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ESTIMATION OF BIRD POPULATION IN SURROUNDINGS OF SELECTED AERODROMES OF KARACHI WITH REFERENCE TO BIRD STRIKES

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ABSTRACT

Roosting in birds is a common phenomenon in Avian Biology. Roosting behavior includes the mode, timing, duration, distance, ecological and seasonal patterns which are topics of primary consideration for the naturalists and avian ecologists. One of the aspects of the bird roosting is its hazardous effects on the airfields. In Pakistan a number of accidents have occurred every year as a result of bird collisions with aircraft. This is of concern for the aircrafts. Some accidents have caused damage to civilian aircrafts as well in Pakista and the present study is undertaken with special reference to three aerodromes in Karachi. Reporting of the wildlife collisions with aircraft is recorded all over the world.. According to the literature, collision between the birds and aircrafts are known to cause substantial loss in the avian industry in terms of damage and delay every year. The existing information reveals that the changes in the bird population around airfield should be noted. The relationship between the bird abundance and strike frequency is complex and the changes in bird number coincide with changes in strike frequency. In the present study 47 species of birds have been recorded with their seasonal occurance data which pose a great threat to aircrafts during Flight, Landing and Take Off. 44 species of flora were recorded which play an important role in providing nesting and roosting areas for avifauna. Globally, bird strikes have been of great safety concern. It is expected that proposed research would advance knowledge about the roosting of birds and methodologies to turn the airport into safe areas.

Keywords: Avifauna, population estimation, aerodromes, birds strike.

INTRODUCTION

A bird strike is a collision of a bird and an aircraft which is in flight or on a takeoff or landing roll. In the last 10 years, the rate of collisions between birds and aircrafts have increased. The first bird strike fatality was recorded in 1912, when Cal Rodgers, who flew across USA, lost his life after a gull became jammed in the controls of his aircraft. The problem of birds strike is worldwide and it has received attention of scientists when it became hazardous for flight. Large flocking birds are considered to be the greatest threat to aircraft among the different types of birds that are commonly involved in the collision with aircrafts.

The increasing concentration of predatory birds near big airports in the country is a matter of concern to all involved in aviation. Birds such as Gulls can travel upwards of 30 miles each day from feeding to roosting sites and commute regularly between breeding colonies and landfills during the breeding season (Horton *et al*., 1983). Airports are attractive for birds as habitat, food sources, and temporary stays or just as loitering area. Bird hazard has become a significant problem to aviation in modern times throughout the world. The birds involved in collision with aircrafts are of many species ranging in size from smaller than a sparrow to larger than a vulture. These problems vary from country to country and often from one aerodrome to another. During the years 1985 and 1999 the United States Air force recorded more than 38,000 bird strikes resulting in costs of more than 500 million dollars (Weitz, 2000; Dolbeer and Escherfelder, 2004).

Thrope (1996) reported that collision between birds and air crafts can have catastrophic consequences and have resulted in the loss of at least 190 lives and 52 aircrafts in civil aviation in United Kingdom. Parr (l968) has reported that birds that fly in groups or lines cross the approach and departure paths of aircrafts and thus pose a serious

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risk to aircraft flight safety. In another study, Richardson and West (2000) stated that there have been 283 military aircrafts losses and 141 deaths recorded in western nations between 1985 and 1999. Demarchi and Searing (l996), Dekkar (l996), Herzog (l997), Jackson and Brown (1998) and Dekkar (2000) have reported the hazardous effects of roaming of birds at airports as well. Hild (2002) reported that airports attract large numbers of birds primarily because they offer immense tracts of foraging and nesting habitats free from the threat of predation.

Due to advancement in technologies during the last decade, the collision rates have increased. This is due to high speeds and lower noise levels in aircrafts that makes it difficult for birds to detect them. Several studies were conducted by Sugg (1965), Meads and Carter (l973), Major and Dill (1978), Mudge and Fems (1982), Horton *et al*. (l983), Merchant *et al*. (l990), Milsom (l990), Pomeroy and Hepner (1992), Hild (1995), Demarchi (1996), Ferns (l996), Seubert (l996), Vantets (l996), Primus and Furcolow (l997), 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.

In Pakistan no significant report has been published on bird strike hazard. But concerned Air Force and Civil aviation authority are hoping to find the solution to this problem. The objective of the present work is to study the hazards of bird strikes around some airfields of Karachi. This included the monitoring of birds present around aerodromes, their threats and effects on aircraft and the methods to prevent these birds by using-Birds Avoidance

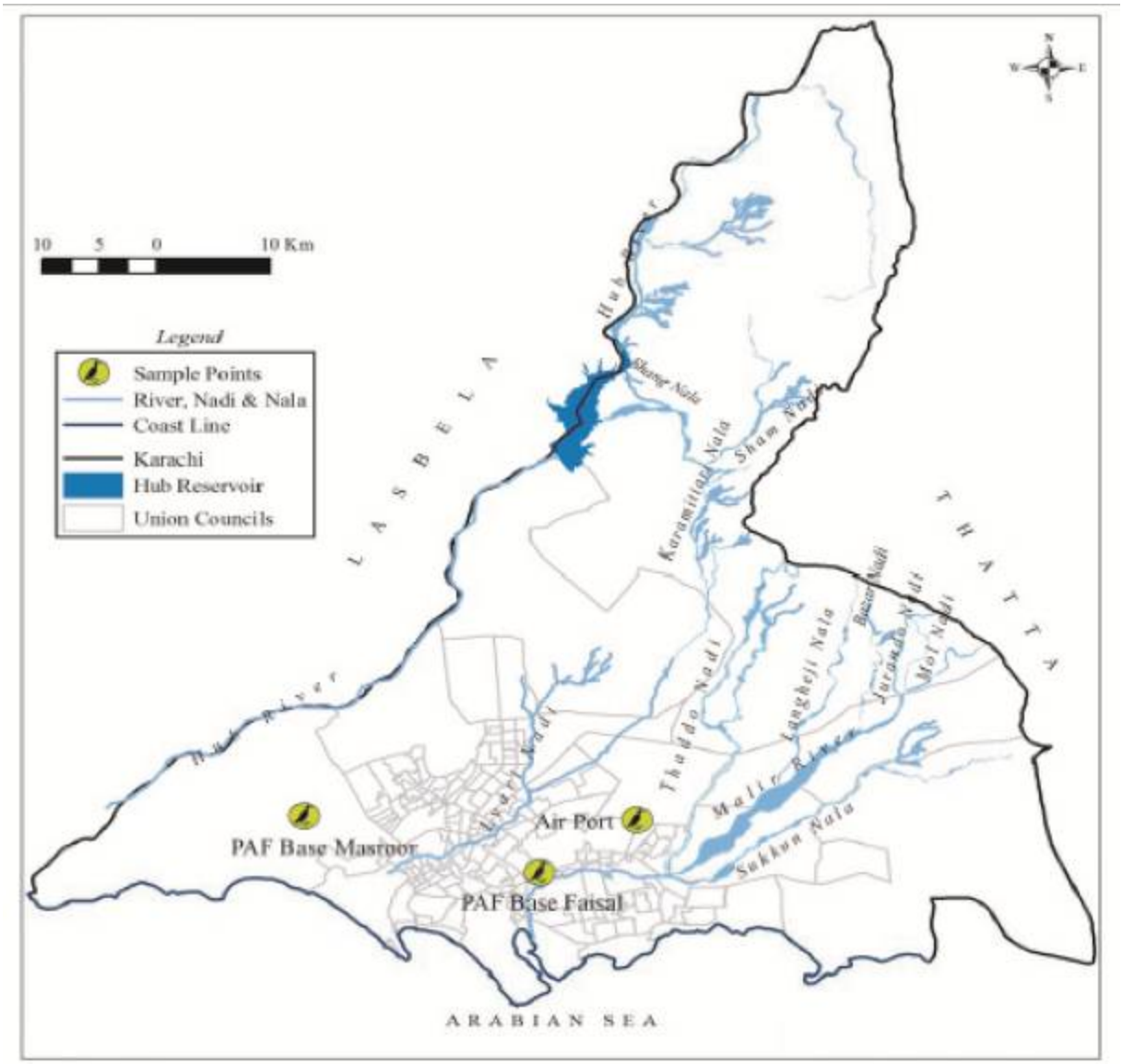

Fig. 1. Map of Karachi with study areas.

models. Several surveys have been done around three major airfields of Karachi namely Masroor Airbase, Faisal Airbase and Jinnah Terminal Airport to monitor the number of species and movement of birds around these airfields.

Bird hazard prevention program requires an inventory on Birds and mammalian species present in that environment. The good methodology to identify the problem birds is by identifying their ruminants which are found on effected aircrafts. Different qualitative programs can be used to overcome this problem by reducing the number of birds in aerodromes through repellents.

MATERIALS AND METHODS

During the present study several surveys were carried out to some particular airfields of Karachi. Geographic latitude of Karachi is 24° 48' N, while Geographic longitude is 66° 59' E and Altitude of Karachi is 4 m. Airfields selected for survey included Masroor Airbase, Faisal Airbase and Jinnah Terminal Airport (Fig. 1). Masroor Airbase is the largest Airbase situated near Maripoor Karachi with large number of bird's population and is affected by Bird strike problem. Boundaries of Masroor are attached with Baldia town, Manghoopeer and Mahajer camp. Two main gates open to the outside are Shershah gate and Shumali gate. Faisal Airbase is located adjacent to Shahrah-e-Faisal Karachi, while Jinnah Terminal is situated near Malir District. Different census techniques were adopted for counting the number of birds and their behavior was observed on regular basis.

Techniques used for census of birds

Bird count methods which were used around aerodromes included "Total counts" and "Sampling estimates". In the former category preliminary population size assessment studies of endangered birds were included.

i). Total counts

Total counts included Heronry counts and Territory mapping. Birds like Egrets, Herons, and Storks were counted by heronry count method. The count time was kept constant during heronry count because the total population of the adult birds fluctuates during the course of the day. This is due to their local foraging or nest material collection flights. Heronry count method included the estimation of total population size (roost count); as well as number of nests.

ii). Sampling estimation

This method included the counting of birds as and when encountered. This method depends on encounter rate (sighting per km) and call index. In this method roost count was also adopted in which total number of birds arriving at the roost were counted. This method is assumed much more accurate than encounter rate method. Binocular with power of 999980 XS were used for spotting the birds some distance away or high up in the sky. Climatic conditions such as temperature, .humidity and topography of those areas were monitored regularly. Direction of wind was also observed on regular basis.

Many plants samples were also collected from those airfields and surrounding areas for identification of species and preserved. They were sent to Botanist for further identification. Personal transport facility was used when performing surveys around the Jinnah terminal airport. Force officials provided transport facility for surveys conducted in and around air force basis. Interviews from bird shooting staff were taken to get information on the movement and behavior of birds near and around runways.

Many experiments were arranged to note any changes in habits of birds according to time, weather and environmental conditions. These experiments include the introduction of scare crows techniques, production of noises from many different devices including shooting sounds from air guns and fire crackers. It also includes application of many different chemical repellents and sometimes poisons.

Methods used for Avoiding/ Repelling birds near runways

i). Trapping: Trapping is an old traditional method to minimize the number of birds (Shake, 1968). Different types of nets can be used like mist net and canon nets (Hardman, 1974; Draulans, 1987; Beg, 1990), Some different traps can also be used like Pole-traps, Funnel traps and cage traps. Some bird's samples were also collected from the bird shooting staff to identify and evaluate the causes of their strike with air craft.

ii). Live ammunition-shooting

Ammunition shooting is also an important technique which has been used in most of aerodromes now a days. Shooting technique has limitations as it kills some birds but others are frightened and move away but come back after some time (Heighway, 1970; Backpoel, 1976; Harrison, 1986). Shooting process can be facilitated by some noise generating devices or distress calls which helps to repel birds (Cooke-Smith, 1965; Mason, 1980; Harrison, 1986).

iii). Water spray technique

Water sprays and other moistening agents can also be used as bird repellents (Harke, 1968; Smith, 1970; Lustick, 1976). It includes Water Cannons and Sprinkle systems. Water sprays can kill birds during extreme cold weather conditions when wet feathers will become lethal for birds. A sprinkler or water spray system is useful as a method of keeping birds away from runways (Spear, 1966).

iv). Scarecrow techniques

Different devices were also used to scare birds away from airfields were placed near runways, Gas canons type bird repellent system were also used, fire crackers, and lethal or non lethal frightening devices were also used to repel birds away from runways. Bioacoustics bird scaring techniques were also used including the alarm and distress calls by using speakers of 30 to 40 watts. Data on the number and species of birds was collected to study their population and behavior (Table 5 and 6). Their breeding and nesting grounds were identified. Some available remains of struck birds were also collected to identify their species and to investigate the nature of the strike.

Identification of bird remains

The sample of bird collected after a bird strike is a highly damaged sample and mostly available in small pieces. Many different techniques has been used for cleaning and purification of feathers before observing them under microscopes .Various grades of Alcohols have been used for removing impurities from them. Washing of feathers has been done with Triton X-100, followed by passing it through different grades of Alcohols, Fresh dry acetone was used for further treatment and finally Air drying technique was used. HMDS (Hexa Methhyl Di Salazan) was also used for further treatment. The HMDS treated samples were mounted along with the alcohol cleaned samples and were examined for comparison.

Attractants for birds were also observed inside and around the airfields to detect the reasons for their presence in those areas. Monitoring of the movement of birds on runways during takeoff and landing of planes were done.

Frequency and day periods

The study areas were visited at different times .mostly in early mornings and in evenings It was noted that large number of birds comes outside for feeding and roaming in early morning and in late afternoon In mid afternoon .the frequency of the movement of birds is low due to high temperature.

RESULTS AND DISCUSSION

Karachi is a type of land with several kinds of principal vegetation which are dominant for providing the best roosting habitat for many species of birds. The present study has covered the effects of climatic conditions on their roosting behavior, including the environmental temperature, humidity, and precipitation rate and wind direction. Flora and bird fauna of three major airfields i.e. Masroor Airbase, Faisal Airbase and Jinnah Terminal Airport Karachi were also observed. The maximum mean temperature recorded 30.4 in the year 2008, 35.2 in 2009 and 32.9^{o}C in 2010. The mean minimum temperature recorded 21.2 in the year 2008, 35.5 in 2009 and 35.5^{o}C in 2010.

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During the study more than 100 samples were collected and 45 species of plants from the study sites were identified (Table 1).

Table 1. Principal Vegetation in and around vicinity of Aerodromes.

S. No.	Species
1.	*Abutilon* sp.
2.	*Acacia modesta*
3.	*Acacia nilotica*
4.	*Aerva javanica*
5.	*Amaranthus viridis*
6.	*Aristida adseensionis.*
7.	*Bougainvillia glabra*
8.	*Caesalpinia bonduc*
9.	*Capparis deciduas*
10.	*Chloris barbatus*
11.	*Chloris virgata*
12.	*Cleoma viscose*
13.	*Cocculupendulus*
14.	*Commicarpus boissieri*
15.	*Convolvulus pluricaulis*
16.	*Conyza canadensis*
17.	*Crotolaria burhia*
18.	*Cyperus rotundus*
19.	*Eclipta prostrata*
20.	*Euphorbia caducifolia*
21.	*Haloxylon recurvum*
22.	*Heliotropium glameratus*
23.	*Heliotropium subulatum*
24.	*Indigofera cordifalia*
25.	*Lantana camara*
26.	*Lasiurus hirsutus*
27.	*Maerua arenaria*
28.	*Moria exotica*
29.	*Pluchea barbatus*
30.	*Prosopis juliflora*
31.	*Pupalia lappacea*
32.	*Ruellia longifolia*
33.	*Saccharum munja.*
34.	*Salsola imbricata*
35.	*Samania samon*
36.	*Schweinfurthia papilionacea*
37.	*Setaria verticillata*
38.	*Sida indica*
39.	*Sporobolus arabicus*
40.	*Suaeda fruticosa*
41.	*Tamarix dioica*
42.	*Tribulus terrestris*
43.	*Vinca rosea*
44.	*Zizyphus mauritiana*

Following birds were identified on the basis of information available from bird strike remnants and from

own visual observations of bird movement at some particular aerodromes. The birds were grouped into three broad functional categories namely as, I. Soaring birds, II. Non-soaring birds and III. Ground birds.

I. Soaring Birds

The characteristics method of flight of these birds is to ride on upward air currents. Thermal bubbles forming over sun heated ground surface cause most of the upward air currents in the plain while hill slopes provide additional updrafts in the hilly terrain. Soaring birds are highly specialized for gliding and take to powered flapping flight only when updrafts are too weak, or for specific purpose. Pilots usually come across these birds from low elevations to as high as about 1.5 km or even more, but some species also come down and settle on runways in air fields.

Description and species identification of some soaring birds which were present in or around the vicinity of selected aerodromes is as follows:

Neophron percnopterus **(Scavenger or Egyptian Vulture)**

The Egyptian Vulture (*Neophron percnopterus)* is a small Old world vulture, the only member of the genus *Neophron.* Egyptian Vultures are scavengers, mainly feeding off carrion, but they also prey on small mammals and eggs. It feeds soft tissues of carcasses, and also takes tid bits from primitive tanneries and slaughter houses, and from city garbage dumps, including human excrement. Apart from soaring on thermals along with larger vultures and other birds of prey .the scavenger vulture also occasionally comes down to airfields to pick up dead insects or small animals.

Milvus migrans **(Black kite or Pariah Kite)**

The Black Kite (*Milvus migrans)* is a bird of prey. It feeds on fish, household garbage and carrion as food stuff. It is a widespread species in Eurasia. Major population of Black Kite resides in city areas. It is the soaring bird and mostly found in soaring conditions on the thermal waves over densely populated city areas. They dive in the air to capture the pray from the roads often leads to vehicle strike. Because of its greater population and big size it poses a serious threat to aircrafts.

The Black Kite nests in forest trees, often close to other kites. In winter, many kites will roost together. Pariah kite is easily identified by its forked tail and dark brown plumage. It feeds off kitchen scraps, as well as tids bits at garbage dumps, primitive tanneries and butcheries besides taking insects and dead rats. This bird is regularly attracted in large numbers to uncovered garbage bins in airfields. Apart from soaring on thermals at high elevations it also quarters very low using any other available air currents, and also frequently settles on runways. Thus at many Pakistani airdromes, the pariah kite poses a problem to aircraft from ground level to higher altitudes most of the day.

Butastur teesa **(White eyed Buzzard Eagle)**

It is a medium sized hawk found in South Asia. White eyed Buzzard Eagle resembles a pariah kite in general appearance, but is distinguished by smaller size and a shorter tail without fork. A prominent white throat divided along the middle by a black stripe, and bright white eyes are conspicuous features. It usually sits vertically on poles and trees, and makes occasional short flights showing its pale shoulders. During breeding season, pairs often soar high up in the sky. It feeds on insects and small mammals.

Pernis ptilorhynchus **(Crested Honey Buzzard)**

It appears long-necked with a small head, and soars on flat wings. It has a long tail and a short head crest. It is brown above and paler below. There is a dark throat stripe.

It is a large bird of prey, somewhat heavier than the pariah kite and distinguishable in flight by its extra broad wings and two distinctly blackish stripes on either under wing. This bird feeds on honey and bee hives without itself being harmed by the bees .It is not a gregarious bird and one usually does not come across more than two or three at any airfield. But its frequent soaring flights over the airfields makes it a likely hazard for aircraft at odd times.

Gyps bengalensis **(White-rumped Vulture)**

Bald head, broad wings and short tail are the identifying features of this bird. Neck ruff is Whitish in coloration. Adults has whitish back, rump while Juveniles are in darker shades. It is a social bird, mostly present in flocks. Due to its scavenger habit, it mostly depends on dead organisms and their carcasses.

II. Non Soaring Aerial Birds

Birds included in this group do not depend on thermals or air currents for aerial movement but usually perform powered flight by flapping the wings. Consequently these birds can be seen flying over airfields through the day and if nocturnal, at night. Non soaring birds usually remain at lower elevations except for long distance flights, particularly on migration.

Corvus splendens **(House Crow)**

It is a highly social bird, living in colonies. Forehead, crown, throat and upper breast are blackish in coloration, Lower parts are grey to white in color. The wings, tail and legs are black.

Corvus macrorhynctuis **(Jungle Crow)**

The Jungle Crow is all black, has a stouter beak, and is also slightly larger than House Crow in size. They often

roost within airfields when suitable trees are present. Crows are a problem at certain airfields particularly for an hour around sunset and sunrise when they cross the runways in loose flocks flying towards or away from their roosts or sleeping quarters.

They are regularly attracted to airfields when insects flushed out during grass thinning operations and to uncovered garbage. Crows also descend on runways in large numbers during the monsoon to pick up insects.

***Egretta gularis* (Western Reef Heron)**
It is a coastal bird with a colonial habit. It forms colonies with many other wading birds. Clutch size is two or three eggs. They use their feet to collect their food from shallow waters. Fish, crustaceans and mollusks are major part of their food.

***Psittacula krameri* (Roseringed Parakeet)**
Rose-ringed Parakeets are very social birds mostly kept as pets. They are sexually dimorphic. Dark black markings under beaks are present in males and a dark band of colors around their necks is the main identifying characteristic.
Like crows, this species too has become a potential hazard at certain airfields at sunrise and sunset when they fly towards or away from their roosts in vast numbers.

***Acridotheres tristis* (Common Myna)**
Dark brown body with large white wings are the identifying characteristics of this bird. It has a dark grey head and bare skin around the eyes and bright yellow colored legs Sexual dimorphism is not clear. It is Omnivorous and mostly depends on the insects for food.

The common Myna is a familiar bird at many Pakistani aerodromes though not often seen in large numbers .This and related birds including the bank myna, the pied myna and certain other starlings gather in thousands in tall vegetation within or near certain airfields for roosting and pose problems to aircrafts at sunrise and sunset. They also fly in small flocks across the runway almost throughout the day. Though small mynas and starlings can be very dangerous when they fly in the flocks.

***Columba livia* (Blue Rock Pigeon)**
This occurs mostly as a feral from regularly nesting within the aerodromes in buildings and frequently flying in small dense flocks low over runways throughout the day. Though the pure form is bluish grey, generations of domestication and selective breeding have produced all sorts of plumage variations including the white, the brown, and the mottled varieties. Apart from feral pigeons those kept by pigeon fanciers near airfields also form potential hazard to aircraft as these often encroach into the approach and climb paths of aircrafts.

***Bubulcus ibis* (Cattle Egret)**
Short thick bill and buff back are main identifying characters. It is a colonial bird mostly available on water bodies along with other wading birds. Clutch size is 1-5 eggs. It is named as Cattle Egret because of its availability near Cattle farms, mostly present in riding conditions on cattles. It mostly feeds on insects and their larvae. Breeding birds acquire beautiful golden brown feathers on the head, neck, and over the back. Egrets visits airfields sometimes in large numbers to feed upon insects flushed in grass thinning operations. These birds also thrive on maggots at city garbage dumps and primitive tanneries. Cattle egrets often stay in flocks and can pose a problem to aircraft at takeoff and landing.

***Haliastur indus* (Brahminy Kite)**
Chestnut plumage, white head and breast and black wing tips are the identifying characteristics of this bird. It is a scavenger.

***Passer domesticus* (House Sparrow)**
Unstreaked lower parts and black streaks on the back are major identifying characters. A large yellowish bill in males while gray bills is present in females.

The House Sparrow, though very small in size, often moves in flocks and hence can cause some damage to jet engines. Being omnivorous the sparrow is easily attracted in large flocks over airfields where insects or grass seeds are plentiful .It may also flock into the airfield for roosting in suitable trees.

***Apus affinis* (House Swift)**
They are black except for a white rump, the white extending on to the flanks. They have a short square tail. The house swift is smaller than the sparrow, but usually occurs in flocks and might be of some significance when many are ingested together by jet engines. It nests and roosts in large numbers under roof domes, archways, rock overhangs etc., and can be regularly seen flying over some airfields catching small insects in flight.

***Hirundo daurica* (Red Rumped Swallow)**
They depend on insects. Clutch size is 3-6 eggs. They have broad wings and mostly nest in buildings.

***Pterocles orientalis* (Black-bellied Sandgrouse)**
It is a small bird with compact body. Wings are elongated. Under wings are white. Belly is black.

***Streptopelia decaocto* (Eurasian Collared Dove)**
It is a colonial species, present in flocks. It depends on cereals and grains as food material.

***Bubo bubo* (Eurasian Eagle Owl)**
It feeds on rodents and other small mammals. It is largest species of owls.
Ear tufts are clearly visible.

***Coracias garrulus* (Eurasian Roller)**
It is bluish in color. It depends on large insects, lizards and frogs for feed. Bright blue coloration with black flight feathers is the main identifying character.

***Coracias benghalensis* (Indian Roller)**
Brown back, lilac breast and face, and blue crown, wings, tail and belly are the main identifying characters. This is a common bird which depends on lizards and frogs and insects as food material.

***Dendrocopos assimilis* (Sindh woodpecker)**
It is a common species which act as a forest pest, making holes in stems and damaging trees in nearby areas of aerodromes.

***Delichon urbica* (House Martin)**
Steel-blue coloration, a white rump, and white lower parts are the identifying characters. Bill is black. It depends on small insects and larvae

***Dicrurus macrocercus* (Black Drongo)**
Blue-black coloration is present on body while wings are duller in color. The tail is long and deeply forked, white spot in front of the eye. It depends on insects and small rodents as food.

***Pycnonotus cafer* (Red-vented Bulbul)**
Brown or black upperparts, a white rump, brown or black breast are the main identifying characters. Lower parts are white with red coloration around the vent. It feeds on insects and their larvae. Some time it also sucks nectar from flowers.

***Larus argentatus* (Herring Gull)**
It is mostly found near garbage dumps and sometimes near coastal areas. White upper parts and grayish lower parts are identifying characters. Ground birds spend most of their time on ground. They mostly travel on runways and disturb flights during landing and takeoff. These birds are the serious risk to aircraft during taxi of these planes as well.

Ill. Ground Birds
***Francolinus francolinus* (Black Partridge)**
Black coloration with reddish brown patches and white spots on the body are main identifying characters. It is a game bird mostly hunted for meat. It poses a risk to aircrafts during taxi and landing on runways.

***Alectoris chukar* (Chukar)**
Light brown back, grey breast, and buff belly are the main identifying characters. Legs are reddish in coloration. It feeds on seeds, grains and small insects.

***Coturnix coturnix* (Common Quail)**
Brown streaks with white base are main identifying characters .Males have a black chin. It feeds on seeds and insects on the ground. It is mostly found hidden in a camouflage manner.

***Hoplopterus malabaricus* (Yellow-wattled Lapwing)**
Pale brown waders, black crown, yellow facial wattles are main identifying characters. Lower parts and tail are whitish in coloration. It mostly feeds on insects and small invertebrates.

Roosting of birds around air fields has been hazardous for aircrafts (see Figs. 2-8). It results in severe damage, high cost losses and high risk for the air passengers. Along with the developing technologies of high speeds and lower noise levels in aircrafts, the risk for bird strike has increased.

The problem of bird destruction on aerodromes appears usually after each serious bird strike. Some aerodromes specialist consider the bird destruction on aerodromes to be the fastest and most effective way of bird strike prevention. Hundreds of birds are known to have been destroyed by shooting, trapping and use of chemical substances in the area of aerodromes.

In the present study it was observed that many nesting areas of birds were present in the vicinity of aerodromes which attracted birds for roosting and nesting. Large variety of trees, shrubs and woodlots were also present (Table 1).

Water ways, Natural ponds, Water fountains and Sewage sludge were also seen. Many different species of Rodents were also present which attract bird of prays (Table 2). Garbage dumps were also present in the surroundings of aerodromes. They play a very important role in attracting birds for foraging purpose especially *Milvus migrans* (Table 2).

Table 2. Different Aerodromes habitat and available food sources for wildlife surviving in those areas.

S. No.	Attractants and Food Sources
1.	Agriculture Croplands
2.	Animal remains/Carcass
3.	Apiaries
4.	Aquatic Vegetation
5.	Canals
6.	Base Waste
7.	Culverts
8.	Drainage Ditches
9.	Earthworms
10.	Feeding Birds and Mammals
11.	Flat roof for Nesting birds
12.	Fishing from shore (Bait, Fish)
13.	Garbage dumps
14.	Insects

S. No.	Attractants and Food Sources
15.	Landscaping
16.	Litter
17.	Low areas
18.	Land fills
19.	Marshes, Swamps
20.	Mudflats
21.	Nesting sites for Crows, Eagles, Vultures, Egrets, Raptors etc
22.	Sewage Ponds
23.	Pastures, Grasslands ,Livestock, Rodents, Raptors etc.
24.	Plouging, Cultivation, Haying, Harvesting etc (Rodents, Insects, Worms)
25.	Reptiles, Amphibians, Fish
26.	Reservoirs, Natural ponds
27.	Retention ponds
28.	Rodents ,Rabbits, Hares, Foxes, Porcupines
29.	Roosting Vegetation (Starling, Crows, Egrets)
30.	Sand and gravel quarries, Borrow pits
31.	Seed producing Vegetation
32.	Sewage Lagoons
33.	Sewage Outfalls
34.	Sewage Sludge
35.	Shorelines
36.	Structures (Buildings, Hangers, Lights, Towers, Signs, Poles, etc)
37.	Trees, Brush, Shrubs, Woodlots
38.	Water ways
39.	Water fountain
40.	Weeds

Aerodromes habitat are important attraction for different birds because of presence of agriculture crops, damage ditches, landfill, marshes, swamps, mudflats, retention, ponds, sewage lagoon and roosting vegetation. Different nesting sites also facilitate the accommodation of birds around of aerodromes. Plough practices have also been observed in vicinity of aerodromes. Cultivation, haying and harvesting also favors the settlement of birds in such areas (Table 2).

Table 3. Birds control techniques around or in the vicinity of Aerodromes.

S. No.	Removal Techniques
1.	Scare Crow and Cattle Guards
2.	Chemical repellent sprayed on Vegetation
3.	Fencing
4.	Herding
5.	Pyrotechnics
6.	Rodent resistant sheathing on electrical and communication cables
7.	Control hunting
8.	Nest destruction
9.	Fumigants
10.	Kill trapping
11.	Live trapping and relocation
12.	Rodenticides (Mice, Rats, Ground Squirrels etc.)
13.	Shooting
14.	Tranquilizing and relocation
15.	Poison baiting

Different Deter and Dispersal techniques of birds are in practice in all these aerodromes including chemical repellent sprayed on vegetation, Fencing, Hunting and Den destruction. Fumigants and Gas cartridges has been used for control of birds and small mammals. Shooting and poison baiting is also common (Table 3). Different toxicants can be used like sodium floroacetate. Starlicide and strychnine alcholoids for killing the uncontrolled population of birds while some frightening agents like aminopyordine can be useful to repel Starlings, House sparrows, Pigeons, Doves and Gulls (Table 4). Caithness (1984) reported the details of poising operation aimed at eliminating a breeding colony of the southern gull. Some poison bait were introduced in their breeding colonies which disrupted their breeding cycles. Crespo (1984) preformed practical observation on falconry as a bird's deterrent method on airports. Hild (1984) studied the use of falcons for scarring birds. They used trained falcons that chase birds to repel them away from aerodromes. Kull (1984) proposed a bird avoidance model for military low level flights in USA. Bird Aircraft strike hazard team developed a computer generated bird avoid model (BAM). The model is based on bird's migration data along with longitudes and latitudes of all military low level routes.

In the present investigation it was noted that major species which is present in vicinity of aerodromes is *Milvus migrans* (Black Kite). Largest number of members of Black Kite were seen during each visit. This bird has become highly populated and continuously increasing in numbers in Karachi because of availability of open garbage dumps as well as strong resistance abilities of these birds toward extreme environmental condition (Table 5).

Different bioacoustics and electronically generated noises (e.g. Av-alarm) can also be used as a scaring device. Distress calls and predator sounds were also used to frighten birds near aerodromes. Beuter and Weiss (1986) discussed the effectiveness of sound signals for scaring birds away from feeding area. Kelly (1999) discussed the possibility of shooting birds in bird control operation as an aid in the range of making the airport area unattractive to the birds or dispersing birds from airports. Long Grass Regime has also been a wide spread and successful tool in

Table 4. Pesticides used to Birds control.

Chemicals	Conc.	Product Form	Species effected
Toxicants			
Sodium flouroacetate	0.3%	Powder	All
Starlicide	0.1%	Dry grain bait	Starlings
Strychnine alcholoid	0.6%	Dry grain bait	Pigeons and House Sparrows
Frightening Agents			
4- Aminopyridine	0.3%-0.5%	Dry grain bait	Starlings, House Sparrows, Pigeons, Gulls, Doves
Chemosterilants			
Ornitrol	0.1%	Dry bait	Pigeons
Repllents and Aversive Agents			
Naphthalene	100%	Flakes	Pigeons, House sparrows, Bats and Swallows
Immobilizing Agent			
Alphachlorolose	0.6%	Dry powder	Pigeons, crows

Table 5. Bird populations in and around airfields of Karachi in 2008.

S. No.	Scientific Name	Common Name	Number of birds observed in Jan. 2008	Number of birds observed in Mar. 2008	Number of birds observed in May 2008	Number of birds observed in Jul . 2008	Number of birds observed in Sep.2008	Number of birds observed in Nov.2008	Number of birds observed in Dec.2008
1	*Bubulcus ibis*	Cattle egret	13	13	7	5	7	6	6
2	*Egretta gularis*	Reef Egret	15	15	11	15	4	8	6
3	*Egretta alba*	Large Egret	17	19	9	10	5	10	8
4	*Ardea cinerea*	Grey Heron	16	14	16	13	7	15	6
5	*Ciconia ciconia*	White Stork	6	21	7	16	3	5	8
	Ciconia nigra	Black Stork	16	14	6	4	5	8	4
7	*Pernis ptilorhyncus*	Creasted honey Buzzard	12	16	13	12	13	8	11
8	*Milvus migrans*	Black Kite	110	93	60	115	82	102	82
9	*Haliaster indus*	Brahminy Kite	61	88	40	43	0	18	46
10	*Neophron percnopterus*	Egyptian Vulture	2	3	2	0	1	0	0
11	*Gyps benagalensis*	White backed Vulture	1	0	0	0	2	0	1
12	*Butastur teesa*	White eyed Buzzard	18	35	9	7	8	13	15
13	*Alectoris chukar*	Chukar	52	76	28	31	28	25	19
14	*Francolinus francolinus*	Black Partridge	28	87	29	37	26	28	25
15	*Francolinus podicerianus*	Indian grey Partridge	19	14	27	37	21	45	29
16	*Coturnix coturnix*	Common Quail	42	51	20	17	26	22	24
17	*Pterocles orientalis*	Imperial Sandgrouse	15	22	16	16	4	3	13

Continued

Table 5 continue…

S. No.	Scientific Name	Common Name	Number of birds observed in Jan. 2008	Number of birds observed in Mar. 2008	Number of birds observed in May 2008	Number of birds observed in Jul . 2008	Number of birds observed in Sep.2008	Number of birds observed in Nov.2008	Number of birds observed in Dec.2008
18	*Pterocles lichtensteinii*	Close barred Sandgrouse	12	43	11	1	1	2	5
19	*Columba livia*	Rock Pigeon	86	125	67	73	82	103	71
20	*Streptopelia decaocto*	Indian ring Dove	52	77	34	41	54	48	35
21	*Streptopelia orientalis*	Oriental turtle Dove	47	57	28	29	35	37	32
22	*Psittacula krameri*	Rose ringed Parakeed	65	77	44	44	73	66	42
23	*Eudynamys scolopacea*	Common Koel	35	61	42	39	32	40	2
24	*Tyto alba*	Barn Owl	3	1	2	1	1	1	0
25	*Bubo bubo*	Northern Eagle Owl	1	4	1	2	2	2	3
26	*Caprimulgus asiaticus*	Little Nightjar	33	31	10	7	7	9	17
27	*Coracias benghalensis*	Indian Roller	19	9	40	30	21	12	10
28	*Coracias garrulous*	Eurasian Roller	12	31	14	10	6	7	10
29	*Upupa epops*	Hooppoe	57	62	63	59	44	31	47
30	*Dendrocopos assimilis*	Sind Woodpecker	17	35	6	8	20	34	4
31	*Hirundo daurica*	Red-rumped Swallow	6	35	15	12	10	9	9
32	*Delichon urbica*	Common house Martin	21	27	10	6	16	15	5
33	*Pycnonotus leucogenys*	White-cheeked Bulbul	23	22	11	15	3	4	4
34	*Pycnonotus cafer*	Red vented Bulbul	26	42	16	8	11	12	11
35	*Corves splendens*	House Crow	113	120	92	90	73	90	114
36	*Corves macrorhynchos*	Jungle Crow	17	10	6	7	8	6	5
37	*Acridotheres tristis*	Common Myna	38	42	48	25	50	53	43
38	*Passer domesticus*	House Sparrow	117	174	55	41	133	122	63
39	*Dicrurus macrocercus*	Black Drongo/King Crow	22	10	11	14	23	14	17
40	*Chloropsis hardwickii*	Orange bellied Leaf Bird	18	12	7	10	15	14	10
41	*Rostratula benghalensus*	Painted Snipe	34	69	36	19	9	12	36
42	*Pluvialis dominica*	Eastern golden Plover	25	23	19	15	26	10	16

Continued…

Table 5 continue…

S. No.	Scientific Name	Common Name	Number of birds observed in Jan. 2008	Number of birds observed in Mar. 2008	Number of birds observed in May 2008	Number of birds observed in Jul . 2008	Number of birds observed in Sep.2008	Number of birds observed in Nov.2008	Number of birds observed in Dec.2008
43	*Hoplopterus malabaricus*	Yellow wattled Lapwing	13	48	15	8	19	24	21
44	*Larus canus*	Common Gull	39	13	25	21	11	41	42
45	*Larus argenttatus*	Herring Gull	23	44	40	10	20	10	7
46	*Apus pallidus*	Pale brown Swift	19	61	8	35	45	25	17
47	*Apus affinis*	House Swift	27	22	15	19	24	35	23

Table 6. Bird populations in and around airfields of Karachi in 2009.

S. No.	Scientific Name	Common Name	Number of birds observed in Jan. 2009	Number of birds observed in Mar. 2009	Number of birds observed in May 2009	Number of birds observed in Jul . 2009	Number of birds observed in Sep.2009	Number of birds observed in Nov.2009	Number of birds observed in Dec.2009
1	*Bubulcus ibis*	Cattle Egret	14	11	46	14	8	13	3
2	*Egretta gularis*	Reef Egret	6	19	9	12	1	5	6
3	*Egretta alba*	Large Egret	4	8	33	14	3	2	9
4	*Ardea cinerea*	Grey Heron	11	14	53	13	4	6	8
5	*Ciconia ciconia*	White Stork	10	16	40	23	9	8	10
	Ciconia nigra	Black Stork	11	16	45	26	1	1	4
7	*Pernis ptilorhyncus*	Creasted honey Buzzard	10	41	44	31	2	7	7
8	*Milvus migrans*	Black Kite	81	63	58	31	84	54	44
9	*Haliaster indus*	Brahminy Kite	27	15	41	25	1	13	11
10	*Neophron percnopterus*	Egyptian Vulture	13	2	2	19	0	0	0
11	*Gyps benagalensis*	White backed Vulture	11	1	2	0	1	0	1
12	*Butastur teesa*	White eyed Buzzard	16	10	53	4	6	1	0
13	*Alectoris chukar*	Chukar	15	78	71	27	35	18	13
14	*Francolinus francolinus*	Black Partridge	22	24	25	10	20	9	7
15	*Francolinus podicerianus*	Indian grey Partridge	27	11	72	8	13	7	6
16	*Coturnix coturnix*	Common Quail	18	11	73	22	30	49	53
17	*Pterocles orientalis*	Imperial Sandgrouse	29	13	79	6	6	19	1
18	*Pterocles lichtensteinii*	Close barred Sandgrouse	11	15	15	13	8	6	0

Table 6 continue…

S. No.	Scientific Name	Common Name	Number of birds observed in Jan. 2009	Number of birds observed in Mar. 2009	Number of birds observed in May 2009	Number of birds observed in Jul . 2009	Number of birds observed in Sep.2009	Number of birds observed in Nov.2009	Number of birds observed in Dec.2009
19	*Columba livia*	Rock Pigeon	53	109	70	51	47	35	23
20	*Streptopelia decaocto*	Indian ring Dove	45	30	95	19	30	9	7
21	*Streptopelia orientalis*	Oriental Turtle Dove	35	26	37	6	14	19	1
22	*Psittacula krameri*	Rose ringed Parakeed	46	52	58	37	16	18	18
23	*Eudynamys scolopacea*	Common Koel	36	53	90	18	20	10	18
24	*Tyto alba*	Barn Owl	24	2	3	2	3	1	0
25	*Bubo bubo*	Northern Eagle Owl	14	2	0	2	7	2	2
26	*Caprimulgus asiticus*	Little Nightjar	9	19	15	3	4	4	8
27	*Coracias benghalensis*	Indian Roller	13	48	33	10	6	2	9
28	*Coracias garrulous*	Eurasian Roller	9	13	7	5	8	9	2
29	*Upupa epops*	Hooppoe	89	40	92	16	10	12	11
30	*Dendrocopos assmilis*	Sind Woodpecker	62	44	56	8	5	1	7
31	*Hirundo daurica*	Red rumped Swallow	8	51	15	3	15	9	6
32	*Delichon urbica*	Common House Martin	9	51	15	7	14	17	10
33	*Pycnonotus leucogrnys*	White cheeked Bulbul	49	34	11	1	4	20	12
34	*Pycnonotus cafer*	Red vented Bulbul	39	54	12	8	12	9	7
35	*Corves splendens*	House Crow	144	203	191	78	44	46	31
36	*Corves macrorhynchos*	Jungle Crow	12	36	28	9	8	7	11
37	*Acridotheres tristis*	Common Myna	31	130	133	33	21	32	13
38	*Passer domesticus*	House Sparrow	149	48	209	46	16	42	36
39	*Dicrurus macrocercus*	Black Drongo/ King Crow	9	29	16	4	6	9	8
40	*Chloropsis hardwickii*	Orange bellied Leaf Bird	12	44	97	8	5	11	10
41	*Rostratula benghalensus*	Painted Snipe	14	55	15	4	1	3	13
42	*Pluvialis dominica*	Eastern golden Plover	40	34	39	7	6	7	3
43	*Hoplopterus malabbaricus*	Yellow wattled Lapwing	13	60	11	9	10	3	6

Table 6 continue…

S. No.	Scientific Name	Common Name	Number of birds observed in Jan. 2009	Number of birds observed in Mar. 2009	Number of birds observed in May 2009	Number of birds observed in Jul . 2009	Number of birds observed in Sep.2009	Number of birds observed in Nov.2009	Number of birds observed in Dec.2009
44	*Larus canus*	Common Gull	26	37	28	22	6	21	26
45	*Larus argenttatus*	Herring Gull	15	30	7	11	3	9	4
46	*Apus pallidus*	Pale brown Swift	16	14	11	6	5	18	2
47	*Apus affinis*	House Swift	12	30	25	3	7	4	1

Fig. 2. Bird strikes cause damage of aircraft windscreen. (Source: http://www.birdstrikenews.com).

the prevention of airfield bird strike. Food will not only be inaccessible but also less available to birds.

According to present investigation, *Milvus migran* (Black Kite) is the major species present in these selected sites and because of its bigger size, it poses a serious risk to Aircrafts during takeoff and landing conditions. *Milvus migran* is also called a garbage bird because it is attracted to garbage dumps. By reducing the number of garbage dumps the population of *Milvus migrans* can be controlled.

Before present study, no scientific data has been reported about the population and status of Avifauna in major Aerodromes of Karachi. Hopefully, this study will serve as a baseline for further research and future management plans for making our aerodromes safe from the bird Hazards.

Fig. 3. A bird strikes to a windscreen. (Source: http://www.metronews.ca/).

Fig. 4. An aircraft engine survived after a bird strikes in Central America. (Source: http://www.aviacrews.blogspot.com/).

Fig. 5. A bird strikes to helicopter in front side. (Source: www.blogs.usda.gov).

Fig. 6. A bird strikes to aircraft front side. (Source: www.abc.net.au).

Fig. 7. A bird strikes to front side of aircraft. (Source: www.expressjetpilots.com).

Fig. 8 Bird strikes seriously to a military aircraft. (Source: www.ww2aircraft.net).

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