

DOI No.: <http://doi.org/10.53550/EEC.2022.v28i04s.076>

Assessment of Avian Biodiversity and Bird strikes to Aircrafts at Bacha Khan International Airport, Peshawar KP, Pakistan

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(Received 4 May 2022; Accepted 30 June 2022)

ABSTRACT

Birds inside or outside the airport is big threat to the aircraft. The main objective of this study was to identify hazards of bird species, population density and richness of birds around BACHA KHAN INTERNATIONAL AIRPORT. The methods being used were point count/vantage point method for the population estimation. The Study was based upon two sites (Site A Airport Premises) spreading over an area of 30 acres and (Site B which is within Airport) spreading over an area of 7.5 Acres. Total Sampling points (Observation Points) were 120 and every sampling point was visited for 15-20 minutes and birds were counted for three to five minutes in a fixed radius. Transact line method spreading over 500 meters was used to analyse the data. Birds were observed every 100 meters. Primary and Secondary data was collected using questionnaire. The study identified the reasons for Bird Air strikes at the Airport and explored possible mitigation measures of avian hazards in Peshawar airport premises. This data will be useful for the aviation authorities in preparing managed bird control program. In this study hypothesis were given in comparison with other attractants tree attracts more birds in Peshawar Airport. Averages of 30 species were observed in Site A and 15 in Site B monthly respectively. The highest Relative Abundance observed at Site A was of House Crow species which is 16.8463612% and in Site B Kite species with relative abundance 21.4953271%. The Highest number of Bird strike occurred at Runway followed by strikes outside the fence with reference to Bird strike report 2021-22. Pigeon and Doves were observed in Flight over the airport premises. 36 Bird's diversity observed around airport in rainfall and cloud cover assessed through Shannon diversity index as 3.024 which indicate good diversity of birds in the study area which might be a potential threat to the aircraft? The study revealed that effective management plan should also be taken into consideration. The Population density of Site A outside the airport premises (30 Acres) is 24.13/Acre and for Site B within Airport which is 7.5 Acres is 14.2/Acre respectively.

Key words: Bacha Khan Airport, Bird Air Strike, Avian Biodiversity, Relative Abundance, Peshawar.

Introduction

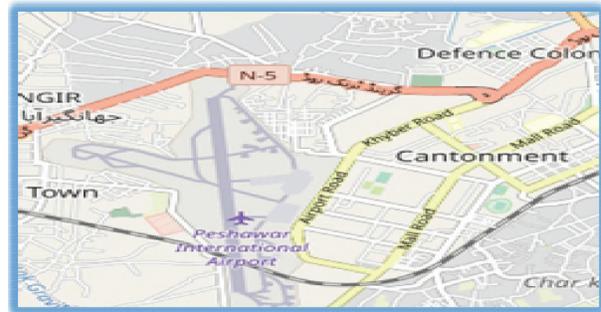
Human lives and aircrafts have been affected by collisions. Many studies have been conducted to analyze civil and military bird strike database all over the world (Dolbeer and ES chenfelder, 2003). The International civil aviation organization (ICAO)

requires airport to implement measures to decrease the risk of wildlife hazard at and in the vicinity of an airport (Merchant *et al.*, 1990). Several studies were conducted by Sugg (1965), Meads and Carter (1973), Major and Dill (1978), Mudge and Fems (1982), Horton (1990), Milsom (1990), Pomeroy and Hepner (1992), Hild (1995), Demarchi (1996), Ferns (1996),

Seubert (1996), Vantets (1996), Primus and Furcolow (1997), Hahn (1997), Dolbeer *et al.*, 1998), Hild and Muentze (2000), Baxter (2001), Hild (2002), Burma (1998) Hild and Morgenroth (2004), Hahn (2004) and Martin *et al.* (2011) on roosting of birds near air fields and their effect on air craft flights safety. Bird strike is at highest at low height and decrease with height (EASA. 1999-2008, Dolbeer *et al.*, 1990-2018). Annual losses to US civil aviation due to wildlife strike (98% involving birds) have been estimated to at least 677 million dollars. (Richardson and west 2000) have reported 286 serious bird strikes, accidents to military aircrafts from 32 countries during the period 1959-1999. Birds air strike crash may cause many loss (Godin, 1994). According to Civil Aviation authority CAA Pakistan 85 incidents of bird's strike took place only at Alama Iqbal International Airport Lahore Pakistan since 2002. Knowledge about hazard species give clues about size, behaviors, breeding and feeding patterns of the problematic species and hence preventive measures could be taken accordingly. As all birds are not hazards to aviation. Therefore, it is important to identify these species of conflict and factors responsible to attract birds near airport or airfield. There should be Wildlife control unit activity including pilot and controller in loop. Over the years collision between birds and the aircraft has resulted in the death of hundreds of people and is responsible for annual loss worth about 1.2 billion US dollar. The decline of bird population is directly associated with the variation in the structure of environments (Rawat and Rao, 2020).

Study Area

Bacha Khan International Airport (Peshawar Airport) is situated in the middle of Peshawar city. The airport was established in 1927 and received international status in 1965. The coordinates of the study area are 33.9898° N, 71.5192° E. The airport is spread over an area of 7.5 Acres. In the recent times airport have improved with infrastructure facilities both



passenger and cargo airlines services.

Method and Methodology



Secondary Data Collection From Civil Aviation Authority

- The point count/vantage point method was used for the population estimation (Buckland, 2006).
- Transect walk method being used. Working methods consist of direct observations from fixed points or in motion on pre-determined routes covered by foot.
- Result shows average month wise population densities of overall from selected sites during study.
- Each sampling point was visited for 15-20 minutes and birds were counted for three to five minutes in a fixed radius (Hingston *et al.*, 2018)
- Primary and Secondary data Collected using questionnaire.
- Field Guide used for bird identification.
- Potential hazard species inside the air field identified by using point count method.

Data Collection

The Study was carried out from February, 2022 to July 2022. Data on bird species and numbers were collected both during morning and evening in 50-meter radius in each site. Each site was visited for about 2-3 hours. Birds were observed for 15 minutes in fixed radius. Binoculars were used during the observations to confirm the identification of differ-

ent bird species which were not clear with naked eyes (*servoss et al, 2000*). All the activities of flying, loafing, nesting, feeding, breeding were recorded. Secondary data was also collected from civil aviation authorities.

It is believed that our data will be use full for upcoming study of birds at Bacha khan international Airport

Results and Discussion

There was no any considerable evidence of any solid waste or water sources in 7.5 acres inside the airport. 18 bird Airstrike Occurred between year 2021-2022. However bird species couldn't be identified by the management. Different birds having different threat level so practical approach to prevention is necessary to check bird status and rank hazards. The specie density birds behaviors feeding preference, breeding cycle, nesting knowledge about roosting, perching Could support the Airport authority for implementing bird control measures to mitigate bird strike. The sanitation structure was good around the

premises. Solid structures such as telephone or electric poles or building within the airport premises act as attractants to targeted species which cause threat to aircrafts. An average of 30 species were observed in Site A and 15 in Site B monthly respectively with total population of 742 individuals in Site A and 107 in Site B respectively. The highest Relative Abundance observed at Site A was of House Crow which is 16.8463612% and in Site B kite species with relative abundance 21.4953271. The Highest number of Bird strike occurred at Runway followed by strikes outside the fence with reference to Bird strike report 2021-22. The Population density of Site A Outside the airport premises (30 Acres) is 24.13/ Acre and for Site B within Airport which is 7.5 Acres its 14.2/ Acre respectively.

Birds diversity around airport in rainfall and cloud cover assessed through Shannon diversity index as 3.024 which indicate good diversity of birds in the study area which might be a potential threat to the aircraft. Attractants within airport were solid structures followed by trees and shrubs. Grasses besides runway act as an attractant for the birds. This

Attraction Factors for Birds in the Airport and Counter Measures to be taken

S. No.	Attraction Factors within and Outside Airport	Relationship with Environmental factors with Bird's species	Possible Control Measures
1)	Tree Vegetations	<ul style="list-style-type: none"> • Feeding and reproduction habitats for species 	<ul style="list-style-type: none"> • Management and modifications of the area According to Standards.
2)	Grasses	<ul style="list-style-type: none"> • Feeding Habitat • Trophic Sources 	<ul style="list-style-type: none"> • Mowing in proper time to prevent feeding.
3)	Fences	<ul style="list-style-type: none"> • Places to rest for birds 	<ul style="list-style-type: none"> • Chemical repellents should be placed to prevent resting.
4)	Constrictions, Buildings	<ul style="list-style-type: none"> • Shelter and nesting places 	<ul style="list-style-type: none"> • Increase attention paid to buildings and constrictions. Blocking the access to towers, bridges. • Covering the cracks and opening in the buildings.

Doves and Pigeons Observed in the Airport Premises during Flight

S.No	Scientific Name	Common Name	Status
1)	<i>Columba Livia</i>	Rock Pigeon	Wild/Domestic
2)	<i>Columbia Livia domestica</i>	Domestic pigeon	Wild/Domestic
3)	<i>Streptopeliadec aocto</i>	Eurasian Collared dove	Wild
4)	<i>Streptopeliaris oria</i>	Barbary dove	Domestic
5)	<i>Streptopelia senegalensis</i>	Laughing Dove	Wild
6)	<i>Columbia livia</i>	Oriental Roller	Domesticated
7)	<i>Columbia livia domestica</i>	Rock dove	Domesticated
8)	<i>Ducula melanochroa</i>	Black imperial pigeon	Domesticated
9)	<i>Columbia Livia domestica</i>	Racing Pigeon	Domesticated

Species Observed in (Site A) Airport Premises Monthly Average (30 Acres)

S. No	Scientific Name	Common Name	Number of Observed Individuals	Relative Abundance R=ni/N*100
1)	Milvusmigrans	Kite	119	16.0377358
2)	Acridotherestrictis	Common Mayna	112	15.0943396
3)	Acridotheres ginginianus	Bank Mayna	6	0.80862534
4)	Corvussplendens	House Crow	125	16.8463612
5)	Passerdomesticus	House Sparrow	102	13.7466307
6)	Columba livia domestica	Feral Pigeon	32	4.31266846
7)	Columba livia domestica	Domestic Pigeon	11	1.48247978
8)	Streptopelia decaocto	Indian ring dove	7	0.94339623
9)	Spilopelia senegalensis	Laughing dove	9	1.21293801
10)	Dicrurusmacrocerus	Black Drongo	6	0.80862534
11)	Upupidae	Hoopoe	2	0.26954178
12)	Cinnyrisasiaticus	Purple Sunbird	1	0.13477089
13)	Coracias benghalensis	Indian Roller/ Blue jay	4	0.53908356
14)	Apusnipalensis	House swift	32	4.31266846
15)	Pycnonotus cafer	Red vented Bulbul	44	5.92991914
16)	Alcedo atthis	Common Kingfisher	1	0.13477089
17)	Psittacula krameri	Rose ringet Parakeet	4	0.53908356
18)	Motacilla cinerea	Grey Wagtail	6	0.80862534
19)	Motacilla alba	White Wagtail	2	0.26954178
20)	Accipiter nisus	Indian sparrow hawk	1	0.13477089
21)	Petrochelidon fluvicola	Indian cliff swallow	34	4.58221024
22)	Eudynamys scolopaceu	Asian koel	8	1.07816712
23)	Trochilidae	Humming Bird	4	0.53908356
24)	Dendrocoposassimilis	Sindh woodpecker	1	0.13477089
25)	Phylloscopuscollybita	Common Chiffchaff	8	1.07816712
26)	Turdoidescaudata	Common Babbler	7	0.94339623
27)	Turdidae	Thrush	11	1.48247978
28)	Delichon dasypus	Asian House Martin	34	4.58221024
29)	Merops orientalis	Little Green Beeeater	3	0.40431267
30)	Lanius excubitor	Grey Shrike	6	0.80862534
Total			742	

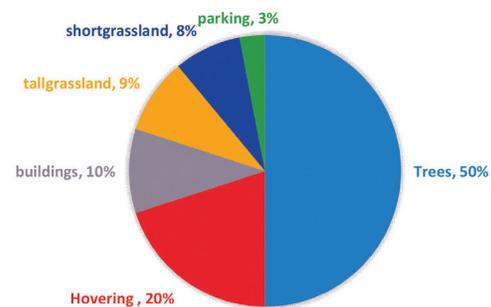
Population density= 24.13/ Acre

is a threat to the aircrafts and its management and should be focused to prevent birds hazards. Attractant mostly outside the Airport were trees and shrubs followed by nesting sides. Species characterized by gregarious behavior represent a real threat to aircraft safety which needs a series of measures that can reduce birds by eliminating or restricting to minimize the trophic resources and opportunities for rest.

According to the data provided by civil aviation authorities to a local newspaper, six hundred and twentytwo incidents were recorded in the past four-and-a-half years, with birds colliding with both domestic and foreign aircraft. According to the data, Lahore airport witnessed the highest number of bird strikes, with 198 incidents being recorded during this period. Karachi airport recorded 192 strikes, Islamabad airport 100, Sialkot airport 53, Peshawar airport 40, Multan airport 26, Faisalabad airport 22

and Quetta airport recorded 17 strikes. According to the CAA, 60 per cent of these incidents were reported during the monsoon season. The months of June, July, August and September saw an increase in such incidents. Due to bird strikes, domestic and in-

OBSERVATION OF AVIAN HABITATS AT BACHA KHAN INTERNATIONAL AIRPORT



Species Observed in Airport (Site B) Monthly Average (7.5 Acres)

S. No	Scientific Name	Common Name	Number of Individual Observed in Airport	Relative Abundance R=ni/N*100
1)	Milvus migrans	Kite	23	21.4953271
2)	Acridotheres tristis	Common Myna	15	14.0186916
3)	Corvus splendens	House Crow	20	18.691588821
4)	Passer domesticus	House Sparrow	10	9.34579439
5)	Columba liviademestica	Feral Pigeon	7	6.54205607
6)	Columba livia domestica	Domestic Pigeon	3	2.80373832
7)	Streptopeliadecaecto	Indian ring dove	3	2.80373832
8)	Spilopeliasenegalensis	Laughing dove	2	1.86915888
9)	Apus nipalensis	House swift	3	2.80373832
10)	Pycnonotus cafer	Red vented Bulbul	7	6.54205607
11)	Psittacula krameri	Rose ringed Parakeet	2	1.86915888
12)	Petrochelidonfluvicola	Indian cliffswallow	2	1.86915888
13)	Eudynamys scolopaceus	Asian koel	3	2.80373832
14)	Delichondasypus	Asian House Martin	5	4.6728972
15)	Little Green Bee eater	Little Green Bee eater	2	1.86915888
	Total		107	

Population density= 14.2/Acre

Bird Species and their general status observed in Bacha Khan International Airport.

Order/Family	Common name (Scientific name)	Status
Ardeidae	Cattle egret (Bubulcus ibis)	R
Accipitridae	Black kite (Milvis migrans)	R
	Brahminy kite (Haliaeetus leucorhynchus)	R
Passeriformes		
Dicruridae	Ashy drongo (Dicrurus leucophaeus)	SB
	Black drongo (Dicrurus macrocercus)	SB
Pycnonotidae	Red-vented bulbul (pycnonotus cafer Humayuni)	R
	White-eared bulbul (pycnonotus leucotis)	R
Cistocolidae	Striated Prinia (Prinia crugera)	AM
Sturnidae	Common myna (Acridotheres tristis)	R
	Bank myna (Acridotheres ginginianus)	R
Passeridae	House sparrow (passer domesticus)	R
Hirundinidae	Asian house martin (Delichon dasypus)	R
Laniidae	Long-tail shrike (Lanius schach erythronotus)	R
Motacillidae	White wagtail (Motacilla alba dukhuen-Sis)	WV
Turdidae	Tickell's thrush (Turdus unicolor)	SB
Corvidae	House crow (Corvus splendens)	R
Columbiformes		
Columbidae	Hill pigeon (Columba rupestris)	R
	Rock pigeon (Columba livia)	R
	E. Collared dove (Streptopelia decaecto)	R
	Red collared dove (S. tranquebarica)	
	Laughing dove (S. senegalensis)	R
Coraciiformes		
Alcedinidae	W. T. Kingfisher (Halcyon smyrnensis)	R
Alcedinidae	Common kingfisher (Alcedo atthis)	R
Meropidae	Green bee-eater (Merops orientalis)	R
Bucerotiformes		
Upupidae	Common hoopoe (Upupa epops)	R
Psittaciformes		

*LC, Least concern; R, Resident; WV, winter visitor; SB, summer Breeder; AM, Altitudinal migrants.

Table 1. Average Birds diversity in rainfall and cloud cover

S. No	Species	Zoological name	No of individuals	pi(proportion)	Log (pi)	-pi*log (pi)	Relative abundance R = ni/N*100
1	Common Myna	<i>Acridotheres tristis</i>	49	0.144	-1.940	0.279	14.370
2	House Crow	<i>Corvus splendens</i>	56	0.164	-1.807	0.297	16.422
3	Red vented Bulbul	<i>Pycnonotus cafer</i>	14	0.041	-3.193	0.131	4.106
4	Black Drongo	<i>Dierurus adsimilis</i>	19	0.056	-2.887	0.161	5.572
5	Little Brown Dove	<i>Streptopelia senegalensis</i>	8	0.023	-3.752	0.088	2.346
6	Asian Koel	<i>Eudynamys scolopaceu</i>	2	0.006	-5.139	0.030	0.587
7	Rose Ringed Parakeet	<i>Psittacula krameri</i>	8	0.023	-3.752	0.088	2.346
8	Grey Tit	<i>Parus major</i>	3	0.009	-4.733	0.042	0.880
9	Grey Shrike	<i>Lanius excubitor</i>	7	0.021	-3.886	0.080	2.053
10	Bullock Oriole	<i>Icterus bullockii</i>	2	0.006	-5.139	0.030	0.587
11	White Breasted Kingfisher	<i>Halcyon smyrnensis</i>	4	0.012	-4.446	0.052	1.173
12	Little Green Bee Eater	<i>Merops orientalis</i>	8	0.023	-3.752	0.088	2.346
13	Asian House Martin	<i>Delichon dasypus</i>	3	0.009	-4.733	0.042	0.880
14	Common Babbler	<i>Turdoides caudata</i>	4	0.012	-4.446	0.052	1.173
15	Thrush	<i>Turdidae</i>	4	0.012	-4.446	0.052	1.173
16	Blacksmith Lapwing	<i>Vanellus armatus</i>	1	0.003	-5.832	0.017	0.293
17	Wild Pigeon	<i>Columbalioia</i>	4	0.012	-4.446	0.052	1.173
18	Common Hoopoe	<i>Upupa epops</i>	1	0.003	-5.832	0.017	0.293
19	Chiffchaff	<i>Phylloscopu s collybita</i>	4	0.012	-4.446	0.052	1.173
20	Sindh Woodpecker	<i>Dendrocopos assimillis</i>	1	0.003	-5.832	0.017	0.293
21	Common Swallow	<i>Hirundo rustiea</i>	3	0.009	-4.733	0.042	0.880
22	Warbler	<i>Parulidae</i>	7	0.021	-3.886	0.080	2.053
23	Wag Tail	<i>Motacilla alba</i>	2	0.006	-5.139	0.030	0.587
24	Collared Dove	<i>Streptopelia decaocto</i>	8	0.023	-3.752	0.088	2.346
25	Robin Magpie	<i>Copsychussaularis</i>	1	0.003	-5.832	0.017	0.293
26	White Eared Bulbul	<i>Pycnonotus leucotis</i>	7	0.021	-3.886	0.080	2.053
27	Indian House Sparrow	<i>Passer domesticus</i>	28	0.082	-2.500	0.205	8.211
28	House Swift	<i>Apus affinus</i>	6	0.018	-4.040	0.071	1.760
29	kite	<i>Milrus migrans</i>	25	0.073	-2.613	0.192	7.346
30	Humming Bird	<i>Trochillidae</i>	8	0.023	-3.752	0.088	2.331
31	Indian Roller	<i>Coracias benghalensi s</i>	2	0.006	-5.139	0.030	0.587
32	Purple Sunbird	<i>Cinnyris asiaticus Latham</i>	16	0.047	-3.059	0.144	4.692
33	Cattle Egret	<i>Bubulcusibis</i>	7	0.021	-3.886	0.080	2.053
34	Red Wattled Lapwing	<i>Vanellus indicus</i>	4	0.012	-4.446	0.052	1.173
35	Spotted Owlet	<i>Athenebrama</i>	3	0.009	-4.733	0.042	0.880
36	Bank Myna	<i>Acridotheres gingianus</i>	12	0.035	-3.347	0.118	3.519

H=3.024

ternational airlines had to bear heavy financial losses. type of Assistance of reduce wildlife Hazards i.e consultation regarding wildlife issues, Training of airport personnel, wildlife Hazard Assessment, wildlife Hazard Management Plan, Environmental Assessment.

Following index was applied during calculation of diversity index in rainfall and cloud cover:

Shannon diversity index:

$$H = \sum_{i=1}^s \text{pilog}(\text{pi})$$

Table 2. Shannon Diversity Index

Index Value	Diversity
<1.5	Low diversity
<2.5 —>1.5	Medium Diversity
>2.5	High Diversity

Where:

H = Shannon Index

Pi = Proportion of each ith species

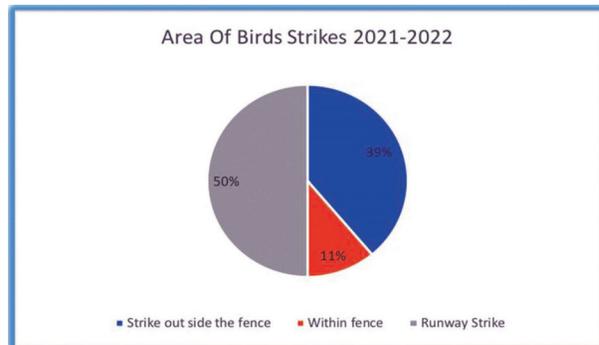
S = Number of species in a community i = Constant

Log = Natural Logarithm

BIRD/ANIMAL HIT DATA 2022

LOCATION: BKIAP PESHAWAR

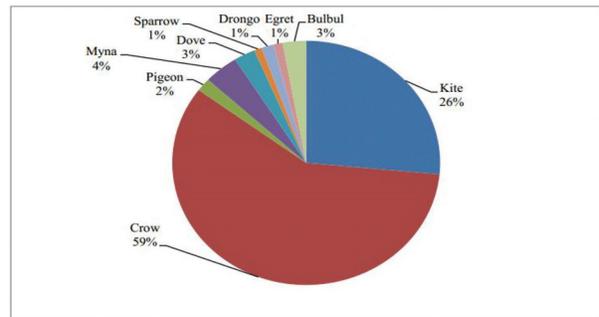
Date of Occurrence	Flight No.	A/C Type	Arrival/Departure	On the Runway	Within the Fence	Outside the Fence	Damages to Aircraft/Effect on flight if any	Remarks
YEAR 2022								
10-01-2022	PK-283	A-320	Departure	After take off			No damage	Suspected
12-04-2022	SV-792	A-330	Arrival	During landing			No damage	Confirmed
06-05-2022	PK-284	A-320	Arrival			Outside the fence	No damage	Suspected
08-05-2022	SEP-1852	A-330	Arrival			Outside the fence	No damage	Suspected
Note: Total Birds/Animals Hits = 02 On Runway = 02 Within Fence = 00 Outside the Fence = 02								



BIRD/ANIMAL HIT DATA FROM JANUARY 2021 TO DECEMBER 2021

LOCATION: BKIAP PESHAWAR

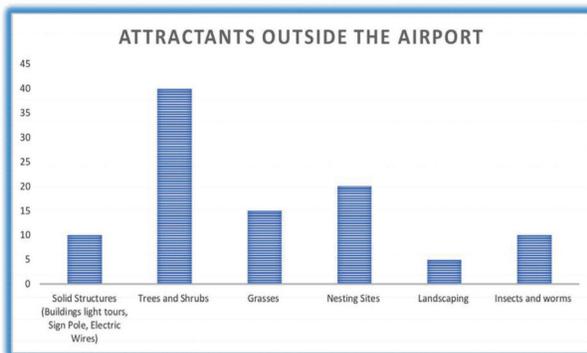
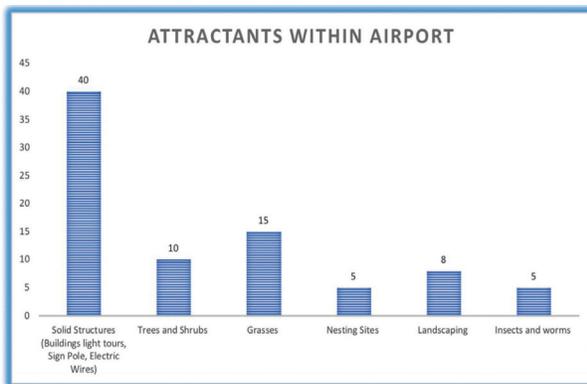
Date of Occurrence	Flight No.	A/C Type	Arrival/Departure	On the Runway	Within the Fence	Outside the Fence	Damages to Aircraft/Effect on flight if any	Remarks
YEAR 2021								
27-01-2021	PK-217	A-320	Departure	After take off			No damage	Confirmed
20-03-2021	QTR-68G	A-320	Arrival			1000 feet down the runway	No damage	Confirmed
05-04-2021	GFA-785	A-320	Departure	After take off			No damage	Suspected
25-04-2021	ABY-555	A-320	Arrival	During Landing			No damage	Suspected
05-05-2021	ABY-554	A-320	Arrival	During Landing			No damage	Confirmed
01-07-2021	PK-218	A-320	Arrival	During landing			No damage	Confirmed
03-07-2021	PK-218	A-320	Arrival			Short final runway-35	No damage	Confirmed
17-07-2021	SIF-151	A-320	Arrival	During Landing			No damage	Confirmed
14-08-2021	SAV-793	B-777	Departure			200 feet after take off	No damage	Suspected
04-09-2021	ABY-554	A-321	Arrival			Short final runway-35	No damage	Suspected
09-09-2021	PIA-234	B-777	Arrival	During landing			No damage	Confirmed
21-09-2021	PK-285	B-777	Departure	Take off roll			No damage	(Porcupine hit)
25-11-2021	EK-636	B-777	Arrival	During Landing			No damage	Suspected
29-11-2021	ABY-864	A-320	Arrival			During landing runway-25	No damage	Confirmed
Note: Total Birds Hits = 13 Animals Hits = 01 On Runway = 07 Within Fence = 02 Outside the Fence = 03								



Population of Crow and Kite increased at the days of Eid Ul Azha

Conclusion

The current study was conducted to gather information about the population assessment of birds around the airport. The data of this paper could support civil aviation authority for devising an effective and sound bird strike control program and measures to mitigate bird strike risks. This information could be incorporated to develop bird species management planning. The current status of data on bird strikes is deficient in Pakistan. Furthermore, meteorological factors should be assessed. The area mostly favorable for bird activities due to greenery, food resources birds are seen flying above the airport. Such increase in numbers can be high potential reason for bird strikes further research work should be carried out to know the similarities and findings. Lack of public awareness is also an issue. There is also a dire need to develop an accurate and reliable database on bird airstrikes. All strikes should be reported, and the species struck should be properly documented for instance information on altitude of strikes those that occurred at approach or climb. Present study focuses on the results of factors that attract birds within the area of Bacha Khan International airport at its close proximity. This Study sug-



gested series of measures that can encounter acts that caused attractiveness generated by the environmental factors (Natural & Anthropogenic). The implementation of aforementioned measures may contribute to the considerable reductions of bird's hazards. But for maintaining of habitats around the runway and in airport surroundings requires cooperation's and involvements of Airport administration, District and concerned Wildlife Department. During the analysis the Relationship of birds with the living environment noticed with many natural and anthropogenic factors (High tree vegetations, High grass, different Constructions) that generate favorable living conditions for birds and determine the temporary or longer presence of birds in the study area. Many of birds showing a high degree of adaptability to the environmental conditions marked by an increased in anthropogenic impacts.

Recommendations

- Currently Bacha Khan International airport management Is using Crackers as a preventive measure as told by Mr. Alamgir Security and vigilance officer, but other methods should be focused which include avian radar, sonic, light on aircraft and adjustment of flight timing
- There is a dire need for the creation of vacancies of forestry/wildlife biologists, ornithology professionals in Bacha khan international airport to study wildlife hazards directly.
- Forest & wildlife department should conduct avian survey minimum once in a year.
- Civil aviation authority and wildlife department should work in close co-ordination and should take joint measures to control wildlife hazard including monitoring, record keeping, procedure for wildlife control during different season.
- Civil aviation authorities should constitute a wildlife hazard working group consisting of members from the communities, forest & wildlife department, airbase, students, district administration and other non-governmental organizations.
- Identification of features near Bacha khan international airport through GIS and remote sensing, the features are; wetlands, ditches, agriculture, forested/shrub areas, infrastructure etc.
- Environmental impact assessment and various ecological studies should be conducted annually.
- Bird strike advisory system should be used.
- The Management plan of forest and wildlife department should reflect the habitat improvement of avian biodiversity at Bacha khan international airport.
- There is need of multisensory drone detection system, laser/visual methods, acoustics should be used to restrict bird's entry.
- Bird hazard control committee should be engaged in quality research activities in order to know bird strikes elevation points.
- Survey should be conducted to know the population density of insects, rodents, reptiles as they are a source of hazards around the airport premises.
- Penalties should be imposed on people domesticating pigeons around the airport.
- Further research is required to know the seasonal variations in bird strikes.
- Management practice should be intensified and information drawn from this study could be incorporated in birds control practice.
- Through habitat management air fields should be made unattractive for birds in order to avoid unwanted situation of bird strikes.
- Where particular plants and seeds within airport area are seen to attract birds and other animals need to removed and replaced by other plant varieties.
- Management of grasses and trees should be done timely before exceeding the prescribed heights to discourage unnecessary bird arrival.
- A comprehensive wildlife hazard management action plan should be fully designed and implemented with full effect to minimize risk of animal collision with aircrafts.
- The use of trained predators/visual repellents of bird species should be considered to scare birds.
- Metrological factors should be assessed to correlate its affect over Bird Strike.
- Various actions are required from district administration to ensure garbage disposal, cleaning around the airport during Eid Ul Azha.
- Thinning of trees.
- Small mammals and reptiles may not constitute direct threat to aircraft, however their presence are carcass when killed by aircraft they attract other large animals creating hazards to aircraft (Engeman et al, 2007)

Air force and civil aviation authority are using their full efforts for the monitoring of birds present around aerodromes; birds hazard preventive pro-

gram requires an inventory on birds. Different qualitative programs may be used to overcome this problem by reducing the number of birds in aerodromes.

Acknowledgment

The Authors would like to express their sincere gratitude to Wildlife department KPK for sponsoring this research work under project titled "TEN BILLION TREE TSUNAMI PROJECT (10BTTP) Wildlife Component". And to Mr. Alamgir Civil Aviation authority for special guidelines and provision of secondary information.

References

- EASA. Bird population trend and their impact of aviation safety 1999-2008.
- Dolbeer, R.A., Begier, M.J., Miller, P.R., Weller, J.R. and Anderson, A.L. 1990-2018. Wildlife Strikes to civil Aircrafts in the United states.
- Merchant et al. (1990), Milsom (1990), Pomeroy and Hepner (1992), Hild (1995), Demarchi (1996), Ferns (1996), Seubert (1996), Vantets (1996), Primus and Furcolow (1997), Hahn (1997), Dolbeer et al., 1998), Hild and Muentze (2000), Baxter (2001), Hild (2002), Burma (2003) Hild and Morgenroth (2004), Hahn (2004) and Martin et al. (2011) on roosting of birds near air fields and their effect on air craft flights safety.
- Ferns, P.N. 1996. Monitoring bird's activity on British airfields. *Vogel und Luftverkehr* Bd.2/96:47-56.
- Baxter, A. 2001. Gull movements in Europe (Part of the evaluation of bird control techniques on landfills sites). NWET Ltd. Trust news issue.8:7-10.
- Burma, L.S. 1998. Long grass surveillance radars as indicators of birds numbers. *Vogel und Luftverkehr*. Bd.1-2/98:107-122.
- Hahn, B.K. 2004. The natural environmental features of the air field of Holzdorr and measures for bird strike prevention. *Bird and Aviation*. 24: 1:68-73.
- Hild, J. and Morgenroth, K. 2004. The significance of habitat structure and vegetation for the prevention of bird strikes at Friedrichshafen Airport. *Bird and Aviation*. 24: 1:15-19.
- Marchant, J.H., Hudson, R. Carter, S.P. and Whittington, P. 1990. Populations trend in British breeding birds. British trust for ornithology Hertfordshire.
- Milsom, T.P. 1990. Lapwings *Vanallus vanallus* on aerodromes the birds strike hazards. *Ibis*. 132:218-231.
- Pomeroy, H. and Hepner, F. 1992. Structure and turning in airborne Rock Dove *Columbia livia*, flocks near airports. *The Auk*. 190:2:256-267.
- Dolbeer, R.S.P. and Escherfelder. 2003. Amplified birdstrike risks related to population increase of large birds in North America.
- Richardson, W.J and T. West. 2000. Serious bird- strike accidents to military aircraft.
- Khan, A.A. 1998. Air accidents in spite of high efficiency. DEF. J. (Pak.), Aug. 1998 issue. Godin, Alfred J. "Birds at airports." (1994).
- Buckland, S.T., 2006. Point-transect surveys for songbirds: Robust methodologies. *Auk*. 123: 345-357. <https://doi.org/10.1093/auk/123.2.345>
- Rawat, S.N., and Rao, R.J., 2020. Urban bird diversity of Sheopur city, north Madhya Pradesh, India. *UttarPradesh J. Zool*. 41: 1-9.
- Grimmett, R., Roberts, T. and Inskipp, I. 2008. *Birds of Pakistan*. Christopher Helm. London. pp. 258.