Nepal Journal of Science and Technology 9 (2008) 119-130

Bird Mobility and Their Habitat at Tribhuvan International Airport, Kathmandu

Bhagawan R. Dahal[1] and Dinesh R. Bhuju[2]
[1]*Biodiversity Conservation Center*
National Trust for Nature Conservation
Sauraha, Chitwan, Nepal
[2]*Nepal Academy of Science and Technology, Khumaltar, Lalitpur*
GPO Box 3323, Kathmandu, Nepal
e-mail : dineshbhuju@gmail.com

Abstract

A study was carried out to prepare a baseline information on bird species and their dynamics at the Tribhuvan International Airport, Kathmandu. A considerable part of TIA contains grassland. A survey around the airport recorded 59 plant species, majority were berbs (57.6%) . Adjacent to the airport, patches of bamboo and other trees were noticed. Based on 144 observation days during Jan-Dec 2001, the study listed 35 bird species visiting TIA, majority were residential type including scavengers. Species richness varied between 23 (January) and 14 species (August). Thirteen species were regular visitors such as dark kite and house crow. During the observation period of three hours each day afternoon, 95 birds were seen in average. The number was high in the western part of the airport which was extended to residential area. More birds were found flying from the west to the east part of the airport. Seasonally, the highest number of birds visiting TIA was in winter (133 individuals). A comparative study at a dumping site indicated that there was a close affinity between bird number/movement and waste disposal.

Key words: bird strike, bird movement, seasonal variation, waste disposal

Introduction

Large open space in the aerodromes provide suitable habitat for birds. Human activities such as waste disposal add attraction to the birds specifically the scavengers. The increased population of birds and their mobility in the airport pose threat to aircraft safety. Since the first recorded air-crash due to bird-hit in 1912 (WWF India 2000), the air traffic has increased substantially with an increased threat of aircraft-wildlife collision. Today, the threat is world-wide and the magnitude and severity of such strike is becoming more obvious. (Dolbeer & Eschenfelder 2003) reported 16% increase in the number of wildlife strikes in 2000 compared to 1990 in the United States. Between 1990 and 2000, the Federal Aviation Administration (USA) recorded a total of 34,370 aircraft-wildlife strikes.

Globally, wildlife strikes have killed more than 400 people and destroyed over 420 aircraft (Dolbeer 2001). Some of the recent examples of bird strikes are: Dhaka (Aug 20, 1998), Lyon (Dec 10, 1998), Calgary (Jul 1, 1999), Reykjavik (Jul 9, 1999), Tel Aviv (Jul 28, 1999), London (Sep 9, 1999), Istanbul (Jan 1, 2000), Kigali (Apr 20,000), Los Angeles (Aug 2000), Dakar (Sep 1, 2000), Warsaw (Sep 7, 2000), Kathmandu (Oct 12, 2000). In a period between 1990 and 2000, USA reported 34,370 wildlife strikes to civil aircraft of which 97.4% were bird strikes (Clearly *et al.* 2002). A few of the wildlife strikes were fatal, example Anchorage (Sep 22, 1995), Eindhoven, the Netherlands (Jul 15, 1996).

Nepal noticed a series of bird strikes in 2000 when at least six aircraft averted near fatal incidents at the Tribhuvan International Airport, Kathmandu in a short span of time between September and October. However, there had been occasional reports on such strikes in the Nepali air in its five-decade old aviation history. Although none of the incidents were fatal, the civil aviation industry was severely affected by the incidents of 2000 during which at least 31 fights were delayed (Table 1). Some of the international airlines even threatened to halt their regular flights for a few days.

Table 1. Bird hazards reported at Tribhuvan International Airport, Kathmandu

Hazard type	1998	1999	2000	2001
Bird hit reported	5	3	10	0
Flying delayed due to bird movement	10	17	31	13
Dead bird reported on run-way	10	6	9	10

Source: Ground Flight Safety Division, TIA, 2002

Nepal (area: 147, 181 sq. km.), in the southern slope of the Himalaya, has unrivaled topography with diverse climatic and altitudinal zones. These geographical diversity contribute to 35 different forest types which harbor about 6,000 species of vascular plants, over 179 species of mammals, 180 species of fish, and 635 species of butterfly. Similarly, a total of 863 birds species have been recorded (BCN Press Release 2009) including nine species protected by the law (DNPWC Act., 1973). Kathmandu valley is surrounded by hills and jungle. The migratory birds usually migrate from high altitude to lowland in winter and vice-versa in summer (Scully 1989). However, such migration is also affected by various environmental factors including solid waste disposal.

Kathmandu is fast growing city. It generates 944 cubic meters of wastes per day (KMC 2000). However, the city has yet a systematic collection of the solid wastes and their dumping. The major dumping site for Kathmandu Municipal Corporation (KMC) is outside the city and often the local people make peprotests. As there occur continued public protest against the disposal, the KMC started dumping the wastes on the banks of Bagmati and Bishnumati rivers as an emergency measure. Accordingly, the collected solid wastes from the different part of the city is poured into the large pits on the banks and are partly covered by soil. The bird species, specifically the scavengers, were found to be attracted by such solid wastes.

The main objectives of the study were to : (i) prepare a baseline information of birds visiting the Tribhuvan International Airport, (ii) analyze seasonal variation in bird species and population, establish birds movement patterns, and (iii) study bird habitat including solid waste relationship.

Methodology

Study site

The study was carried out in and around the Tribhuvan International Airport, Kathmandu (Fig 1). The airport is located about 6 km away from the city center. Very close to the airport are Bagmati river in the north and west while Manahara in the east and south. The nearest forested area is that of the Pashupatinath area in the north. Human settlements are very close to the airport and ring road, Kathmandu's busy road, also passes very close to it. Historically, the site was cattle grazing pasture land called Gaucharan. It saw the first landing of aircraft in 1949, and later developed as an airport for its spacious open area. Today, the airport is serving for both the domestic and international flights and manages a busy schedule of a flight for every two minutes.

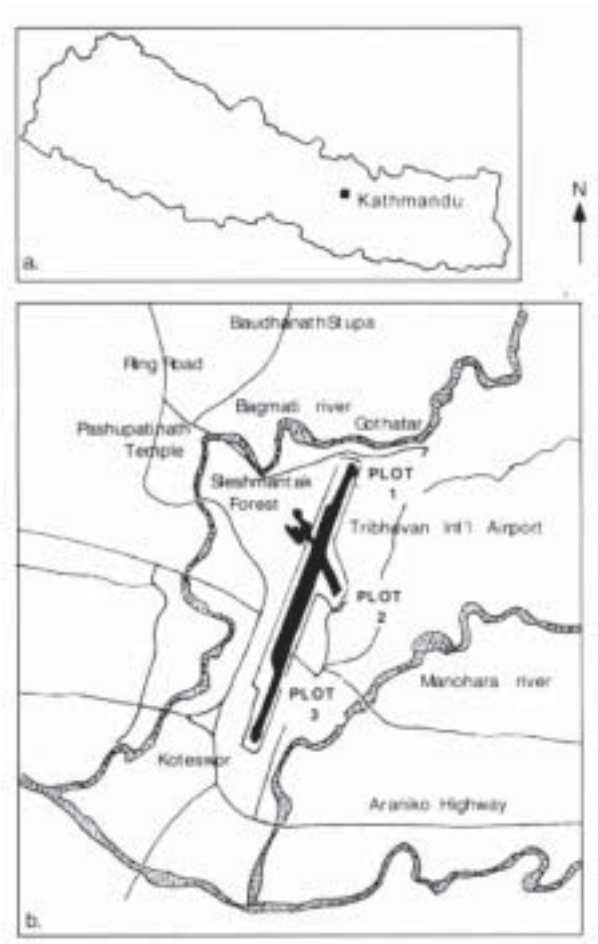

Fig. 1. a. Map of Nepal Showing Kathmandu, b. Study sites: plots 1, 2 and 3 at Tribhuvan International Airport

Kathmandu valley (area : 642 sq.km; alt : 1339 m asl) is located within 85° 22'E and 27° 42'N far from the huge water bodies and surrounded by high hills and rugged topography of varying altitudes. The Bagmati and Bishnumati are the major river systems of the valley. The valley has sub-tropical climate with high humidity, rainfall and precipitation in summer. Mean maximum temperature ranges between 20 °C in December and 29 °C in April, while the mean minimum temperature varies between 2 °C in January and 20.1° C in July. In January, the temperature falls to the lowest (-1 ⁰ C), and in April it rises to the maximum (32 °C). Rainfall is mainly by summer monsoon. Average annual rainfall of Kathmandu valley is about 1600 mm (DOHM 2001).

Observation points

The study site was first categorized into three major parts: plot-I, plot-II and plot-III. Plot I includes the urban area of Koteshwor which extends from the western end of TIA. Plot-II encompasses the central part of the runway which includes the airport tower. Plot-III is the north eastern part of the airport which reaches to the Bagmati river (Fig. 1).

To verify the relationship between bird population and solid waste disposal, a survey was also conducted at Balkhu dumping area. The number and type of bird species were recoreded at the site during and after the dumping of solid wastes for five consecutive days.

The first month of survey (January 2001) was devoted to determine the appropriate time (dawn or dusk) for bird watching in the site. Afternoon (1500-1800 hrs) was selected for the survey for two reasons: (i) the population size of birds was found greater in the evening, (ii) the winter months in Kathmandu are usually foggy to watch the birds in the morning. For general understanding by size/weight, the recorded birds were categorized into three types : (i) small (e.g., House sparrow) (ii) medium (e.g., House crow) and (iii) large (e.g., Dark kite).

Observation period

Direct count of the birds was carried out by using the binoculars. The field observation was conducted for 12 consecutive days (4 days in each plot) in the first two weeks of the month in the afternoon (15:00 – 18:00 hrs.). Thus, a total of 144 days were spent for the survey covering each month of the year 2001 except in January when the survey was conducted to determine the frequency and movement of the bird visit at the study site.

Vegetation Survey

A vegetation survey was carried out to determine the type of habitat close to the restricted area (runway) of the Tribhuvan International Airport. There was a road (about 11 km) running around the airport. For representative samplings, seven accessible plots were selected around the airport viz: (i) western end of the runway (Koteswor side), (ii) Jadibuti side-1, (iii) Jadibuti side-2, (iv) Pepsicola side, (v) Gothatar side, (vi) Tilganga side, and (vii) Sinamangal side. Major plant species-grasses, shrub and trees were noted and identified.

Results

Vegetation Type

A large part of the Tribhuvan International Airport was grassland. The vegetation survey recorded 59 plant species with herb (57.6%), trees (27.1%), shrub (11.8%), and others (3.2%) (Fig. 2, Table 2). Most frequently distributed herbs were – *Ageratum conyzoides*, *Cynodon dactylon*, *Cyperus* sp., *Bidens pilosa*, *Imperata cylindrica*. Local people were allowed to cut and collect grasses seasonally. Similarly, over 310 trees were counted around the road bordering TIA, majority (56%) of which were avenue trees such as *Eucalyptus citriodora*, *Grevillea robusta*, *Jacaranda mimosifolia*, and *Populus deltodoes*. Most remarkably, acorss the road in the eastern part of the airport, over 100 stands of bamboo clumps were observed. The religious forest patch of Pashupatinath and Gujeswori extend to the north eastern side of the airport. A large residential area could still be found at the south-east of the airport, where we counted over 600 houses.

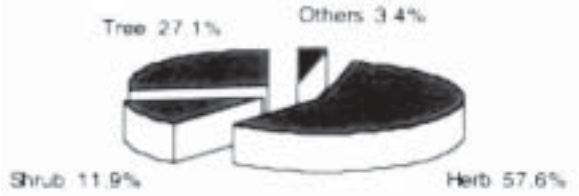

Fig. 2. Plant species recorded around Tribhuvan International Airport, Kathmandu 2001.

Table 2. List of vascular plants recorded around Tribhuvan International Airport, Kathmandu

SN	Scientific name	Nepali name	Family	Habit	Freq. %
1.	*Adiantum capillus-veneris*	Kani Unyu	Pteridaceae	F	42.86
2	*Ageratum conyzoides*	Boke Ghans	Compositae	H	71.43
3.	*Alnus nepalenis*	Uttis	Betulaceae	T	14.29
4.	*Amaranthus spinosus*	Latte	Amaranthaceae	H	14.29
5.	*Amaranthus viridis*	Latte Sag	Amaranthaceae	H	28.57
6.	*Artemisia indica*	Titepati	Compositae	H	28.57
7.	*Artemisia* sp.	Gandhe Jhar	Compositae	H	14.29
8.	*Barleria cristata*	Bhede Kuro	Acanthaceae	S	57.14
9.	*Bidens pilosa*	Kalo Kuro	Compositae	H	57.14
10.	*Bidens* sp.	Kuro	Compositae	H	42.86
11.	*Buddleja asiatica*	Bhimsen Pati	Loganiaceae	S	14.29
12.	*Callistemon citrinus*	Kalkai phul	Myrtaceae	T	42.86
13.	*Cannabis sativa*	Bhang	Cannabaceae	H	14.29
14.	*Celtis australis*	Khari	Ulmaceae	T	42.86
15.	*Centella asiatica*	Ghodtapre	Umbelliferae	H	28.57
16.	*Cirsium wallichii*	Khalvun	Compositae	H	28.57
17.	*Clerodendrum* sp.		Verbenaceae	S	14.29
18.	*Colocasia* sp.	Pindalu	Araceae	H	14.29
19.	*Cynodon dactylon*	Dubo	Graminae	H	71.43
20.	*Cyperus iria*	Mothe	Cyperaceae	H	42.86
21.	*Cyperus* sp.		Cyperaceae	H	42.86
22.	*Datura metel*	Kalo Dhaturo	Solanaceae	H	14.29
23.	*Datura stramonium*	Dhaturo	Solanceae	H	14.29
24.	*Dendrocalamusn* sp.	Bans	Graminae	B	28.57
25.	*Duranta repens*	Nil Kanda	Verbenaceae	S	28.57
26.	*Eucalyptus citriodora*	Masala	Mytraceae	T	14.29
27.	*Eupatorium adenophorum*	Banmara	Compositae	H	14.29
28.	*Ficus religiosa*	Pipal	Moraceae	T	14.29
29.	*Fimbristylis miliaceae*	Pani Mothe	Cyperaceae	H	28.57
30.	*Fraxinus floribunda*	Lankuri	Oleaceae	T	14.29
31.	*Galinsoga parviflora*	Chitlange Jhar	Compositae	H	14.29
32.	*Grevillea robusta*	Kangiyo Rukh	Proteaceae	T	57.14
33.	*Imperata cylindrica*	Khar	Graminae	H	14.29
34.	*Ipomoea aquatica*	Kalami Sag	Convovulaceae	H	14.29
35.	*Ipomoea* sp.		Convovulaceae	H	14.29
36.	*Jacaranda mimosifolia*	Jacaranda	Bignoniaceae	T	42.86
37.	*Lagerstroemia indica*	Asare Phool	Lythraceae	T	14.29
38.	*Lantana camara*	Masini Kanda	Verbenaceae	S	42.86
39.	*Melia azederach*	Bakenu/Khaibasi	Meliaceae	T	42.86
40.	*Phragmites karka*	Narkat	Graminae	H	14.29
41.	*Polygonum plebeium*		Polygonaceae	H	42.86
42.	*Populus deltoides*	Lahare Pipal	Salicaceae	T	42.86
43.	*Prunus cerasoides*	Painyu	Rosaceae	T	14.29
44.	*Prunus persica*	Aaru	Rosaceae	T	14.29
45.	*Psidium guajava*	Amba	Myrtaceae	T	14.29
46.	*Punica granatum*	Aanar	Punicaceae	S	28.57
47.	*Pyrus pashia*	Mayal	Rosaceae	T	14.29
48.	*Ranunculus* sp.		Ranunculaceae	H	14.29
49.	*Saccharum* sp.		Graminae	H	14.29
50.	*Sambucus canadensis*	Kanike Phul	Sambucaceae	S	28.57
51.	*Senecio cappa*		Compositae	H	42.86
52.	*Solanum aculeatissimum*	Kataiya	Solanaceae	H	57.14
53.	*Solanum nigrum*		Solanaceae	H	14.29
54.	*Sonchus asper*	Dudhe	Compositae	H	14.29
55.	*Sporobolus diander*	Khude Ghans	Graminae	H	14.29
56.	*Stellaria vestita*	Karna Phul Jhar	Caryophyllaceae	H	14.29
57.	*Thuja orientalis*	Mayurpankhi	Cupresaceae	T	28.57
58.	*Trifolium repens*	Pyauli	Leguminosae	H	14.29
59.	*Urtica dioca*	Sisnu	Urticaceae	H	14.29

Abbreviations: B: bamboo, F : fern, H : herb, S : shrub, T : tree

Bird dynamics in the months

In the first month of the survey (January 2001) the frequency of bird visit at dawn and dusk was determined. A total of 490 individuals of birds was observed at the evening while 435 individuals in the morning. Of the total 23 birds species recorded, House crows were highest in number whether in the evening (149) or in the morning (221). They were followed by Common myna (165 individuals in the evening and 57 individuals in the morning). During the month, a total of 27 individuals of Black kites was sighted with the largest flock size of 12 in the evening while six individuals were in the morning. Based on the results, the surveys for the remaining months were conducted in the evening.

Table 3. Recorded bird species at Tribhuvan International Airport (Jan-Dec 2001)

SN	English Name	Zoological Name	Family	Type	Size
1	Barn swallow	*Hirundo rustica*	Hirundinidae	r	S
2	Baya weaver	*Ploceus philippinus*	Ploceidae	r, s	S
3	Black bulbul	*Hypsipetes leucocephalus*	Pscnonotidae	r	S
4	Black drongo	*Dicrurus macrocercus*	Dicruridae	r	S
5	Black headed shrike	*Lannius schach*	Laniidae	r	S
6	Black kite	*Milvus migrans*	Accipitridae	r, s	L
7	Blue rock pegion	*Columba livia*	Columbidae	r	M
8	Cattle egret	*Bubulcus ibis*	Ardeidae	r	M
9	Common kestrel	*Falco tinnunculus*	Falconidae	r	L
10	Common myna	*Acridotheres tristis*	Sturnidae	r	M
11	Common stonechat	*Saxicola torquata*	Turdidae	w	S
12	House swift	*Apus affinis*	Apodidae	r	S
13	Crested serpent eagle	*Spilornis cheela*	Accipitridae	r	L
14	Eurasian tree sparrow	*Passer montanus*	Ploceidae	r	S
15	European goldfinch	*Carduelis carduelis*	Fringillidae	w	S
16	Green bee eater	*Merops orientalis*	Meropidae	r, s	S
17	House crow	*Corvus splendens*	Corvidae	r	M
18	House sparrow	*Passer domesticus*	Ploceidae	r	S
19	Jungle myna	*Acridotheres fuscus*	Sturnidae	r	M
20	Nepal house martin	*Delichon nipalensis*	Hirundinidae	r	S
21	Oriental magpie robin	*Copsychus saularis*	Turdidae	r	S
22	Paddy field pipit	*Anthus rufulus*	Motacillidae	r	S
23	Pariah kite	*Elanus caereleus*	Accipitridae	r	L
24	Pied bushchat	*Saxicola caprata*	Turdidae	r	S
25	Pied kingfisher	*Ceryle rudus*	Cerylidae	r	S
26	Red avadavat	*Estrilda amandava*	Ploceidae	r	S
27	Red vented bulbul	*Psycnonotus cafer*	Pscnonotidae	r	S
28	Rose ringed parakeet	*Psittacula krameri*	Psittacidae	r	S
29	Scaly thrush	*Zoothera monticola*	Turdinae	w, pm	S
30	Spotte owlet	*Athene brama*	Caprimulgidae	r	M
31	Spotted dove	*Streptopelia chinensis*	Columbidae	r	M
32	Steppe eagle	*Aquila nepalensis*	Accipitridae	w	L
33	White wagtail	*Motacilla alba*	Motacillinae	r	S
34	White rumped munia	*Lonchura punctulata*	Fringillidae	r, s	S
35	White-throated Kingfisher	*Halcyon smyrnensis*	Alcedinidae	r	S

Abbreviations : r : residential ; s : spring visitor; w : winter visitor; pm: passing migratory; S : small; M : medium; L : large

Table 4 . Bird species frequency at the Tribhuvan International Airport, Kathmandu

SN	Species	Remarks	Jan	Feb	Mar	Apr	May	Jun	Jul	Agu	Sep	Oct	Nov	Dec	Total
1	Black drongo	R	83.3	91.7	91.7	91.7	91.7	91.7	83.3	66.7	33.3	50.0	25.0	66.7	100.0
2	Blue rock pegion	R	83.3	75.0	83.3	100.0	100.0	91.7	33.3	100.0	100.0	100.0	50.0	100.0	100.0
3.	Cattle egret	R	66.7	33.3	8.3	8.3	8.3	33.3	50.0	50.0	16.7	33.3	16.7	58.3	100.0
4.	Common myna	R	100.0	91.7	100.0	91.7	100.0	91.7	91.7	25.0	100.0	100.0	50.0	91.7	100.0
5.	Black kite	R	100.0	91.7	91.7	91.7	91.7	91.7	41.7	25.0	16.7	16.7	50.0	83.3	100.0
6.	House crow	R	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	25.0	91.7	100.0
7.	Paddy field pipit	R	33.3	66.7	100.0	100.0	91.7	83.3	33.3	83.3	75.0	100.0	33.3	25.0	100.0
8.	Eurassian tree sparrow	R	33.3	25.0	50.0	50.0	75.0	50.0	66.7	75.0	50.0	100.0	8.3	33.3	100.0
9.	White wagtail	R	83.3	50.0	66.7	66.7	33.3	8.3	58.3	25.0	66.7	16.7	16.7	33.3	100.0
10.	House sparrow	R	-	66.7	50.0	75.0	75.0	75.0	75.0	25.0	83.3	100.0	25.0	58.3	91.7
11.	Barn swallow	R	-	41.7	58.3	66.7	91.7	100.0	33.3	8.3	58.3	91.7	25.0	50.0	91.7
12.	Pied bushchat	R	50.0	50.0	-	33.3	50.0	25.0	58.3	-	25.0	8.3	33.3	75.0	83.3
13.	Spotted dove	S	16.7	8.3	16.7	16.7	16.7	25.0	16.7	8.3	16.7	16.7	-	-	83.3
14.	Red vented bulbul	S	66.7	16.7	50.0	8.3	8.3	8.3	33.3	66.7	-	-	8.3	-	75.0
15.	Common stonechat	S	83.3	91.7	25.0	8.3	8.3	8.3	-	-	-	-	25.0	33.3	66.7
16.	Jungle myna	S	50.0	16.7	50.0	-	-	-	-	-	66.7	50.0	16.7	25.0	58.3
17.	Black-headed shrike	S	66.7	75.0	-	-	-	-	50.0	66.7	-	-	8.3	16.7	50.0
18.	White-throated kingfisher	S	-	8.3	-	-	-	-	-	-	16.7	8.3	-	16.7	33.3
19.	Crested serpent eagle	O	16.7	33.3	58.3	-	-	-	-	-	-	-	-	-	25.0
20.	Black bulbul	O	-	33.3	16.7	-	-	-	-	-	-	-	-	-	16.7
21.	Common kestrel	O	-	-	-	-	-	-	-	-	-	-	33.3	41.7	16.7
22.	Nepal house martin	O	-	-	-	-	-	-	-	-	-	-	16.7	16.7	16.7
23.	Oriental magpie robin	O	33.3	-	-	-	-	-	25.0	-	-	-	-	-	16.7
24.	Spotted owlet	O	-	-	-	-	-	-	16.7	-	-	8.3	-	-	16.7
25.	Baya weaver	O	-	-	8.3	-	-	-	-	-	-	-	-	-	8.3
26.	Green bee eater	O	-	-	-	-	-	-	8.3	-	-	-	-	-	8.3
27.	European goldfinch	O	16.7	-	-	-	-	-	-	-	-	-	-	-	8.3
28.	Common swift	O	-	-	-	-	8.3	-	-	-	-	-	-	-	8.3
29.	Red avadavat	O	33.3	-	-	-	-	-	-	-	-	-	-	-	8.3
30.	Rose-ringed parakeet	O	-	-	-	-	-	-	8.3	-	-	-	-	-	8.3
31.	Pied king fisher	O	8.3	-	-	-	-	-	-	-	-	-	-	-	8.3
32.	Scaly thrush	O	16.7	-	-	-	-	-	-	-	-	-	-	-	8.3
33.	White-rumped munia	O	50.0	-	-	-	-	-	-	-	-	-	-	-	8.3
34.	Steppe eagle	O	16.7	-	-	-	-	-	-	-	-	-	-	-	8.3
35.	Pariah kite	O	-	-	-	-	-	-	16.7	-	-	-	-	-	8.3
	Total Species		23	20	18	15	16	15	20	14	15	16	18	18	35

Note : Value 0 means less than 1; R – Regular; S – Semi-regular; O-Occasional

The total number of bird species sighted during the study period (January-December 2001) was 35 species (Table 3). At least nine species were recorded in all the months, they were: Black drongo, Blue rock pegion, Cattle egret, Common myna, Black kite, House crow, Paddy field pipit, Eurasian tree sparrow and White wagtail (Table 4). By size, the most abundant birds were that of small size (24 species, e.g., Barn swallow, Baya weaver, Black-drongo. Common stone-chat, House sparrow, Paddy field pipit) followed by medium (10 species, e.g., Bank myna, House crow, Cattle egret) and large (5 species, e.g., Black kite, Steppe eagle) (Fig. 3). All recorded bird species at TIA and Balkhu belonged to common category.

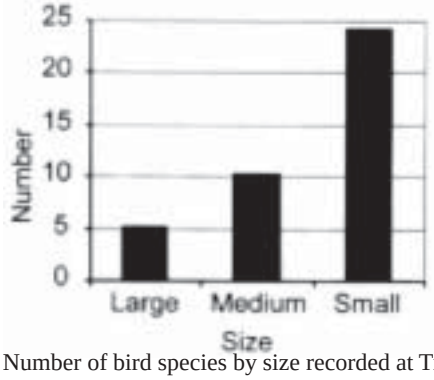

Fig. 3 Number of bird species by size recorded at Tribhuvan International Airport, Kathmandu

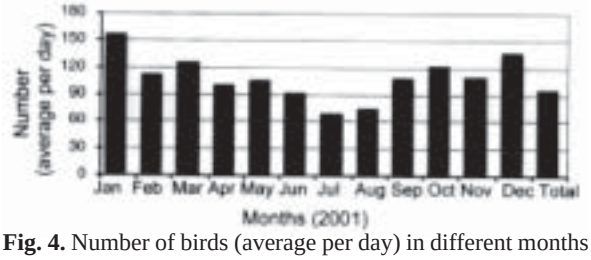

Fig. 4. Number of birds (average per day) in different months at Tribhuvan International Airport, Kathmandu

The highest number of species was observed in January (23 species), while the lowest number was in August (14 species). In average, 95 birds were counted during the observation period (each day three hours in the afternoon). The highest number of birds were seen in January (154), while the lowest number was in July (67) (Fig. 4). In each month, the number of birds were highest in the plot I with 129 in average and lowest in the plot II with 88 in average. Plot I encompasses the western part while the plot II covers the runway of the airport (Table 5).

Table 5. Bird population (average number per day) at TIA

Month	Plot I	Plot II	Plot III	Total
January	-	-	-	154
February	115	78	135	109
March	142	108	122	124
April	125	76	93	98
May	131	80	102	104
June	125	67	78	90
July	71	70	62	67
August	85	56	75	72
September	124	100	91	104
October	144	100	112	119
November	165	115	96	115
December	189	119	95	135
Total	129	88	96	95

Birds passing

Beside the standing bird survey at TIA, bird movement from east to west and vice-versa were also noted. TIA is relatively a small airport, birds were found moving from one side to other easily than staying for a long time at one site. In total, 11, 984 individuals (27.7 per hr) were sighted passing from east to west and 21,232 individuals (49.1 per hr) from west to east. The highest number of birds passing from east to west was 64.1 per in April and the lowest was 13.3 in November. Similary, the highest number of birds passing from west to east was 133.4 per hr in March, and the lowest was 25.8 per hr in November (Fig. 5).

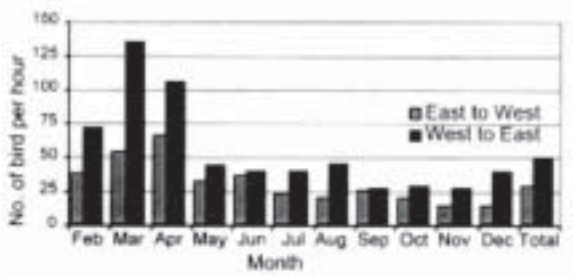

Fig. 5. Number of birds passing from east to west and west to east side of the Tribhuvan International Airport, Kathmandu

Western sector of the airport comprising Koteswor bazaar and Bagmati riverside was densely populated area while the eastern sector comprising Gothatar and Manahara River side was still agricultural land with few houses. The eastern sector extends up to Gokarna jungle towards north east. Thus, the western sector provided food stuff attracting the birds to visit in large number, while the eastern sector provided many tree species suitable for nesting and roosting. During the survey some of the trees were found hosting up to seven nests of the birds. It is assumed that the birds fly back from west to east for nesting and/or roosting after foraging in the evening.

Seasonal variation

Seasonally, the highest number of species (29 species) was observed in the winter (December-February), followed by 21 species in summer (June-August) and autumn (September-November), and 20 species in spring (March-May). Fifteen birds species including Black kite (large size bird), House crow, Common myna, Blue rock pigeon, Eurasian tree sparrow, Paddy field pipit, White wagtail, Black drongo and House sparrow were found in all four seasons. During the observation period (3 hours in the afternoon) in average 133 individuals per day were observed in the winter, followed by 110 in autumn, 109 in spring and 76 in summer season (Table 6).

In winter, a higher number of bird species was sighted which included birds such as White-rumped munia, Red avadavat, European goldfinch, Scaly thrush, Steppe eagle and Pied king fisher. These birds were recorded from Manahara Riverside in January which was not covered in the later survery. Thus, the higher number of species in winter can mainly be attributed to the survey area covered in January. The sighted birds at TIA were mostly residential type. A slight change observed in bird species diversity and

Table 6. Seasonal bird variation at the Tribhuvan International Airport, Kathmandu in 2001

SN	Species	Number of Birds			
		Winter	Spring	Summer	Autumn
1.	House crow	42	32	31	24
2.	Common myna	24	14	7	21
3.	Blue rock pegion	17	14	7	14
4.	Eurasian tree sparrow	11	9	8	9
5.	Paddy field pipit	3	12	6	10
6.	White wagtail	6	5	2	3
7.	Cattle egret	4	0	2	3
8.	Black kite	4	3	1	1
9.	Black drongo	2	2	1	2
10.	House sparrow	6	5	4	12
11.	Barn swallow	4	8	5	5
12.	Pied bushchat	1	1	0	0
13.	Spotted dove	0	1	0	0
14.	Red-vented bulbul	0	1	1	0
15.	Common stonechat	1	0	0	0
16.	Jungle myna	3	1	-	4
17.	Black headed shrike	1	-	1	0
18.	White-throated kingfisher	0	-	-	0
19.	Crested serpent eagle	0	1	-	-
20	Nepal house martin	1	-	-	1
21.	Common kestrel	0	-	-	1
22.	Black bulbul	0	0	-	-
23.	Oriental magpie robin	0	-	0	-
24.	Spotted owlet	-	-	0	0
25.	White-rumped munia	1	-	-	-
26.	Red avadavat	1	-	-	-
27.	Green bee eater	-	-	0	-
28.	Rose-ringed parakeet	-	-	0	-
29.	European goldfinch	0	-	-	-
30.	Scaly thrush	0	-	-	-
31.	Steppe eagle	0	-	-	-
32.	Pariha kite	-	-	0	-
33.	Baya weaver	-	0	-	-
34.	House swift	-	0	-	-
35.	Pied kingfisher	0	-	-	-
	Total number of birds observed	133	109	76	110
	Total Bird Species	29	20	21	21

Note : Value 0 means less than 1 ; * observation time 3 hours a day

population between various months was due to the small-size birds such as Nepal house martin, Pied dushchat and Common stonechat. Occasionally such birds were seen in large flock. The low sighting of birds in the summer can be attributed to rainfall during the period.

Sighting regularity

On the basis of sighting frequency, birds were categorized into (i) regular (seen almost everyday), (ii) semi-regular (seen at least on alternate day), and (iii) occasional (seen not more than four times during the 12 days survey). Out of 35 species recorded at TIA, 13 species were found regular visitors, 5 species were semi-regular and remaining 17 species were the occasional visitors. The regular visitors included large-size bird such Dark kite and medium-size species such as House crows (Table 4).

Feeding

On the basis of food habit, the recorded bird species at the TIA, Kathmandu were categorized into two types:

(i) scavenger; e.g., Black kite, Steppe eagle, Crested serpent eagle, and (ii) omnivorous; e.g. House crow, Blue rock pigeon, etc. The scavenger type of birds spend relatively longer time in food search, pick up small chicken from when they get chance. During the summer season, they also feed on earthworms. As the monsoon rain ceases in September, many earthworms succumb on the runway under the heat. The airport authority collected 275 kg in September and 305kg of earthworms in October (NCAA 2001).

The omnivores, on the other hand, feed both on plant seeds and fresh as well ad dead insects such as grasshopper and others. These birds were found picking earthworms on the runway as well. During the survey, a cluster of 42 crows were sighted at one spot. In addition, the omnivore birds were found feeding on the domestic wastes. They hunt on chicken viscera, bony flesh, pieces of flesh, vegetables, grains, kitchen refuses etc.

Roosting

At the adjacent of TIA, some planted vegetation, appropriate for roosting, were found. The Pashupati jungle was found as good roosting habitat for the scavenger birds. Obviously birds like Black kite, Pigeons, and House crow find safe roosting in the jungles. At the study site of TIA, Plot III is very close to the jungle of Pashupati and bamboo bushes of Gothatar. In its conformity, the birds were found passing from western side of the TIA to the eastern side.

The green belt along the ring road also supported habitat suitable for bird roosting. During the vegetation survey around the airport 71 bird nests were counted. *Populus* hosted 58 nests, some of which had as many as six nests in one tree. Crows and Mynas utilized different species of plants for their nesting purpose. Moreover, the open grass land of TIA could provide flying territory for the birds. The open area of the airport, thus, could function as a corridor between the two areas-feeding and roosting. They used the one urban area for foraging and pass to the next using the same open floor. These birds for roosting mostly used provided fencing, electric pole, telephone and electric wire at the TIA area.

Birds at dumping site

Birds were also observed and counted at Balkhu dumping site to verify the relationship between waste disposal and bird population dynamics. The result showed that mobility of the birds was found higher during dumping. Birds were bound flying over in large number to feed upon the wastes as soon as they were unloaded by the trucks. The average bird population was 139 individuals after dumping while it was 54 before dumping. A total of 52 Black kites was sighted after dumping which was over by threefold when compared to before dumping for certain area (about 500 sq m). A similar trend was seen for House crow which reached up to 60 (average number) after dumping. This kind of situation continued throughout the period during the dumping (Fig. 6)

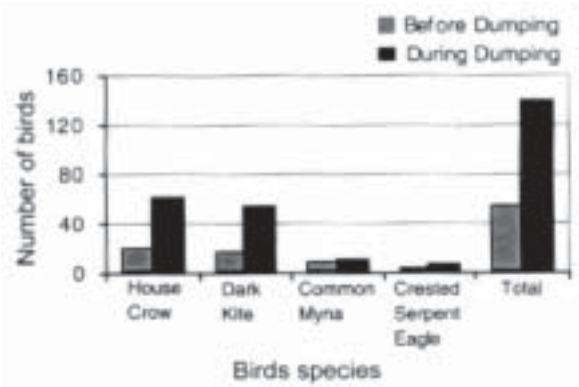

Fig. 6. Number of birds at Balkhu dumping site before and during waste dumping.

Discussion

Total bird diversity

Fleming *et al*. (1976) reported a total of 31 birds of prey in Kathmandu valley including those observed at Nagarjun forest in the western side of the valley. The reported birds of prey included 11 eagles, eight vultures, seven hawk eagles and five kites. A study conducted by BCN (1997) in Taudaha Pond in the south of Kathmandu reported 121 species which included winter visitor (44.6%), resident (27.3%), summer visitor (14.0%), and passage migrant (2.5%). A similar study reported 286 species of birds from Phulchowki, a forest area to the south of Kathmandu valley (BCN 1999). Shakya (2002) reported 35 species of frequently seen birds in Suryavinayak forest, out of which 71.4% were residential type. The forest lies in the south of Kathmandu valley.

The present study observed 35 species at ITA and nine at Balkhu, some of the species were common in the sites. Majority of the reported species included resident (71.8%), and rest included resident summer (12.8%), resident winter (5.1%), winter (5.1%), passage migrant (2.6%), and unknown (2.6%). The reported birds represented 23 families. Most of the families were represented by single species. Five birds of prey including those four reported by Fleming (1979) were found in the study sites. The species were: Crested serpent eagle, Black kite, Common kestrel, Steppe eagle and Pariah kite.

The official documents of TIA has reported visits by Scavenger vulture and King vulture at the airport (GFSD 2002). Some of the bird hit incidents such as those of 1996 at TIA, also reported the vulture as the culprit. However, our observation did not find any kind of vultures in the study sites. Bird Conservation Nepal has been conducting a study on vultures of lowland Nepal including Kathmandu valley since 1999. The study has yet to report on the visit of vulture in Kathmandu, and fears its disappearance due to some kind of infection a few years back. Hari Sharan Kazi, a reputed orinthologist, confirmed that vultures have not been observed in Kathmandu for several years (personal communication).

Seasonal variation

Monthly an average of 14.4 species were observed at TIA. However, the species richness varied between 23 and 14 species, the highest was in January (23 species) and the lowest in August (14 species). The January survey covered relatively a large area up to Manohara river bank. The sighting of birds such as European gold finch, Pied kingfisher, Scaly thrush, Steppe eagle, Red avadavat, White-rumped munia in January, therefore, could be attributed to the larger area. Seasonally, the bird species richness was highest in the winter with 29 species, while the number was 20 in spring and 21insummer and autumn. Similarly, the bird population was recorded high during the winter (133), and low in the (76). It is assumed that many birds visited TIA area seeking warm days during winter, while the rainy days prevented them to do so in the summer.

Bird population dynamics

In average, every day 95 birds were observed during the study time (3 hours). The number of the birds was lowest in July (67) which gradually increased in January (154). Majority of the months and over 100 birds (January 154, February 109, March 123, May 104, September 104, October 119, November 115 & December 135). Seasonally, the number of birds visiting TIA was lowest in summer (in average 76) and highest in winter (in average 133). In spring and autumn season, the number of the bird sighted were 109 and 110 respectively. The lower sighting of the birds in summer could partly be attributed to the rainy days during the period.

Among the three plots in the study site TIA, Plot I had the highest number of birds (128.7 in average) followed by Plot III (96.4) and Plot II (88.0). The Plot I is in the south west end of the airport and lies outside the runway, while Plot II includes the runway area. Plot III, though lies inside the airport, is at the north end of the airport and close to the forested area and river. The lower number of birds in Plot II could be attributed to the increased wildlife chasing activities such as siren, firing, noise, etc. in the runway area as safety measures applied by TIA recently.

Most of the birds were found active during morning and evening time than in the noon. It was observed that the number of large and small types of birds was slightly high in the evening (large total 29, small 93) than in the morning (large 6, small 64). However, the number was not so different for the medium (evening 368, morning 365).

Bird passing across

During study period a total of 11,984 (average 90.8 per day) passed from east to west and 21,232 (average 160.8 per day) from west to east. The highest number of such mobility was in March (total 4804; average 400.3), and lowest in November (total 929; average 77.4). This kind of bird mobility could be because of the different roosting and nesting habitat in both sides. It was noted that eastern part of the airport (Gothatar – Manhara side) contained a large roosting sites such as bamboo bushes while the western part of the airport (Koteswor – Sinamangal side) is residential and bazaar site with scattered foods. Till November 2001, there was no strict prohibition to enter the western part of the airport. Street vendors used to display their shops including food stuff here and there, and the visitors scattered wastes in the site. The counted birds during the study, therefore, could be on their way back for roosting in the eastern side after feeding at Koteswor and western part of the airport.

To understand the frequency of sighting, birds were categorized into regular, semi-regular and occasional visitors on the basis of their observation. The regular visiting birds were those which were sighted at least 10 days during the survey period of 12 days. Those sighted for five to nine days were kept under semi-regular while those sighted less than five days were categorized as occasional type. Accordingly, there were 13 regular birds including Black kite, Blue rock pigeon and House crow which have been reported as the aircraft hitters in the past. Similarly, there were five semi regular and 17 occasional bird species.

Birds and waste disposal

Kathmandu produces approximately 944 m^3 per day, and 70% of the waste is collected (Environment Department, KMC 2002). As the main source of the waste is mainly domestic, the major content of the waste is organic in nature (69.8%). The rest consists of paper, plastic, glass, inert materials and other components. Gokarna, about 10 km from TIA to the north, had been the major dumping site of Kathmandu's wastes for several years. After a huge opposition by local people, dumping was stopped at Gokarna. As a alternative Kathmandu Municipal Corporation started dumping the wastes in the banks of Bagmati river close to the airport. In the process, the bank is excavated, and is partly covered by soil after dumping the waste materials.

Waste dumping in the Bagmati river bank continued till 2000, the year which saw highest number of bird strike incidents at TIA. After a huge public pressure, the dumping site was removed but allocated at Bishnumati river bank-Balkhu. It was argued that the waste dumping near the airport could have increased the mobility of the birds, specially those scavengers, in the area. Ground Flight Safety Division of TIA (2002) reported that there were 10 bird hits and 31 flight delayed in 2000 while they were only 3 and 17 respectively in previous year. In 2001, there was no such hit and number of flight delayed was reduced to 13.

In our study at Balkhu, nine species of birds were recorded, majority of which were scavenger type such as House crow, Black kite and Crested serpent eagle. The number of the birds varied by over four times before and during the waste dumping. In a small area (about 500 m^2), we counted 138 during the as noted that a large number of birds was found hovering above the waste when the trucks brought the wastes and unloaded them. The number of some birds, however (example Common myna) were found more at TIA than at Balkhu at the same time which could be attributed to the birds' feeding habit.

It is notable that Kathmandu Municipality used to dump at banks of Bagmati river closed to western side of the airport, that is Koteswor side, was open till recently where street vendors had their shops including tea stalls, butcheries, fruit and food shops. In absence of regular waste collection and dumping system, wastes including chicken viscera, bone, food materials, etc. got scattered rampantly in the area. Sometimes, dead dogs were also found there. Similarly, Pashupati and Gujeswori temples and Sleshmantak jungle near the TIA support a large number of birds such as Pigeons, House crow, Kites and Eagles. Pilgrims and picnic makers visiting the temple throw away foods in the area. Thus, the birds are attracted by these food stuff and fly over the TIA sky en-route.

With their large open space, the aerodromes provide passage and suitable site to birds and other wildlife for foraging and strolling. Sometimes the sites serve as passage and/or corridor to the birds and other wildlife. Human activities such as improper waste disposal containing food stuff, viscera and bones in and around the airport area add attraction to the scavenging birds and other animals. The increased movement of the birds and animals in the airport increase threat to human health and aircraft safety. Therefore, baseline information on bird species and their movement becomes a prerequisite to determine the nature of problems. To address the safety issue and bird strikes, a regular bird survey and strike reports ensuring consistent data becomes necessary to carry out. Such information and data are essential for analyses critical to determine the magnitude and nature of the problems so that corrective actions can be taken.

Acknowledgement

Dr Pralad Yonzon of Resources Himalaya helped design the methodology of this project. Mr. Gokarna Khanal and Mr. Buddhi Ratna Dongol helped collect the field data, and Ms. Lipika Karmacharya assisted in report preparation. Civil Aviation Authority of Nepal is acknowledged for cooperation during the study. This research project was funded by NAST.

References

Bird Conservation Nepal. 1997. *Taudaha pond restoration project. A report to the King Mahendra Trust for Nature Conservation.* BCN, Kathmandu, 13. p.

Bird Conservation Nepal. 1999. *Bird Survey in Phulchoki forest. BCN*. Kathmandu, Unpublished check list.

Clearly, E.C., S.E. Wright and R.A. Dolbeer. 2002. *Wildlife strikes to civil aircraft in the United States 1900-2000*. Federal Aviation Administration, National Wildlife Strike Data Base, Serial Report No. 7 Office of Airport Safety and Standards, Airport Safety and Certification, Washington DC. 38 pp.

Department of Hydrology and Meteordogy. 2001. Climatological data.

Dolbeer, R.A. and P. Eschenfelder. 200.3 Amplified bird-strike risks related to population increases of large birds in North America. In : *Proceedings of the 26th international bird strike committee meeting*. Warsaw. 49-67 pp.

Fleming, R.L. Sr., Fleming, Jr. R.L. and L.S. Bangdel. 1976. *Birds of Nepal (with text & photographs)*. Nature Himalayas Kathmandu, Department of Tourism, HMG, Kathmandu.

Girl, J.B. 1996. *A study of bird's behavior in Gokarna sanitary land-fill site, Kathmandu, Nepal.* A dissertation paper submitted to Central Department of Zoology, Kirtipur, Kathmandu, Nepal 70 pp.

Grimmett, R., C. Inskipp and T. Inskipp. 2000. *Birds of Nepal*. Princeton University Press, Princeton, 287 pp.

Ground Flight Safety Division. 2001. *Activities to control birds and wildlife at Tribhuvan International Airport –a review paper*. Ground Flight Safety Division, TIA, Kathmandu, 42 pp. (In Nepali).

Kathmandu Municipal Corporation. 2000. *Solid waste management of Kathmandu*. A report prepared by Environment Department KMC, Kathmandu. 12 pp.

Shakya, S. 2002. *A bird watcher's paradise.* Suryavinayk, Bhaktapur tourism information. Bhaktapur Tourism Development Committee, Bhaktapur.

WWF India. 2002. Saving birds and aircraft. WWF *India Newsletter*, 2002: 11-12