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Ecology of Feral Pigeon (*Columba livia)* in Urban Areas of Rawalpindi/ Islamabad, Pakistan

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Abstract.- This study was designed to study the ecology of feral pigeon *(Columba livia)* in the urban areas of Rawalpindi/Islamabad, Pakistan. Seasonal changes in population density, sex ratio, age group, roosting sites, nesting sites, food and water points of pigeons were recorded in Rawalpindi/Islamabad. Higher population density of the pigeon in Islamabad was recorded in winter season followed by autumn, spring and summer season (0.13, 0.13, 0.10 and 0.09 individuals/ha respectively) whereas the higher population density of the pigeon in Rawalpindi was found in summer season followed by winter, spring and autumn (0.13, 0.11, 0.11 and 0.10 individuals/ha, respectively). The male and female sex ratio of the pigeon population confirms 1:1 sex ratio, both in Rawalpindi/Islamabad in different seasons. However, adult and juvenile numbers in the pigeon population did not follow 1:1 ratio; adults were more than juveniles in Rawalpindi/Islamabad in all seasons. The roosting sites, nesting sites, food and water points did differ in different seasons in Islamabad. Highest population of the pigeon was recorded in old buildings (0.30 individual/ha) and lowest in parklands (0.008 individual/ha). It is concluded that population density of the pigeon mainly concentrated in old buildings; roosting sites, nesting sites, food and water points used by pigeons changed with respect to different seasons.

Keywords: Feral pigeon, population density, sex ratio, age group.

INTRODUCTION

Natural habitat of the feral pigeon (*Coulmba livia*) is crevices and cracks between the bare rock cliffs however, these birds are adapted to a wide variety of habitats especially in human settled areas. The iron girders of bridges, ledges of tall concrete and brick or stone buildings are the main sources of attraction in the urban environment (Roberts, 1991; Sacchi *et al.*, 2002). Because of the risk of life and uncertain food availability in its natural habitat, they adapt to man-made structures (Haag, 1998). They are commonly found in areas having old and new buildings, bridges, roadsides, old towns, paved areas, parks, gardens, farmyards, grain elevators, feed mills and in agricultural fields. All these places vary in size, shape and condition to provide suitable habitat for the pigeon (Williams and Corrigan, 1994; Burgman and Lindenmayer, 1998; Angold *et al*., 2001). The population of the pigeon has increased worldwide in larger cities, due to the availability of variety of food, mostly due to feeding by pigeon enthusiasts, food discarded by humans, accidental food spillage, and seasonally occurring natural food (Simms, 1979; Haag-Wackernagel, 1995).

The feral pigeon populations increase by adding new individuals through birth and immigration and they decrease by subtracting individuals through death and emigration. The food resources dictate the increase, decrease or stability in populations (Haag, 1998). The populations of feral pigeon may create problems for humans in urban areas if their droppings accumulate on buildings, sidewalks, automobiles and other structures (Haag-Wackernagel, 2000). The accumulation of pigeon droppings in roosting sites may contain the pathogenic fungi, bacteria and parasites of human diseases (Weber, 1979). The management of feral pigeon in urban areas is a serious issue in various countries because the regular supply of food encourages the population of feral pigeons. This may cause problems like direct losses to structure of buildings, and the human

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health and food (Haag, 1988; Harris, 1996; Buijs and Wijnen, 2001). The cost for the cleaning and washing of pavements in Trafalgar square, London was £ 90,893 (Rs. 13,633,950) (Harris, 1996). To counter the problem scientists use different techniques to play down their population in cities (Johnston and Janiga, 1995; Haag, 1995). It is likely that information about the seasonal changes in population, their roosting sites, nesting sites, food and water points and facilitating building structures may help manage the feral blue rock pigeon population in urban environments.

A remarkable population of the feral pigeon is residing in urban areas of Rawalpindi/Islamabad. However, little is known about the ecology of the feral pigeon in these cities. This study was designed to determine the seasonal changes in population density, sex ratio, age group, roosting sites, nesting sites, and food and water points of the feral blue rock pigeons in Rawalpindi/Islamabad.

MATERIALS AND METHODS

Study area

The study was carried out in the twin cities Rawalpindi/Islamabad, Pakistan (30º 36´N and 73º 03´E), which cover an area of 207 Km^2 (20,700 ha). The area envisages buildings, farmlands, urban parks, bridges and hospitals. The climate is arid (average temperature 1ºC in winter and 38.9ºC in summer), precipitation ranges from 900 to 1900 mm, whereas, average annual rainfall is from 380 to 510 mm. The overall population is 2,038,948 people (Population Census Organization, 1998). Architectural features of buildings differ according to the date of construction; that's why the buildings were categorized as new/modern buildings, and old buildings.

There is no information about when the pigeons appeared in the areas of Rawalpindi/Islamabad, their populations are however expected to increase rapidly in the urban areas due to the availability of a large number of old buildings and the food.

Method

The urban area was divided into following habitat categories (1) Old buildings, (2) Modern buildings, (3) Educational Buildings, (4) Hospitals, (5) Parklands and (6) Bridges (Fig. 1). In general, the proportion of built in areas in the study areas increased, whereas the proportion of open fields decreased with the human density.

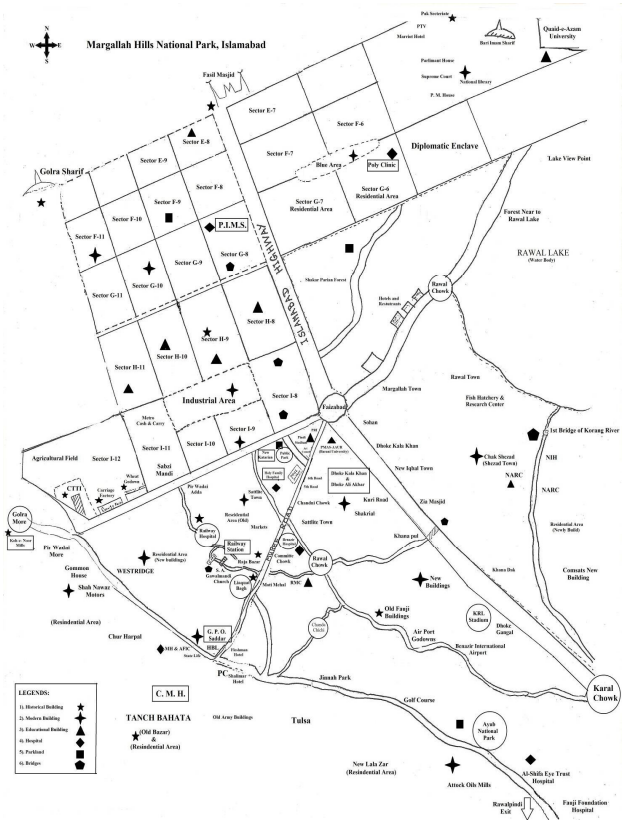

Fig. 1. Map of the study area

Data collection

Data were collected from August 2008 to July 2009, throughout the year. Field observations did not consist of a single route in the study area; a zigzag walk throughout the study area was taken for data collection. Field observations were taken in the late morning (09:00 am to 12:00 h) and in the afternoon to the evening (04:00 to 07:00 pm). Field observations were taken by binocular (20×50), and location recorded with the help of GPS. Photographic evidence was also recorded with digital camera. Each sampling site represented the season, ecological factors (nesting site, roosting site, water resource and feeding site) and building structures that facilitated the population as described

by Sacchi *et al.* (2006).

The population of the pigeon was surveyed within the roosting sites, nesting sites, feeding sites and water points at regular intervals. Food was usually found as a heap of spillage around which the birds clustered. Water points were the reservoirs of water found in the areas of Rawalpindi/Islamabad. Population surveys were conducted three times in one season. Flock size, age and sex ratio were systematically recorded. Flock was recognized as small that would contain (6-19 individuals), medium (20-49 individuals) and large (more than 50 individuals) as suggested by Phelan (1987). Feeding and roosting flocks were recorded with respect to the time of observation.

Juvenile pigeon distinguished by morphological features; grey or reddish legs and feet and grey or dull brown ochre and yellow iris, and the adult pigeons by their pale or dark grey orbital skin (Johnston and Janiga, 1995; Kautz and Malecki, 1990). Sex was determined through their behavior (Rose *et al.,* 2006); shiny plumage on neck and size of head is bigger in male birds. Behavior and morphological features included; vocalization and tail dragging.

Statistical analysis

The analysis of variance (ANOVA) one factor used for analysis of ecological factors such as roosting sites, nesting sites, food resources and water points with respect to different seasons.

RESULTS AND DISCUSSION

The data on population density of the pigeon in Rawalpindi/Islamabad is presented in Table I. Population density of the pigeon in Islamabad was recorded as 0.13, 0.13, 0.10 and 0.09 individuals/ha respectively in winter, autumn, spring and summer seasons. The population density of the pigeon in Rawalpindi was 0.13, 0.11, 0.11 and 0.10 individuals/ha respectively in summer, winter, spring and autumn. Haag (1995) reported that seasonal changes did not change population structure, and had little effect on the population of pigeons in urban areas. But we observed that the roosting sites, nesting sites, food and water points did differ in different seasons in Rawalpindi and Islamabad showing that the ecological factors changed with respect to season (Table II). It is well documented that ecological factors like roosting sites, nesting sites, food and water points have definite relationship with population of feral pigeon in urban areas (Murton *et al.*, 1972; Burleys, 1980; Barbieri and De Andreis, 1991; Haag, 1995; Johnston and Janiga, 1995; Arndt, 2005). The populations of pigeons were mainly regulated by its ecological factors, hence, the population density in Rawalpindi/Islamabad remained similar due to the constant availability of roosting sites, nesting sites, food and water points.

In our study, male and female numbers in different seasons remained in a 1:1 ratio; this is in line with the results reported by Williams and Corrigan (1994) and Johnston and Janiga (1995). The age group in our pigeon population however did not confirm the 2:1 population in different seasons as reported by Williams and Corrigan (1994) and Johnston and Janiga (1995); more adults were observed than juveniles in the pigeon population in every season. Higher numbers of adult pigeon could have been due to early mortality, diseases and some predators affecting the number of young pigeon (Hetmanski, 2004). The pigeon in Rawalpindi/Islamabad were observed to breed in all seasons. The breeding season of the feral pigeon has been reported to range from late autumn to early winter; though they could breed during all the seasons of the year if the conditions were favorable (Hakkinen *et al.*, 1973; Murton *et al*., 1972; Murton *et al*., 1974; Johnston, 1984; Dabert, 1987; Johnston and Janiga, 1995; Hetmanski, 2004; Soldatini *et al.*, 2006). Similarly, Hetmanski and Wolk (2005) observed that blue rock doves bred only if the favorable conditions were present *i.e.* the food and shelter was available.

The data on the population of feral pigeon in different types of buildings are given in Table III. Highest population of feral pigeon was recorded in old buildings (0.30 individuals/ha) and lowest in parklands (0.003 individuals/ha). Sacchi *et al.* (2002) also observed higher number of blue rock pigeons in old buildings, and suggested that (old) historical buildings provided shelter in a large number of roosting and nesting sites to pigeons. On the contrary modern/newer buildings made of glass

Table I.- Population density, sex ratio and age group of feral pigeon in different seasons of the year at Rawalpindi and Islamabad.

City	Season	Population density (Ind./ha)	Sex ratio		Age group	
			Male (n)	Female (n)	Adult (n)	Juvenile (n)
Islamabad	Autumn	0.13	775	714	1489	389
	Winter	0.13	720	690	1410	329
	Spring	0.10	694	672	1366	314
	Summer	0.09	643	617	1260	274
Rawalpindi	Autumn	0.11	170	149	319	72
	Winter	0.11	183	154	337	79
	Spring	0.11	164	139	303	83
	Summer	0.13	193	161	354	92

Table II.- Relative occurrence of roosting site, nesting site, food resources, and water points with respect to different seasons of the year.

Site	Season	Ecological factors (Mean±SE)			
		Roosting sites	Nesting sites	Food resources	Water Points
Islamabad	Autumn	27.7±9.2	30.7±10.4	3.2±0.4	3.0±0.3
	Winter	23.2±7.2	32.9±10.3	3.2±0.2	2.7±0.3
	Spring	28.5±8.4	26.7±6.4	3.2±0.1	2.8±0.3
	Summer	32.8±8.8	24.2±5.2	3.1±0.2	2.6±0.0
Rawalpindi	Autumn	18.7±2.5	15.5±2.5	2.7±0.1	2.6±0.0
	Winter	16.1±2.2	17.6±2.0	2.9±0.1	2.9±0.1
	Spring	24.2±1.9	18.4±2.0	2.9±0.1	2.6±0.2
	Summer	26.9±2.5	16.8±2.0	3.0±0.1	2.4±0.1

ANOVA Single Factor (Islamabad)

Source of Variation	SS	df	MS	F	P-value	F crit
Between Groups	1.57265	3	0.524217	0.002357	0.999833	3.490295
Within Groups	2668.488	12	222.374			
Total	**2670.061**	**15**				

ANOVA Single Factor (Rawalpindi)

Source of Variation	*SS*	*df*	*MS*	*F*	*P-value*	*F crit*
Between Groups	20.46315	3	6.82105	0.06903	0.975367	3.490295
Within Groups	1185.74905	12	98.81242			
Total	**1206.2122**	**15**				

and concrete do not provide suitable roosting and nesting sites for the pigeon. The minimum numbers (0.003 individuals/ha) of the pigeon were observed at Parklands; may be due to high risk of predation. It is known that the pigeon population needs only feeding resources where human population is low and same in the case of nesting and roosting (Murton *et al.*, 1972). Populated areas and less availability of food are the possible reasons for absence of feral pigeons in parklands (Johnston and

Janiga, 1985). It is concluded that roosting sites, nesting sites, feeding sites and water points are the four major factors contributing to population establishment of feral pigeons in twin cities. Age, architectural features and colour of building also play a major role in the selection of nesting and roosting sites. It is concluded that age and sex ratio could be more accurately determined visually when flock size comprised of less than 30 individuals, but identifying skills and expertise are required to determine age and sex ratio.

Table III.- Types of buildings and population of the feral pigeon in Rawalpindi/ Islamabad.

Building type/habitat	Total no. of buildings	No. of birds	
		Mean	Individuals/ha
Old buildings	13	120±6.0	0.30
Modern/New	14	30.2±8.3	0.07
Educational	10	32.4±6.8	0.08
Hospital	6	30.3±9.5	0.07
Parkland	4	1.2±1.2	0.003
Bridges	6	3.3±1.54	0.008

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REFERENCES

ANGOLD, P., SADLER J.P., L. PEATY., WHITEHAND, J.W.R., BALE, J. AND PULLIN, A., 2001. *Biodiversity in urban habitat patches.* The University of Birmingham, Birmingham.

ARNDT, E.J., 2005. Status of the rock pigeon *(Columba livia)* in Nelson, British Columbia. *Wildl. Afield*, **2** :19-22.

BARBIERI, F. AND DE ANDREIS, C., 1991. Indagine sulla presenza dei colombi (*Columba livia forma domestica)* nel centro storico di Pavia e nell' Oltrepo. *Suppl. Ric. Biol. Selvaggina,* **17**: 195-198.

BUIJS, A.J. AND WIJNEN, J.H.V., 2001. The survey of the feral rock dove (*Columba livia*) in Amsterdam, a bird-human association. *Urban Ecosys.,* **5**: 235-241.

BURGMAN, M.A. AND LINDENMAYER, D.B., 1998. *Conservation biology for the Australian environment.* Beatty and Sons, Surrey, pp. 128-145.

BURLEY, N., 1980. Clutch overlap and clutch size: alternative and completely reproductive tactics. *Am. Natural,* **115**: 223-246.

DABERT, J., 1987. Breeding ecology of the feral pigeon *Columba livia f. domestica* in Poznan, Poland. *Acta Ornithol.,* **23**: 177-195.

HAAG, D., 1988. Die dichteabhangige Regulation im Brustschwarm der Strassentaube *Columba livia farma domestica. Ornithol. Beob.,* **87**: 147-151.

HAAG-WACKERNAGEL, D., 1995. Regulation of the street pigeon in Basel. *Wildl. Soc. Bull.,* **23**: 256-260.

HAAG-WACKERNAGEL, D., 1998. Ecology of feral pigeons in Basel, Switzerland. In: *Proc. 7th Intern. Congr. Ecol.* (eds. A. Farina Kennedy and V. Bossu). Florence, pp. 1-4.

HAAG-WACKERNAGEL, D., 2000. Behavioural responses of the feral pigeon (Columbidae) to deterring systems. *Folia Zool.,* **49** :25-39.

HAKKINEN, I., JOKINEN, M. AND TAST, J., 1973. The winter breeding of the feral pigeon *Columba livia domestica* at Tampere in 1972/1973. *Ornis. Fenn.,* **50**: 83-88.

HARRIS, E.C., 1996. *Report for the control of the pigeon population in Trafalgar Square.* Unpublished report to Department of National Heritage.

HETMANSKI, T., 2004. Timing of breeding in feral pigeon *Columba livia f. domestica* in Slupsk (NW Poland). *Acta Ornithol.,* **39**: 105-115.

HETMANSKI, T. AND WOLK, E., 2005. The effect of environmental factors and nesting conditions on clutch overlap in the feral pigeon *Columba livia f. urbana* (Gm.). *Pol. J. Ecol.,* **53**: 523-534.

JOHNSTON, R. F., 1984. Reproductive ecology of the feral pigeon *Columba livia*. *Occ. Pap. Mus. Nat. Hist. Univ. Lawrence.*, **114**: 1-8.

JOHNSTON, R.F. AND JANIGA, M., 1985. *Feral pigeons.* Oxford University Press, New York, pp. 125-128.

JOHNSTON, R.F. AND JANIGA, M., 1995. *Feral pigeons,* Oxford University Press, New York. (2nd Edition), pp. 19-23.

JOKIMAKI, J. AND SUHONEN, J., 1998. Distribution and habitat selection of wintering birds in urban environments. *Lands. Urb. Plann.,* **39**: 253-263.

KAUTZ, E.J. AND MALECKI, R.A, 1990. Effect of harvest on feral rock dove survival, nest success and population size. *Fish Wildl. Tech. Rep.,* **31**: 1-16. United State department of Interior, Fish and Wildlife service, Washington D. C.

MURTON, R.K., THEARLE, R.J.P. AND COOMBS, C.F.B., 1972. Ecological studies of the feral pigeon *Columbia livia* var. II. Flock behaviour and social organization. *J. appl. Ecol.,* **9**: 875–889.

MURTON, R.K., THEARLE, R.J.P. AND COOMBS, C.F.B.,

1974. Ecological studies of the feral pigeon Columbia livia var. III. Reproduction and plumage polymorphism. *J. appl. Ecol.*, **11**: 841–854.

PHELAN, P.J., 1987. Some components of flocking behavior in the rock pigeon *(Columba livia). J. Field Ornithol.,* **58** :135-143.

ROBERTS, T.J., 1991. *The birds of Pakistan (Vol-II non-Passeriformes)*, Oxford University Press, Karachi.

ROSE, E., NAGEL, P. AND HAAG-WACKERNAGEL, D., 2006. Spatio-temporal use of the urban habitat by feral pigeons (*Columba livia*). *Behav. Ecol. Sociobiol.*, **60**: 242-254.

SACCHI, R., RAZZETTI, E., GENTILLI, A. AND BARBIERI, F., 2002. Effects of building features on density and flock distribution of feral pigeons *(Columba livia var. domestica)* in an urban environment. *Can. J. Zool.*, **80**: 48-54.

SACCHI, R., RAZZETTI, E. AND GENTILLI, A., 2006. Study on a methodological approach to feral pigeon, *(Columba livia)* census in urban areas. *Italian ornithol. Milano,* **75**: 119-127.

SIMMS, E., 1979. *The public life of the street pigeon.* Hutchinson, London.

SOLDATINI, C., MAINARDI, D., BALDACCINI, N.E. AND GIUNCHI, D., 2006. A temporal analysis of the foraging flights of feral pigeon *(Columba livia f. domestica)* from three Italian cities. *Italian J. Zool.,,* **73**:83-92.

WEBER, W., 1979. *Health hazards from pigeons, starlings and English sparrows*. Thomson Publications, Fresno, California, pp. 137.

WILLIAMS, D. E. AND CORRIGAN, R.M., 1994. Pigeons (Rock Doves) Prevention and control of wildlife damage ADC-1. Coop. Ext. Serv. Purdue Univ. West Lafayette, Indiana pp. 87-96.

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