FEEDING RESOURCE UTILIZATION STRATEGIES OF (*Corvus splendens*) IN URBAN HABITAT OF PRAYAGRAJ (U.P.), INDIA

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AUTHORS' CONTRIBUTIONS

This work was carried out in collaboration between both authors. Author PK designed the study, performed statistical analysis, wrote the protocol and wrote first draft of the manuscript. Author AKO carried out all necessary field observations. Both authors read and approved the final manuscript.

Original Research Article

ABSTRACT

Aim: Habitat abundance relationships suggest that House crows are highly dependent on anthropogenic food sources. Thus urban locality is a prime preference as habitat by House crow. It is now well established that house crow is an invasive species and may be threat to local bird fauna. Over population may lead to unhygienic condition and economic damages. On the other hand there are Reports from some part of India where it is claimed that house crows are less in number to meet their cultural/religious demand. It is necessary for us to know how this bird utilizes feeding resources around us that is important for proper population management of this invasive bird species. Present study was conducted in urban locality of city Prayagraj, having plenty of feeding opportunities for House crows to know feeding strategies adopted by House crow.
Methodology: Focal animal sampling method has been adapted to record feeding behavior of House crow. Total 41 feeding sites were visited to calculate number of House crows by following total count method with the use of available instruments. Two types of feeding sites have been identified namely regular feeding site and irregular feeding site. Apart from this, six land use categories i.e. residential area, public park/roadside, meat shop/ fish market, commercial area, municipal dumping site and cultural/religious place were observed to work out feeding resource utilization strategies adopted by House crow. Appropriate statistical tests have been applied in this regard.
Results: Significant difference has been found between total number of regular and irregular feeding sites (Calculated $\chi2$ 4.60 < critical $\chi2$ 3.84 p= .031). There was no significant difference in number of feeding sites among land use categories (Calculated $\chi2$ 4.72 < critical $\chi2$ 11.07 p= .448). Likewise no significant difference have been found in number of regular (Calculated $\chi2$ 2.72 < critical $\chi2$ 5.99 p= .256) and irregular (Calculated

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χ2 6.79< critical χ2 9.48 p= .147) feeding sites among land use categories. Significantly more House crow feed on regular feeding sites in comparison to irregular feeding sites (calculated t-value 7.084 >critical t-value 2.022 p < .0001).Significant difference has been found among number of house crow feeding under different land use categories(calculated F-value 4.828 > critical F- value 2.485 p .0018). No significant correlation has been observed among number of feeding sites in each land use categories and number of house crow feeing on them (calculated r- value 0.069 < critical r- value 0.811 p .895). Significant correlation has been observed between amount of food available in different land use categories and number of House crows feeding on them(calculated r-value 0.995> critical r- value 0.811 p .002). No positive correlation has been observed between number of feeding sites and amount of food available in each land use category (calculated r- value 0.152 < critical r-value 0.811 p .773).

Conclusion: It was concluded that in present circumstances House crows mostly relay on dumping and cultural religious places for feeding purpose and hence for survival. Present work will help in proper population management of this environmental/cultural important bird.

1. INTRODUCTION

Proper nutrition is one of the most basic needs of a bird to survive [1,2]. Because improper feeding or malnutrition in birds has many negative consequences that in many cases cause their death [3,4]. Weakness and vulnerability to various diseases, depression, production of weakly fertilized eggs or empty eggs, full shedding in different parts and loss of beautiful appearance and very slow growth are the most important side effects of incomplete and inappropriate nutrition in birds [5,6]. If the food received by the birds is sufficiently varied and balanced in terms of nutrients and nutrients, the bird will be much fresher and more active [7]. Also, birds that have a more complete and varied diet have a much longer lifespan [8].

House crow, *Corvus splendens* (Vieillot, 1817) is a native bird of Indian subcontinent. It is a typical bird of crow family *Corvidae* of order *Passeriformes*. House crow inhabit a wide range of urban and suburban environment. It is one of the commonest birds observed by peoples without any confusion in identification. This bird is usually sedentary in nature and does not like to migrate unless there is shortage of food [9]. House crow is omnivorous scavenger, eat everything it can eat whether alive or dead. It highly relay on human refuses as food item. Food items includes seeds, fruits, bird's eggs, nestlings, insects, fishes, amphibibians, reptiles, carrions and food scraps/human refuses [10]. House crow also eats agricultural produce and stored food [11]. House crow has also been observed to attack fledglings for food [12]. House crow can be easily seen to searching food items in parks, road sides and garbage dumping areas [13]. [2] reported that house crow spend much time for searching food items on ground and occasionally feed on the trees (Invasive animal risk assessment, state of. Thus food preference of House crow is very broad and highly opportunistic. House crow is highly adaptive to the urban environment. It lives in close association with people up to the extent that non – dependent population may no longer exist [14]. Thus, abundance of house crow is closely associated with the availability of food scraps. Habitat abundance relationships suggest that House crows are highly dependent on anthropogenic food [15,16]. In an indirect estimation a House crow eats about 300gm of food daily [17]. Most of it is in the form of food scrap. In this way House crow contribute a lot as natural environment cleaner, and thus help us to keep environment eco friendly. In India, house crow is associated with cultural/ religious rituals. As per Brahmanism, it is believed that what peoples feed to House crows reaches to their ancestors during sacred fortnight known as "PitraPaksha" in the month of September /October.

It is now well established that house crow is an invasive species and may be threat to local bird fauna. Over population may lead to unhygienic condition and economic damages [18]. Apart from this house crow has both beneficial as well harmful activity related to agriculture. House crow may acts as natural pest controller. On the other hand it is an important crop depredator. Apart from this house crow has both beneficial as well harm full activity related to agriculture [19]. House crow may acts as natural pest controller. On the other hand it is an important crop depredator. It is important for us to know how this important bird utilize their surroundings specially for feeding purpose and hence survival. The understanding of feeding resource utilization of House crow may aid us for their proper population management. This is in need today both because of environment as well as cultural/ religious point of view. Present study has same focus and aim.

2. MATERIALS AND METHODS

Present study is based on idea and methodology as described by Saiyad et.al. [13]. Observation made in the city of Prayagraj (Allahabad) in the district Prayagraj (25°45' N to 81° 85' E) located in the southernmost part of the state Uttar Pradesh (U.P.), India. The city Prayagraj (Allahabad) is located at the confluence of river Ganga and Yamuna. Present recorded area of the city is about 365 Km2 with population of about 1.53 million (2011 census). Average density of the city is 4200/Km2. Prayagraj is the seventh most populous city of the state Uttar Pradesh and thirty sixth in country. City Prayagraj is big center of education, administration and religious activity in the state concern. It is also very important commercially in the region. Meat shops, fish markets of the city look busy. City encompasses many religious/ cultural and recreational places. It is easily understandable that huge quantities of food scrap/ human left over animal remains are produced in the city every day. Thus city has plenty of diverse feeding opportunities for House crow. We have identified six land use categories namely residential area, public park/roadside, meat shop/ fish market, commercial area, municipal dumping site and cultural/religious place for present study purpose (Fig. 1).

Fig. 1. Showing various land use categories (a) Residential area, (b) Public park/roadside, (c) Meat shop/ fish market, (d) Commercial area, (e) municipal dumping site and (f) Cultural/religious place

Keeping in mind the availability of food and frequency of visit by House crow, feeding sites have been categorized as regular feeding sites and irregular feeding sites. Regular feeding sites are those that are visited by House crow regularly and have continuous availability of food. Irregular feeding sites are visited by house crow occasionally or infrequently and have discontinuous availability of food. We have identified four types of food items utilized by House crow i.e. food scraps/ human refuges, plant products, meat/carcasses/slaughter byproducts and specific food offered by human beings. Food preference to these feeding items has been quantified by counting the House crows to feed upon. Amount of food items have been quantified indirectly with the help of information provided by municipal workers, meat/fish shopkeepers, persons offering food to House crows and other local public. Dumping sites mostly have human refuses and other organic/in organic waste. Cultural/ religious places were observed to have various ritual wastes either organic (Specific food offered, Body remains after cremation, flowers etc.) and/or inorganic (e.g. Clothes). Fish/meat market mostly has slaughter wastes. Residential and commercial area mainly harbor human refuses/ kitchen left over while public park / road side observed to have feeding material of human refuses/carcasses and plant products. Total count method [13] has been adopted to calculate number of house crows at each feeding site. Every feeding site has been visited trice in a month during period of April, 2019 to April, 2021. The observation at each visit day starts following sunrise and ends up to 09.00 AM and in evening 04.00PM to 06.00PM.Focal sampling method has been adapted to record feeding activity of House crow with procedure described by Altmann [20]. For focal sampling method, continuous recording with short time interval of 10 min. was followed, because of high activity of bird. Groups of few individuals at a time were chosen to record feeding activity. We have considered activities related only to feeding for present study. Binocular (Olympus 10×50) has been used to observe feeding activity and crow counting with precision. It also makes

observation free of human interference as possible. Photographs and videos were taken with the help of LG mobile phone (model no. LM-K610IM), 48mega pixel capacity. Statistical analysis have been performed using "Graph Pad Prism" software.

3. RESULTS AND DISCUSSION

Total 41 feeding sites have been observed in all six land use categories. Differential composition of each land use category with respect to type of feeding sites is as mentioned in Table 1.

Significant difference has been found between total number of regular and irregular feeding sites (Calculated $\chi2$ 4.60 < critical $\chi2$ 3.84 p= 0.031). There is no significant difference in number of feeding sites among land use categories (Calculated $\chi2$ 4.72 < critical $\chi2$ 11.07 p= 0.448). Likewise no significant difference have been found in number of regular (Calculated $\chi2$ 2.72 < critical $\chi2$ 5.99 p= 0.256) and irregular (Calculated $\chi2$ 6.79< critical $\chi2$ 9.48 p= 0.147) feeding sites among land use categories. Although the case may be different when we consider land use categories separately for type of feeding site it has.

Total six land use categories have been identified against five by Saiyad et.al. [13]. Apart from this Alam and Alam [16] have described just three land use categories. We could not recognize agricultural land use category [13] because of no such land has been observed in the city Prayagraj. Although, feeding behavior of house crow is well documented in agricultural land [19,21]. We have definitely identified dumping area and cultural/religious place as land use categories. Dumping area and cultural/religious place have been observed with plentiful feeding activity that cannot be ignored. In present study we have monitored 41 feeding sites against 30 and 14 observed by Saiyad et.al. [13] and Alam and Alam [16] respectively, thus tried to make more comprehensive study. We have found

Table 1. Number of regular/irregular feeding sites in different land uses categories

S. No.	Land use category	Number of regular feeding sites	Number of irregular feeding sites	Total
01	Residential area	-	12	12
02	Public park/road side	-	09	09
03	Meat/Fish market	01	01	02
04	Commercial area	-	05	05
05	Dumping area	07	-	07
06	Cultural /Religious place	03	03	06
	Total	11	30	41

Table 2. Comparison of number of House crows feeding on different types of feeding site

S. No.	Types of feeding site	Number of House crow (Mean ±SD)	Calculated t-value	Critical t-value	p- value	Result
01	Regular	175.45±120.61	7.084	2.022	<.0001	Significant
02	Irregular	21.30±10.45				

Table 3. Comparison of number of house crows feeding under different land use categories

S. No.	Land use categories	Number of House crow feeding (Mean ±SD)	Calculated F- value	Critical F-value	p- value	Result
01	Residential area	24.16±13.35	4.828	2.485	.0018	Significant
02	Public park/ Road side	18.33±10.14				
03	Meat/Fish market	84.00±93.33				
04	Commercial area	19.20±05.97				
05	Dumping site	168.57±133.96				
06	Cultural/Religious place	111.66±127.93				

significant difference between total number of regular and irregular feeding sites that is similar to result described by Saiyad et al. [13] in case of macro and micro feeding sites. In addition, significantly more House crow feed on regular feeding sites in comparison to irregular feeding sites as shown in Table 2.

This result is comparable to what observed in case of macro and micro feeding sites [13].

Significant difference have been found among number of house crow feeding under different land use categories as mentioned in Table 3 .

Dumping and cultural/religious land use categories were observed to have more number of House crows feeding on it in comparison to other land use categories. Maximum feeding by house crow has been recorded in residential area followed by commercial land [13,16]. It is possible that better garbage /waste collection and dumping system provided food for House crow in one place (dumping grounds) rather than scattered in residential and commercial land use categories. In addition to this cultural/ religious activities might aid a lot to feeding materials.

No significant correlation has been observed among number of feeding sites in each land use categories and number of house crow feeing on them (Table 4).

Similar observation has been made with five land use categories by Saiyad et.al. [13]. So number of feeding sites in each land use category is not a deciding factor for how much House crows will feed on it.

Table 4. Correlation between number of feeding sites in each land use categories and number of house crow feeing on it

S. No.	Land use categories	Number of feeding sites	Number of House crows	Calculated r- value	Critical r- value	p- value	Result
01	Residential area	12	290	0.069	0.811	0.895	Not significant
02	Public park/ Road side	09	165				
03	Meat/Fish market	02	168				
04	Commercial area	05	96				
05	Dumping site	07	1180				
06	Cultural/Religious place	06	670				

Table 5. Correlation between amount of food and number of House crow in each land use categories

S. No.	Land use categories	Amount of food (Kg.) approx.	Number of House crows	Calculated r- value	Critical r- value	p- value	Result
01	Residential area	90	290	0.995	0.811	.002	Significant
02	Public park/ Road side	50	165				
03	Meat/Fish market	35	168				
04	Commercial area	25	96				
05	Dumping site	300	1180				
06	Cultural/Religious place	160	670				

Significant correlation has been observed between amount of food available in different land use categories and number of House crows feeding on them (Table 5).

No positive correlation has been observed between number of feeding sites and amount of food available in each land use category (calculated r- value 0.152 < critical r-value 0.811 p .773).

So amount of food available in each land use category is not governed by number of feeding site present in it. House crow preferred to eat where more amount of food is available at one place. It is important to note that against slaughter waste [13] in present study maximum feeding material and number of House crow feeding on it has been observed in dumping sites followed by cultural/religious places. Least amount of feeding material and number of House crow has been observed in public park/road side, which is similar to observation of Saiyad et.al. [13]. Withney and Marzluff [22] observed parks and lawns as great habitats for food to House crows.

4. CONCLUSION

In present circumstances House crows mostly relay on dumping and cultural/religious places for feeding purpose and hence for survival as far as urban environment is concerned. Slaughter wastes aid in this a lot. Better garbage collection/ dumping system might create a situation in that House crow got concentrated to these localities. Cultural/ religious places are another hope for survival of House crows. In addition to organic / inorganic wastes of these places, specific foods offered by humans provide ample supply of food material to this environmental/cultural important bird. Reports are there from some part of India where it is claimed that house crows are less in number to meet their cultural/religious demand. On the other hand its invasive nature and crop depredation habit make

space for proper population management of this bird. In these circumstances present finding may help for proper population monitoring of this bird.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Mohammadabadi MR, Nikbakhti M, Mirzaee HR, et al. Genetic variability in three native Iranian chicken populations of the Khorasan province based on microsatellite markers. Russ J Genet. 2010;46:505-509.
2. Moazeni S, Mohammadabadi MR, Sadeghi M, et al. Association between UCP gene polymorphisms and growth, brreeding value of growth and reproductive traits in mazandaran indigenous chicken. Open J. Anim. Sci. 2016a;6:1-8.
3. Mohammadifar A, Faghih Imani SA, Mohammadabadi MR, Soflaei MM. The effect of TGFb3 gene on phenotypic and breeding values of body weight traits in Fars native fowls. Agric. Biotech. J. 2014;5:125-136.
4. Moazeni SM, Mohammadabadi MR, Sadeghi M, et al. Association of the melanocortin-3(MC3R) receptor gene with growth and reproductive traits in Mazandaran indigenous chicken. J. Livest. Sci. Techno. 2016b;l4:51-56.

5. Shahdadnejad N, Mohammadabadi MR, Shamsadini MM. Typing of clostridium perfringens isolated from broiler chickens using multiplex PCR. Genetics in the third millennium. 2016;14 (4):4368-4374.

6. Mohammadifar A, MR, Mohammadabadi MR. the effect of uncoupling protein polymorphisms on growth, breeding value of growth and reproductive traits in the fars indigenous chicken. Iran J ApplAnimSci. 2017;7:679-685.

7. Mohammadifar A, Mohammadabadi MR. Melanocortin-3 receptor (mc3r) gene association with growth and egg production traits in Fars indigenous chicken. Malays ApplBiol. 2018;47:85–90.

8. Zandi E, Mohammadabadi MR, Ezzatkhah M, Esmailizadeh AK. typing of toxigenic isolates of clostridium perfringens by multiplex PCR in Ostrich. Iranian Journal of Applied Animal Science (IJAS). 2014;4 (4):509-514.

9. Robertson D. Bird families of the world: Corvidae; 2000.
    Available:http://www.montereybay.com/creagrus/corvids.html

10. Invasive animal risk assessment, Indian house crow (*Corvussplendens*): Department of Agriculture and Fisheriesbio security Queensland, Queensland government; 2016.

11. Chahal BS, Simwat GS, Brar HS. Bird pests of crops and their control. Pesticides. 1973;7(5):18-20.

12. Kumar P. Reproductive behavior and parental care in little brown dove, *Streptopelia senegalenssis* during COVID-19lockdown period in Prayagraj (Allahabad) UP, India. World Journal of Zoology. 2020;15(3): 14-23.

13. Saiyad SK, Soniand VCB, Radaria B. Urban resource utilization for feeding purpose by House crow (*Corvussplendens*). International journal of recent scientific research. 2015;6(12):7933-7935.

14. Nyari A, Ryall C, Peterson TA. Global invasive potential of the house crow *Corvussplendens* based on ecological niche modeling. Avian biol. 2006;37(4):306-311.

15. Lim HC, Sodhi NS, Brook BW, Soh MS. Undesirable aliens: Factors determining the distribution of three invasive bird species in Singapore. Journal of tropical ecology. 2003;19:685-695.

16. Alam I, Alam MDN. Feeding habits of house crow, *Corvusspendens*in the urban ecosystem of Kolkata. Proc. Zool. Soc. India. 2018;17(2):57-62.

17. Sen S. In praise of crows; 2011.
    Available:http://birdsofindia-ssen.blogspot.in/2011/08/inpraise

18. Nxele BJ, Shivambu CT. House crow (*Corvus splendens*) eradication measures from eThekwini municipality, KwaZulu-Natal, South Africa. Journal of biodiversity management & forestry. 2018;7(2):1-5.

19. Koul S, Sahi DN. Feeding ecology of house crow *(Corvussplendens)* in open agricultural fields in Jammu (J&K), India. International Research Journal of Environment Sciences. 2013;2(06):85-87.

20. Altmann J. Observational study of behavior – sampling method. 1974;227-267.

21. Khan HA, Jabeen G, Anwar N. Foraging rhythms of house crow (*Corvussplendens*) for 30 and 60- minute durations on some crops in an agro-ecosystem in Faisalabad.Pakistan Journal of Agricultural Sciences. 2007;44(02):283-288.

22. Marzluff JM, Neatherlin E. Corvid response to human settlements and campgrounds: Causes, concequences and challenges for conservation. Biological conservation. 2006;130:301-314.

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