Eco. Env. & Cons. 28 (January Suppl. Issue) : 2022; pp. (S114-S118)
Copyright@ EM International
ISSN 0971–765X

http://doi.org/10.53550/EEC.2022.v28i01s.016

Interaction of Avian Assemblages with the Local Environment of Solid Waste Disposal Area: A Case Study from Pramodnagar Waste Dumping Ground in Kolkata Metropolitan City

Tanmoy Dutta[1], Samir Sardar[1], Bulganin Mitra[1], *Arunava Mukherjee[1] and *Banani Mandal[2]

[1]Department of Zoology, Ramakrishna Mission Vivekananda Centenary College, Kolkata 700 118, West Bengal, India
[2]Department of Zoology, Jogesh Chandra Chaudhuri College, Kolkata 700 033, West Bengal, India

(Received 14 June, 2021; Accepted 23 August, 2021)

ABSTRACT

Waste disposal sites are very important area for urban ecosystem due to sharp increment of solid waste generation day by day from municipalities. These sites also provide resources to various bird species though yet their assemblage patterns are not well documented. In the present communication 26 avian species were recorded and spatial assemblage pattern of birds was found among different sub sites ($p < 0.05$). Wilson-Shmida beta diversity index and Jaccard and Sorenson similarity indices reflects commonness among three sub-sites named tree site, garbage site and locality site in respect of the species composition related to local dispersal of bird between disposal site and human colonies. These disposal sites have usual potentiality to be an important reservoir for various harmful pathogens and parasites.

***Key words**: Waste disposal site, Urban, Assemblage, Avian, Human colonies, Pathogens*

Introduction

Appropriate and eco-friendly solid waste management (SWM) is an utmost necessity for healthy living of human beings in an urban area. In most of the cities of developing Asian countries, major part of municipal solid waste are collected and dumped on particular land in uncontrolled manner. Kolkata ranked 4th in respect of wastes generation (tpd) among the major cities of India (Bhat *et al.,* 2018). Air pollution from landfill emissions, ground water pollution from leachates, health problems due to breeding of disease-causing vectors and social problems such as decreasing land values and aesthetic appeal of an area etc. are some associated problems (Bandara and Hettiarachchi, 2003). Birds are not uncommon in these disposal landscapes. But few works have been done yet on the avifaunal assemblage on waste disposal area. 17 bird species were documented from dumping site of Tanjania (Massawe, 2017), 57 species from Italy (Camerini and Groppali, 2014) and 17 avian species from Ethiopia (Meles and Bogale, 2018). In India, 103 species were recorded from dumping stations of Rajasthan and Punjab (Mehra *et al.,* 2017). Zhang *et al.* (2015) told that the improper dismantling of e-waste might impose severe negative impact on diversity and bird assemblages especially for woodland insectivorous and grassland specialists. Significant difference in birds' spatial diversity was found

within dumping zone due to variation of resources, high productivity and disturbance at sewage stabilization ponds (Massawe, 2017).

Till now no single work has been done on diversity and assemblage of birds within solid waste disposal area in and around Kolkata Metropolitan city. The present study was conducted to know the pattern of avian assemblages within a solid waste disposal area. Avian assemblages of adjacent areas of dumping site were also observed to understand the extent of similarities between dumping site and associated areas in respect of assemblages of birds.

Study area

This study was conducted in Pramodnagar Waste Disposal Site, Dum Dum and its associated area (nearly 60 acres/ 24 hectare) (Lat 22.6462ºN and Long 88.3958ºE) of Kolkata metropolitan city, West Bengal (Fig.1). Pramodnagar is used as a solid waste disposal site for six municipalities (South Dum Dum, Dum Dum, North Dum Dum, New Barrackpore, Baranagar and Kamarhati) and dumping municipal garbage (600 metric tons approximately/day) regularly, those constitute household garbage, sludge and biomedical wastes. Diversity of landscape, heap of garbage, unpleasant decaying smell, heavy smoke (waste material The main waste dumping site is bordered from three sides by a waste water canal, which in turns encircled by canal side plantations and few colonies for human habitation and a fresh water pond is also situated in close vicinity to the dumping ground.) altogether attract group of birds.

Materials and Methods

The study was carried out from January, 2018 to December, 2018. For the purpose of better study the entire site was divided into five sub-sites depending upon their basic functional characteristics such as garbage disposal site (Garbage site), waste water canal (Canal site), planted tree along the canal side (Tree site), locality for human habitation (Locality site) and freshwater pond (Pond site) (Fig. 1). Data of few environmental parameters like temperature, relative humidity and rainfall were seasonally recorded from standard references (AccuWeather App and http://www.imdkolkata.gov.in, Indian meteorological Department Kolkata). The birds were observed by using modified point count survey (Sorace *et al*., 2000) from each of the above-mentioned sub-sites in five seasons such as winter (December-January), spring (February-March), summer (April-June), monsoon (July-September) and post monsoon (October-November). The data (richness) collection frequency was twice in a week per month. Birds were observed by Olympus Binocular and were identified up to smallest taxonomical category (Ali and Ripley, 1995). According to Kolmogorov-Smirnov test as the data sets followed normal distribution pattern ($p > 0.05$), thus one-way ANOVA and post hoc analysis were performed for seasons and sub-sites, whereas, for environmental parameters one sample t-test was carried out Two similarity indices like, Jaccard and Sorenson (Goodall, 1966) and Wilson-Shmida beta diversity index (Wilson, 1984) were also calculated to understand degrees of species similarities among different sub-sites. All statistical tests were carried out by using Microsoft Excel and SPSS 17.0 software.

Fig. 1. Map of the study area (Promodnagar, Dum Dum, West Bengal) with different sub site

Results

Overall, 26 species of birds under 23 genera and 20 families were recorded within the study period (Table 1). One sample t-test indicated significant seasonal variation in temperature, relative humidity and average rainfall ($t_{Temperature} = 10.85$, $df = 4$, $p < 0.01$; $t_{Relative\ Humidity} = 17.77$, $df = 4$, $p < 0.01$; $t_{Rainfall} = 2.71$, $df = 4$, $p < 0.05$). One-way ANOVA indicates number of bird species were not varied

significantly (F = 0.128, p>0.05) among five different seasons, but showed significant variation (F = 72.711, p<0.01) among the different sub-sites. Post hoc test (Duncan test) showed that the mean values of avian richness followed the pattern, such as tree site > canal site, garbage site > locality site > pond site (Figure 2). Wilson-Shmida beta diversity index (based on presence-absence data) which varied significantly (t = 8.578, df = 9, p < 0.01) between each of five sub-sites showed the lowest value between tree site and locality site (0.286) and the highest value was observed between garbage site and pond site (0.875), indicating the species composition of pond site was quite different from the other sub-sites. Jaccard and Sorenson similarity index which varied significantly between each of five sub-sites (tCj = 5.367, df = 9, p < 0.01; tCs = 6.330, df = 9, p < 0.01) showed higher values between tree site and locality site (Cj = 0.556, Cs = 0.714) and between garbage site

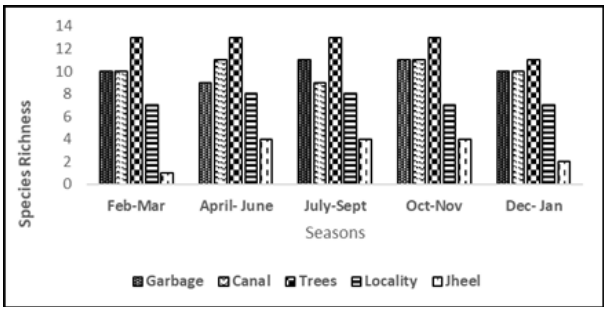

Fig. 2. Comparative species richness of five sub sites in five different seasons

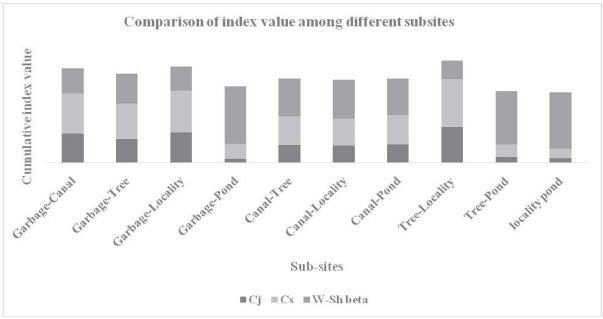

Fig. 3. Similarity indices (Jaccard and Sorenson) and beta diversity index (Wilson-Shmida) among different sub sites

Table 1. Birds species observed in and around the disposal ground at Pramodnagar during the study

Sl No.	Species	Common name	Family	Assemblage at different sub sites				
				Garbage	Canal	Tree	Locality	Pond
1	*Bubulcus ibis*	Cattle egret	Ardeidae	+	+	-	-	-
2	*Ardeola grayii*	Indian pond heron	Ardeidae	-	+	-	-	+
3	*Halcyon smyrnensis*	White throated kingfisher	Alcedinidae	-	+	+	-	+
4	*Alcedo atthis*	Common kingfisher	Alcedinidae	-	+	+	-	-
5	*Milvus migrans*	Black kite	Accipitridae	+	+	+	+	-
6	*Corvus splendens*	House crow	Corvidae	+	+	+	+	+
7	*Corvus corax*	Raven	Corvidae	+	-	-	-	-
8	*Spilopelia chinensis*	Spotted dove	Columbidae	-	-	+	+	-
9	*Eudynamys scolopaceus*	Asian Koel	Cuculidae	-	-	+	+	-
10	*Dicrurus macrocercus*	Black drongo	Dicruridae	+	-	+	-	-
11	*Psilopogon haemacephalus*	Coppersmith barbet	Megalaimidae	-	-	+	-	-
12	*Motacilla alba*	White wagtail	Motacillidae	+	+	-	-	-
13	*Motacilla citreola*	Citrine wagtail	Motacillidae	+	+	-	-	-
14	*Copsychus saularis*	Oriental Marpie robin	Muscicapidae	-	-	+	+	-
15	*Cinnyris asiaticus*	Purple sunbird	Nectariniidae	-	-	+	-	-
16	*Passer domesticus*	House sparrow	Passeridae	+	-	+	+	-
17	*Microcarbo niger*	Little cormorant	Phalacrocoracidae	-	+	-	-	+
18	*Pycnonotus cafer*	Red vented bulbul	Pycnonotidae	+	-	+	+	-
19	*Dinopium benghalense*	Woodpecker	Picidae	-	-	+	-	-
20	*Psittacula krameri*	Rose ringed parakeet	Psittaculidae	-	-	+	-	-
21	*Amaurornis phoenicurus*	White breasted waterhen	Rallidae	-	+	-	-	-
22	*Actitis hypoleucos*	Common sandpiper	Scolopacidae	-	+	-	-	-
23	*Acridotheres tristis*	Common myna	Sturnidae	+	+	+	+	-
24	*Acridotheres fuscus*	Jungle myna	Sturnidae	+	+	+	+	-
25	*Gracupica contra*	Asian pied starling	Sturnidae	+	+	+	+	-
26	*Upupa epops*	Hoopoe	Upupidae	-	-	+	-	-

and locality site (Cj = 0.467, Cs = 0.636), respectively, and, the lower values were found between garbage site and pond site (Cj = 0.067, Cs = 0.125) and between locality site and pond site (Cj = 0.077 Cs = 0.43), respectively (Figure 3), again indicate the species composition of garbage site, tree site and locality site were more similar. It was also found that many bird species recorded there showed local dispersal regularly among garbage site, nearby locality site and tree site (Table 1).

Discussion

All the birds observed in the Promodnagar during study period were residential to the area as no significant seasonal variation ($p > 0.05$) observed in respect of species richness. Species varied among above mentioned five sub sites significantly ($p < 0.05$) and highest richness was found in sub-site named tree site (species richness 18), whereas, lowest number of species was recorded from sub-site named pond site (only 4 species). Species like Indian pond heron, white throated kingfisher, little cormorant and house crow made them available in pond site and all these 4 birds also found in canal site. House crow was the only species that was recorded from all the sub-sites of Promodnagar. Raven was only recorded from garbage site, whereas, coppersmith barbet, purple sunbird, rose-ringed parakeet and hoopoe were only observed in tree site and white-breasted water hen and common sandpiper were only recorded from canal site. Four species, black kite, common myna, jungle myna and pied sterling wereobserved from 4 sub-sites among all, except from the pond site. Among the 7 bird species common at three sub sites (garbage site, tree site and locality site) six bird species, black kite, house crow, house sparrow, red vented bulbul, common myna and Asian pied starling were recorded from waste disposal ground in previous literature but jungle myna was not recorded earlier as scavenger bird (Mehra *et al.*, 2017). Easy availability of food throughout the year, minimal anthropogenic activities and presence of adjacent water bodies might be the causal factors for visit of diverse birds in the disposal areas. Usually waste disposal sites are packed with various pathogens (Plazza *et al.*, 2017). Many avifauna of waste disposal ground often serves as reservoirs and/or mechanical vectors for spreading of many common pathogenic microorganisms like *Fasciola hepatica* and *Escherichia coli* and diseases like chicken pox, , meningitis, tuberculosis and influenza (Clark, 2014; Hasan *et al.*, 2017; Navarro- Gonzalez *et al.*, 2019). Birds being capable to move long distance in regular basis, their potentiality of spreading the infection often are increased manifold. Shifting in wildlife ecology also create opportunities for cross-species transmission which amplifies pathogen invasion under altered environmental conditions (Fisher *et al.*, 2013).

Conclusion

Pramodnagar waste disposal ground is highly influenced by waste disposal from nearby municipalities. Change in physicochemical parameters of water and soil , compositional variation in the waste over time along with the disposal landscape continuum influence randomly on avian assemblage pattern and their local transitory movement from waste disposal site to tree site to surrounding locality site (human settlements). Our results predict the possibility of easy transfer of some infectious pathogens or parasites due to local dispersal of few bird species. The current research also suggest that it's a high time to think about new policy related to maintenance of minimum distances of human colonies adjacent to waste disposal area.

Acknowledgement

The authors are thankfully acknowledging the Principal of RKMVC College, Rahara and Baranagar Municipality for their cooperation

References

Ali, S. and Ripley, S.D. 1995. A *Pictorial Guide to the Birds of Indian Subcontinent*. Centenary Publication, Edn 2. Bombay Natural History Society.

Bandara, N.J.G.J. and Hettiarachchi, P.J. 2003. Environmental impacts associated with current waste disposal practices in a municipality in Sri Lanka – A case study. *Workshop on Sustainable Landfill Management 3–5 December,* Chennai, India.

Bhat, R.A., Dar, S.A., Dar, D.A. and Dar, G.H. 2018. Municipal solid waste generation and current scenario of its management in India. *Int. J. Adv. Res. Sci. Eng,* 7(2) : 419-431.

Camerini, G. and Groppali, R. 2014. Landfill restoration and biodiversity: A case of study in Northern Italy. *Waste Manag. Res.* 32 (8) : 782–790.

Clark, L. 2014. Disease risks posed by wild birds associated

with agricultural landscapes. In: K.R. Matthews, G.M. Sapers, and C.P. Gerba, editors. *The Produce Contamination Problem*, Second edition. Academic Press, Elsevier Inc., Boston, MA. 139-165.

Fischer, J.W., Phillips, G.E., Nichols, T.A. and Ver Cauteren, K.C. 2013. Could avian scavengers translocate infectious prions to disease-free areas initiating new foci of chronic wasting disease? *Prion*. 7(4): 263–266

Goodall, D.W .1966. A new similarity index based on probability. *Biometrics*. 22 (4) : 882-907.

Hassan, M. M., Hoque, M. A., Debnath, N. C., Yamage, M. and Klaassen, M. 2017. Are poultry or wild birds the main reservoirs for avian Influenza in Bangladesh? *Eco Health.* 14 (3) : 490–500.

Massawe, G.P. 2017. Diversity of bird's communities on dumpsite and sewage stabilization ponds of Moshi Municipal, Kilimanjaro, Tanzania. *Int. J. Hum Capital Urban Manage*. 2 (4) : 309-318.

Mehra, S.P., Mehra, S., Uddin, M., Verma, V., Sharma, H., Singh, T., Kaur, G., Rimung, T. and Kumhar, H.R. 2017. Waste as a resource for avifauna: Review and survey of the avifaunal composition in and around waste dumping sites and sewage water collection sites (India). *Int. J. Waste Resour.* 7 (3) : 1-8.

Meles, S.K. and Bogale, B.A. 2018. Assessment of bird diversity and abundance from waste disposal sites in and around Gubre Subcity, Wolkite Town, Southwestern Ethiopia. *Int. J. Waste Resour.* 8(4): 1-7.

Navarro-Gonzalez, N., Wright, S., Aminabadi, P., Gwinn, A., Suslow, T. V. and Jay-Russel, M. T. 2019. Carriage and subtypes of foodborne pathogens identiûed in wild birds residing near agricultural lands in California: A repeated cross-sectional study. *Appl. Environ. Microbiol*. 3 : e01678-19.

Plazza, P.I. and Lambertucci, S.A. 2017. How are garbage dumps impacting vertebrate demography, health, and conservation? *Glob. Ecol. Conserv.* 12 : 9-20.

Sorace, A., Gustin, M., Calvario, E., Ianniello, L., Sarrocco, S. and Carere, C. 2000. Assessing bird communities by point counts: Repeated sessions and their duration. *Acta Ornithol.* 35 : 197-202.

Wilson, M.V. and Shmida, A. 1984. Measuring beta diversity with presence absence data. *J. Ecol*. 72 : 1055-164.

Zhang, Q., Wu, J., Sun, Y., Zhang, M., Mai, B., Mo, L., Lee, M.T. and Zou, F. 2015. Do bird assemblages predict susceptibility by e-waste pollution? A comparative study based on species- and guild-dependent responses in China agro ecosystems. *PLoS One*, 10(3): 1-16.