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Population Dynamics of House Sparrow (*Passer domesticus*) and House Crow (*Corvus splendens*) in Punjab (District Sargodha), Pakistan

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Abstract.- The aim of present study was to estimate population dynamics of house sparrow and house crow in district Sargodha, Pakistan. This study was conducted from November, 2010 to March, 2011. Population comparison of house sparrows with sex differentiation and house crows without sex differentiation were conducted in rural (98 Chak 'N' and Morre 125 Chak Shaheenabad) and urban (Cheema colony and Awan colony) areas. During this study period, a total 5617 from rural and 3929 birds from urban sampling sites were counted. A statistically significant difference was observed between both populations. In rural areas 2998 house sparrows (1433 male and 1565 female), while 1873 sparrows (848 male and 1025 female were observed from urban study points and significant difference was observed between house sparrows population. Throughout the study period, from rural check points 2619 house crows, while 2056 crows were observed from urban study areas. The present study is very useful in prediction of population dynamics of bird's spp. in other ecological regions of Pakistan.

Key words: House sparrow, house crow, population dynamics.

INTRODUCTION

Birds ranked on basis of many criteria and can be defined as "selecting indicator taxa". On a local scale, patterns of bird distribution may not always match well the distribution patterns of other taxa (Pearson, 1995). In terrestrial habitats birds are responsible to work as important component of biodiversity (especially in well-vegetated areas) than in either freshwater or marine habitats. It has been widely reported that birds are highly valuable (even though imperfect) indicator of endemism patterns and species richness in a given ecosystem, which ultimately helped the scientist to gauge the ecological deterioration (Bibby *et al.*, 1992; Burgess *et al.*, 2002). Birds inhabiting our surrounding environment also played an important role indicating the environmental pollution in different ecosystems (Balmori, 2003).

According to Lack (1966) and Lawton (1996) it has been known since long, especially from studies of passerines (Curnutt *et al.*, 1996; Sæther *et al.*, 2003) and game birds (Cattadori and Hudson, 1999; Williams *et al.*, 2003) that variation in population dynamics occurs within the distribution range of bird species. However, the mechanisms behind these variation are poorly investigated (Brown *et al.*, 1995; Lawton, 1996). Similarly common species are house sparrow and house crow (*Corvus splendens*); that is an omnivorous bird and spend its life as a klepto parasitic on various avian species. It is a predator of eggs, chicks and other bird species (Long, 1981; Cramp, 1994). It has been reported that large scale declines in house sparrow (*Passer domesticus*) population in many European towns and cities. In urban sub-urban Britain, decline

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is started in mid-1980s and continued upto the 1990s (Summers-Smith, 2003; Robinson *et al.*, 2005). Moreover, in South East England, urban birds population appeared to be declining more rapidly than sub-urban or rural populations (Crick *et al.*, 2002); there have been dramatic reductions, almost to the point of extinction, in Hamburg, Edinburg, Glasgow and Ghent, although the species has increased in Wales and Scotland (Summers-Smith, 2003).

For nature conservation, trends in numbers over time are of particular interest (Bibby *et al*., 1992). Disappearance of the *P. domesticus* from the urban areas is not something new. A few years ago, some alarms bells rang completely in London when the population of common house sparrows declined by upto 85% (ANI, 2009) and the most probable reason added by Hole *et al*. (2002) was food shortage in winter caused by agricultural intensification in rural England. Dr. Vijayan from India reported another reason that house sparrow were also vanishing from areas where mobile phone towers were installed in large numbers and especially from cities where electromagnetic contamination was very high (Mukherjee, 2003).

Many populations of house sparrow have disappeared recently in Brussels (De Laet, 2004); declines of same kind were also observed in Dublin (Prowse, 2002). The best-documented changes have occurred in London where 60% decline was recorded in the numbers of breeding *Passer domesticus* between 1994 and 2004 (Raven *et al.*, 2005). According to a study, decrease in colony size below some critical (captious) value may enfeeble breeding behavior to the extent that breeding declines, resulting in the disappearance of the colony as a breeding unit (Summers-Smith, 2003). Another possibility about the urban decline of common house sparrow is possible link with electromagnetic radiations (Balmori and Hallberg, 2007). Mobile phones, also called as cellular phones or handies are indeed a great boon (favour) to people all over the World. Its widespread use has been accompanied by the installation of an increasing number of base station antennas on masts and buildings, and these GSM base stations are emitting electromagnetic radiations that are posing problems (Hyland, 2000; Belyaev, 2005a, b).

The objectives of the present study were to compare population and its dynamics of house sparrow and house crow from rural and urban areas of Sargodha region, Pakistan.

MATERIALS AND METHODS

Study area

This study was conducted from November 2010 to march 2011 to estimate the population of house sparrow (male and female) from rural areas (98 Chak (N) and Morre 125 Chak Shaheenabad), sparrow (male and female) from urban areas (Cheema colony and Awan colony) with sex differentiation. Similarly, population comparison of house crow from rural areas (98 Chak (N) and Morre 125 Chak Shaheenabad) with house crow from urban areas (Cheema colony and Awan colony) without sex differentiation.

A population comparison of house sparrow (*P. domesticus*) and house crow (*Corvus splendens*) was accomplished at 12 sampling transects (each of 1Km length) in four observation points for comparative analysis of populations in district Sargodha. Population density of house sparrow and house crows per 1Km of each transect was recorded. The fluctuation in the number of bird density depends on the location where the sampling was conducted, so the density cannot be predicted at any time in the entire selected rural or urban area.

Sampling time

The methodology was imitated for sampling accomplishment between 07:00–10:00 AM. In rural areas (98 Chak 'N' and Morre 125 Chak Shaheenabad), sampling took place on Saturday while in urban (Cheema colony and Awan colony) areas, it took place on Sunday, respectively. There was less noise and city traffic pollution on these sampling days.

Data collection

The sampling was carried out in selected areas and tree lined, relatively isolated streets that made the population computing process easy enough (with a well known and area of known limits). House sparrows (*P. domesticus*) with sex and house crow (*C. splendens*) were counted without sex differentiation.

Statistical analysis

Finally, the data was organized into tables and was subjected to run ANOVA to check the populations' significance in urban and rural sampling sites. Analysis of Variance (ANOVA) is a hypothesis-testing technique used to test the equality of two or more population (or treatment) means by examining the variances of samples that are taken. ANOVA allows one to determine whether the differences between the samples are simply due to random error (sampling errors) or whether there are systematic treatment effects that cause the mean in one group to differ from the mean in another. Most of the time ANOVA is used to compare the equality as significant ($P<0.05$) and non significant ($P>0.05$).

RESULTS

In rural areas, total 5617 birds and in urban areas 3929 birds were counted. The number of birds from rural were greater than the urban and statistical difference between birds population was highly significant (*$p<0.05$*). The average number of birds observed during the study period were highest (n=606) in the rural (98 Chak 'N') and lowest (n=354) in urban (Cheema colony) area (Table I)

Table II shows that 2998 house sparrows from rural and 1873 sparrow from urban sampling sites were counted. The number of sparrows recorded from urban were lower than the rural and a highly significant ($P<0.05$) statistical difference was recorded. In the rural locality 98 Chak (N), the average number of house sparrow observed was highest (n=338) while it was lowest (n=155) in urban sampling site Cheema colony.

Throughout the study period, total 2056 crows were observed from urban observation sites while 2619 house crows were counted from rural localities. The total number of house crows were greater in rural and moreover, the statistical difference was highly insignificant; $P>0.05$, (Tables III). The highest average number (n=268) and lowest (n=199) of *Corvus splenden* was observed in the rural (98 Chak 'N') and in urban (Cheema colony) areas, respectively (Table III).

According to Total 1433 male and 1565 female sparrow were counted from rural areas and a total 848 and 1025 respectively were recorded for the same sexes in urban sampling sites. The total number of both male and female sparrow was greater in rural and lower in urban study points, and this statistical difference was highly significant (Tables IV, V). The average number of male and female house sparrows observed during the study period was highest (n=164 and n=174, M & F, respectively) in the rural (98 Chak 'N') and lowest (n=73 & n=82) in urban (Cheema colony) area (Table IV and V).

DISCUSSION

The birds (house sparrow and house crow) counted from rural check points were more than the birds from urban sampling sites. Overall characteristics of urban and rural habitat explained variations of productivity and densities of birds. In the present study the variation in bird's population might be due to urbanization that has posed a challenge for conservationists. Similar observations have been reported by Khera *et al*. (2009). In this study, authors observed the high-density of house sparrow in rural areas against the urban areas. Our results were in accordance as the finding of Scott (1993) reported that urbanization leads to reduction in species richness, indicating that avian population changes with urbanization. Moreover, Khera *et al*. (2009) reported that house sparrow was present in low density in dense urban areas of India (Delhi), in comparison to rural area having dominant species. It may be due to herb diversity and increase in density of the house sparrow in rural area indicated that herb cover may be causal to the food supply to the house sparrow. Therefore, its low density in urban areas could be due to limited food availability (insects due to reduced natural grass and herb cover in the home gardens and parks of the urban area) due to urbanization (Balmori and Hallberg, 2007).

House sparrow (male and female) and crow from rural areas were recorded more than urban sampling sites. According to our observations, there was the scarcity of urban parks, garden and tiled houses. Furthermore, the human intervention like new or old reformed close constructions, noise pollution, and severe climatic conditions were considered possible factors vanishing excellent nesting and breeding habitat that directed the birds

Table I.- Population comparison of house sparrow and house crows in rural and urban areas.

	Rural		Urban	
	98 Chak (N)	**Morre 125 Chak Shaheenabad**	**Cheema colony**	**Awan colony**
Months				
November (2010)	625	541	275	499
December (2010)	455	344	364	456
January (2011)	690	624	369	465
February (2011)	614	499	278	289
March (2011)	646	579	483	451
Total	3030	2587	1769	2160

Groups	***Count***	***Sum***	***Average***	***Variance***
98 Chak (N)	5	3030	606	7970.5
Morre 125 Chak Shaheenabad	5	2587	509	12318.3
Cheema colony	5	1769	354	7245.7
Awan colony	5	2160	432	6741

	ANOVA					
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	174412.2	3	58137.4	6.784717947	0.00366471	3.238871522
Within Groups	137102	16	8568.875			
Total	311514.2	19				

Table II.- Population comparison of house sparrow (*Passer domesticus*) in rural and urban areas.

	Rural		Urban	
	98 Chak (N)	**Morre 125 Chak Shaheenabad**	**Cheema colony**	**Awan colony**
Months				
November (2010)	382	293	157	282
December (2010)	236	181	141	248
January (2011)	401	324	174	233
February (2011)	332	240	108	129
March (2011)	340	269	195	206
Total	1691	1307	775	1098

Groups	***Count***	***Sum***	***Average***	***Variance***
98 Chak (N)	5	1691	338	4087.2
Morre 125 Chak Shaheenabad	5	1307	261	2974.3
Cheema colony	5	775	155	1092.5
Awan colony	5	1098	220	3318.3

	ANOVA					
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	88459.75	3	29486.58333	10.28096662	0.000516008	3.23887152
Within Groups	45889.2	16	2868.075			
Total	134348.95	19				

Table III.- Population comparison of house crow (*Corvus splenden*) in rural and urban area.

	Rural		Urban	
	98 Chak (N)	**Morre 125 Chak Shaheenabad**	**Cheema colony**	**Awan colony**
Months				
November (2010)	243	248	118	217
December (2010)	219	163	223	208
January (2011)	289	300	195	232
February (2011)	282	259	170	160
March (2011)	306	310	288	245
Total	1339	1280	994	1062

Groups	***Count***	***Sum***	***Average***	***Variance***
98 Chak (N)	5	1339	268	1276.7
Morre 125 Chak Shaheenabad	5	1280	256	3393.5
Cheema colony	5	994	199	3978.7
Awan colony	5	1062	212	1058.3

ANOVA

Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	16658.95	3	5552.983	2.288191583	0.117560628	3.238871522
Within Groups	38828.8	16	2426.8			
Total	55487.75	19				

Table IV.- Population comparison of male house sparrow (*Passer domesticus*) in rural and urban areas during the study period.

	Rural		Urban	
	98 Chak (N)	**Morre 125 Chak Shaheenabad**	**Cheema colony**	**Awan colony**
Months				
November (2010)	187	144	82	124
December (2010)	116	77	60	105
January (2011)	195	151	90	96
February (2011)	162	116	48	62
March (2011)	160	125	85	96
Total	820	613	365	483

Groups	***Count***	***Sum***	***Average***	***Variance***
98 Chak (N)	5	820	164	953.5
Morre 125 Chak Shaheenabad	5	613	123	848.3
Cheema colony	5	365	73	327
Awan colony	5	483	97	504.8

ANOVA

Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	22788.55	3	7596.183333	11.53733799	0.000282319	3.238871522
Within Groups	10534.4	16	658.4			
Total	33322.95	19				

Table V.- Population comparison of female house sparrow (*Passer domesticus*) in rural and urban areas.

	Rural		Urban	
	98 Chak (N)	**Morre 125 Chak Shaheenabad**	**Cheema colony**	**Awan colony**
Months				
November (2010)	195	149	75	158
December (2010)	120	104	81	143
January (2011)	206	173	84	137
February (2011)	170	124	60	67
March (2011)	180	144	110	110
Total	871	694	410	615

Groups	***Count***	***Sum***	***Average***	***Variance***
98 Chak (N)	5	871	174	1108.2
125 Chak Shaheenabad	5	694	139	682.7
Cheema colony	5	410	82	330.5
Awan colony	5	615	123	1281.5

	ANOVA					
Source of Variation	***SS***	***df***	***MS***	***F***	***P-value***	***F crit***
Between Groups	21915.4	3	7305.133333	8.586950346	0.001258243	3.238871522
Within Groups	13611.6	16	850.725			
Total	35527	19				

to migrate. Similarly, Summers-Smith (2003) reported that reduction in availability of appropriate nesting sites in rehabilitated old and modern buildings that must have been responsible for decline in population of house sparrow. Chamberlain *et al.* (2007) reported that this decline is due to the private gardens or horticulture areas-providing nesting space in hedges-declines. Likewise, Heij (2001) investigated the four possible causes of declines in urban population in Netherlands. First, the use of a new type of roof tiles has resulted into decrease in the numbers of nesting places which offers little space for birds to nest. Second, in recent decades, cities have become much cleaner, due to which a scarcity in nesting material has resulted. Third, a gradual fall in food abundance for the same reason, Fourth, an increase in predation.

Another possible aspect that we correlated for less urban population of male and female house sparrow were the signal emitting towers (GSM mobile phone towers and Radio station towers etc) that were installed in so large number in the urban centers than rural sites that they caused urban environmental electromagnetic problem or "electrosmog" and moreover the contingency about the urban decline of common house sparrow in correlation with electromagnetic radiations were reported (Balmori, 2003, 2007). The results showed less number of house sparrow in vicinity of rural and urban observation points. Our results are correlated with Everaert and Bauwens (2007) in Flanders (Belgium), "fewer house sparrow males were seen at locations with relatively high electric field strength values of GSM base stations and therefore support the concept that long-term exposure to higher levels of radiation negatively affects the abundance or behavior of house sparrows in the wild". These all results were consistent with the possibility that the reproduction of white stork is interfered by microwaves and they would confirm (corroborate) the results of laboratory research by other authors (Balmori, 2005). House sparrows are mainly seed-eaters, in order to feed their young one's they depends on insects and other invertebrates. It is more likely that they will prefer areas having abundance of invertebrates at the beginning of the breeding period. Many researchers

have reported that in urban areas lack of insects, might be an important factor in the reported decline of house sparrow populations (Wotton *et al.*, 2002; Summers-Smith, 2003). Another important factor is short-term exposure of pulsed mobile phone radiation with carrier frequency 900MHz resulted in a 50-60% decrease of the reproduction capacity of insects (Panagopoulos *et al*., 2004). Similar observations were as the microwave radiation at other frequencies (Bol'shakov *et al*., 2001; Atli and Unlu, 2006) The feathers of birds were known to act as dielectric receptors of high frequency electromagnetic fields and some experiments indicated that piezoelectric effects in the feathers are induced by the audio frequency pulse-modulated high frequency fields (Bigu-del-Blanco and Romero-Sierra, 1975a, b). These results were important in view of the influence of environmental factors on bird behavior and in the basic role that feathers play in the life of bird. Similar observations were reported by Romero-Sierra *et al.* (1969), that microwave radiation can have the same adverse effects on flight of birds as those observed in caged birds.

It was estimated that the replacement of the horse by the automobile as a means of transport resulted in the first urban decline of the house sparrow (Summers-Smith, 2005). This removed not only a great source of food from the sparrow, but also the faster moving traffic made the streets less safe to feed (Bergtold, 1921) and were consequently responsible for a disproportional mortality of native young birds.

The results showed mostly the top cap of these towers were nested upon by house crows that was amazing enough to possibly correlate that the high frequency emitted radiations or signals from emitters were probably less severe to cause effects on physiology or anatomy of house crow than house sparrow. It explored that some other salient factors could be involved in population fluctuations of house crow that are needed to be monitored.

The present study is restricted to one season only; it does not provide enough data to understand the population trends of the house sparrow and house crow, and their interrelationship with other co-occurring species. Further studies are needed to analyze the data of the type and class of green space, and compare those to the occurrence of the house sparrow in the study area. To understand the population dynamics of the house sparrow and house crow and to analyze their relationship with other co-occurring common species, a regular monitoring is required. According to Siriwardena *et al*. (2008) environmental change may further affect the population trend of the house sparrow. It suggests that a long term monitoring over various habitats will provide perfect population trends. Involvement of local community in monitoring will not only ensure sustainability of the programme, but will also help in gaining public support for the conservation of important species (Khera *et al*., 2009).

CONCLUSIONS

It is difficult to conclude the most probable reason for the low abundance of the house sparrow and house crow in the urban study area. It might be a combination of one or more factors. In the farming area, where the conditions seem to be favorable, a higher density of both species was observed. Therefore, it is recommended that modification of the built structure and intensive management of the Green spaces within the cities by humans is leading to a differential change in habitat for both species and the average density of house sparrow was also less as compared to house crow in urban areas. The bird's population has changed in response to urbanization, which have posed a challenge for conservationists.

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