vulture (*Gyps bengalensis*) in Himachal Pradesh, India. *J. Ecol. Nat. Environ.*, **4(7)**: 173-180.
- Thomas, C. D., Cameron, A., Green, R. E., Bakkenes, M., Beaumont, L. J., Collingham, Y. C., Erasmus, B. F., De Siqueira, M. F., Grainger, A., Hannah, L., 2004. Extinction risk from climate change. *Nat.*, **427(6970)**: 145-148.
- Virani, M. Z., Kendall, C., Njoroge, P. & Thomsett, S., 2011. Major declines in the abundance of vultures and other scavenging raptors in and around the Masai Mara ecosystem, Kenya. *Biol. conserv.*, **144(2)**: 746-752.
- Yasué, M. & Dearden, P., 2006. The potential impact of tourism development on habitat availability and productivity of Malaysian plovers *Charadrius peronii*. *J. Appl. Ecol.*, **43(5)**: 978-989.

Received: 03-02-2016

Revised:11.03.2016

Accepted: 29-07-2016