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© Research Center for Climate Change and Department of Biology, Faculty of Mathematics & Natural Sciences, University of Indonesia, Depok 16424, INDONESIA.
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Roosting of black kites (*Milvus migrans*) in Dhaka Metropolis, Bangladesh

Black kites, *Milvus migrans*, thrive in urban areas, agricultural areas and grasslands with adequate nesting locations (Ferguson-Lees & Christie 2001, Orta *et al*. 2020) and also occurs in villages and towns, deciduous forest and open areas including wetlands throughout Bangladesh (Khan 2008, 2018, Siddiqui *et al*. 2008, IUCN Bangladesh 2015). Black kites roost communally (Mazumdar *et al*. 2017) in trees and groves of trees (Siddiqui *et al*. 2008). Communal roosting is thought to provide benefits in terms of decreased predation risk and increased foraging efficiency (Eiserer 1984, Ydenberg & Prins 1984). Some findings suggest communal roosting is influenced by day length, light intensity and local environmental conditions (Eiserer 1984, Elkins 1988) but this remains controversial (Richner & Hebb 1996). Roosting sites can play a significant role in population regulation in birds (Gadgil 1972).

Black kites thrive in urban areas, are widely distributed in towns and are considered to be of Least Concern in Bangladesh (IUCN Bangladesh 2015). The species is a highly opportunistic predator, and their broods can sustain variable provisioning rates depending on environmental conditions (VinÄuela & Veiga 1992). In contrast, black kites have one of the most varied diets among birds (Delibes 1975, Cramp & Simmons 1980, Vinuela 1992). However, loss of suitable roosting sites could have a significant impact on kite populations. Distribution and abundance is likely responsive to the often changing spatial distribution of habitat and food sources within a city (Meghwal & Soni 2017). How the species is faring in a metropolis has never been ecologically assessed, thus this study aimed to identify the factors determining black kite roost sites, roosting substrate and roost height selection in Dhaka. Dhaka is the capital of Bangladesh and it is the 7th most populated city in the world (UN 2018).

Methods. Four study sites were selected within the Dhaka South City Corporation, where black kite is a common urban raptor (Akash *et al.* 2013, Rajia *et al.* 2015, Banu *et al.* 2016). The survey was carried out by three observers between October 2017 and January 2018 in the following areas: Ramna Park (23.7381°N, 90.4013°E), Dhaka University Campus (23.7341°N, 90.3925°E), Suhrawardy Udyan (23.7331°N, 90.3984°E), and Osmani Udyan (23.7259°N, 90.4083°E) (Fig. 1). Each site was visited three times to count the population of black kite.

We followed Mahabal & Bastawade (1985) to identify roosts of black kites. To pinpoint a roosting site, we observed flight pattern and in-flight behavior of black kite. Thus, roosting sites were identified by following individuals and flocks which exhibited directional flight for longer than one hour. Although some individuals went to roost 2–3 hours before sunset, and some 1 hour after sunset, usually before roosting, kites gradually accumulated at potential roosting sites having flown for about one hour in a flock. Before roosting, large flocks separated in smaller flocks and went to their roosts mostly at sunset. Local shop keepers confirmed that some black kites were recorded at roosting sites throughout the day. Triangulation of flight lines of different individuals proved to be a good method to predict the location of roosts. To get more information on their roosting behaviour, we conducted a semi-structured interview of the shop keepers located within 50–100 m of the roosting sites.

A total of 32.5 hours on 12 days (typically 3 hours, 1600–1900 h in a day) were spent observing roosting sites, substrates, roost height and extent of disturbance. Once identified, geocoordinates of the roosting site were recorded using a handheld Garmin eTrex 10GPS receiver. Binoculars (10 × 42) and cameras were used to record the number of kites. Roosting trees were identified based on Dey (2009). The diameter at breast height (DBH) was measured, and height of each roosting tree was measured

with a CP-40S distance meter. Sometimes, black kites roosted with other species, in which case roosting heights of other species were also measured. The heights and numbers of individuals on man-made structures (mobile towers and buildings) were also recorded. The canopy coverage of the trees was measured using Google Earth Pro (Monkkonen 2008, Duhla *et al*. 2012).

To test significance of possible association ($p<0.05$) between number of black kites and height, DBH and canopy coverage, nonparametric Spearman rank-order correlation (r) test was used with the R statistical software program (v4.0.4; R Core Team 2021). To test the impacts of human presence and sound pollution on roosting site selection, threats were ranked from 0 to 4 for type of vehicle based number of people as disturbance parameters (Table 1). These ranks were used to determine correlations between disturbance types and roosting numbers.

Table 1. Disturbance parameters (vehicle type based on the engine capacity and horn type and number of people) in and around roosting sites; hyd, hydraulic.

Disturbance parameters			
Vehicles with		Number of people	Disturbance rank
Engine	Horn		
non	non-hyd.	0–50	0
small	non-hyd.	51–200	1
medium	non-hyd.	201–400	2
medium	hydraulic	401–600	3
large	hydraulic	above 600	4

Two parameters, (i) presence of vehicles and (ii) number of people within 50 m of the roost site were considered for threat analysis. In every case the nearest distance to a main road was within 50 m. To estimate the disturbance frequencies, we collected data for 30 minutes at each site.

Results. ***Roosting sites*****.** A total of 825 (±31) individual black kites were estimated from 38 roosting sites; 19 from Dhaka University, 11 from Suhrawardy Udyan, 7 from Ramna Park, and 1 from Osmani Udyan (Table 2). 92% of roosting sites were trees and 8% were man-made structures. Altogether 35 individual trees were recorded as roosting sites (Table 3) with Rajloroi, *Albizia richardiana* (Fabaceae) as the most commonly used species (Table 3). In total, nine species of plants belonging to five families and nine genera were used (Table 3). Trees belonging to the Fabaceae family were strongly preferred (83%) (Table 3; Fig. 2A). Only three man-made structures were used: two telecommunications towers (one with 2 kites the other with 273±10 kites) and one high-rise building (with 6±1 kites). The number of kites roosting at a site was positively correlated with height of the site (r=0.44, p=0.01), although this was strongly influenced by three taller roosts. The height of roosting sites ranged from 19.5 to 29.5 m (23.1±2.3, n=38). The highest were two telecommunications towers at 25 and 29.5 m (Fig. 2B). The height of trees used ranged from 17.5 to 25.8 m (22.9±2.1, n= 35) (Table 3). The DBH of roosting trees ranged from 0.44 to 1.94 m (0.8±0.3). The greatest DBH was recorded for Malay Padauk, *Pterocarpus indicus* (Fabaceae) (Table 3). There was no significant relation between DBH and roosting numbers (r=0.23, p=0.06). The canopy coverage of roosting trees ranged from 17.5 to 1,295 m^2 (241.9±217.8, n=35). The number of kites roosting at a site was not correlated with canopy coverage (p=0.85).

Roosting Behavior**.** Most of the black kites roosted in single species groups (96%, n=788). The remainder (4%, n=37) roosted in association with house crows, *Corvus splendens*, and common mynas, *Acridotheres tristis.* In the case of associate roosting, the kites roosted higher in the canopy (13 m) than the other associate species (8 m).

Table 2. Roosting sites and populations of black kites in the study areas; — not applicable

Study location	No. of roosting sites		Population of black kite (average±sd)	Roost height (m) (average±sd)	Natural site DBH (m) (average±sd)
	Man-made	Natural			
Ramna Park	0	7	36±4	24±1	1.15±0.5
Dhaka University	2	17	403±11	21±2	0.77±0.22
Suhrawardy Udyan	0	11	113±4	24±2	0.74±0.18
Osmani Udyan	1	0	273±12	29.5	—
Total	3	35	825±31	—	—

Plate 15

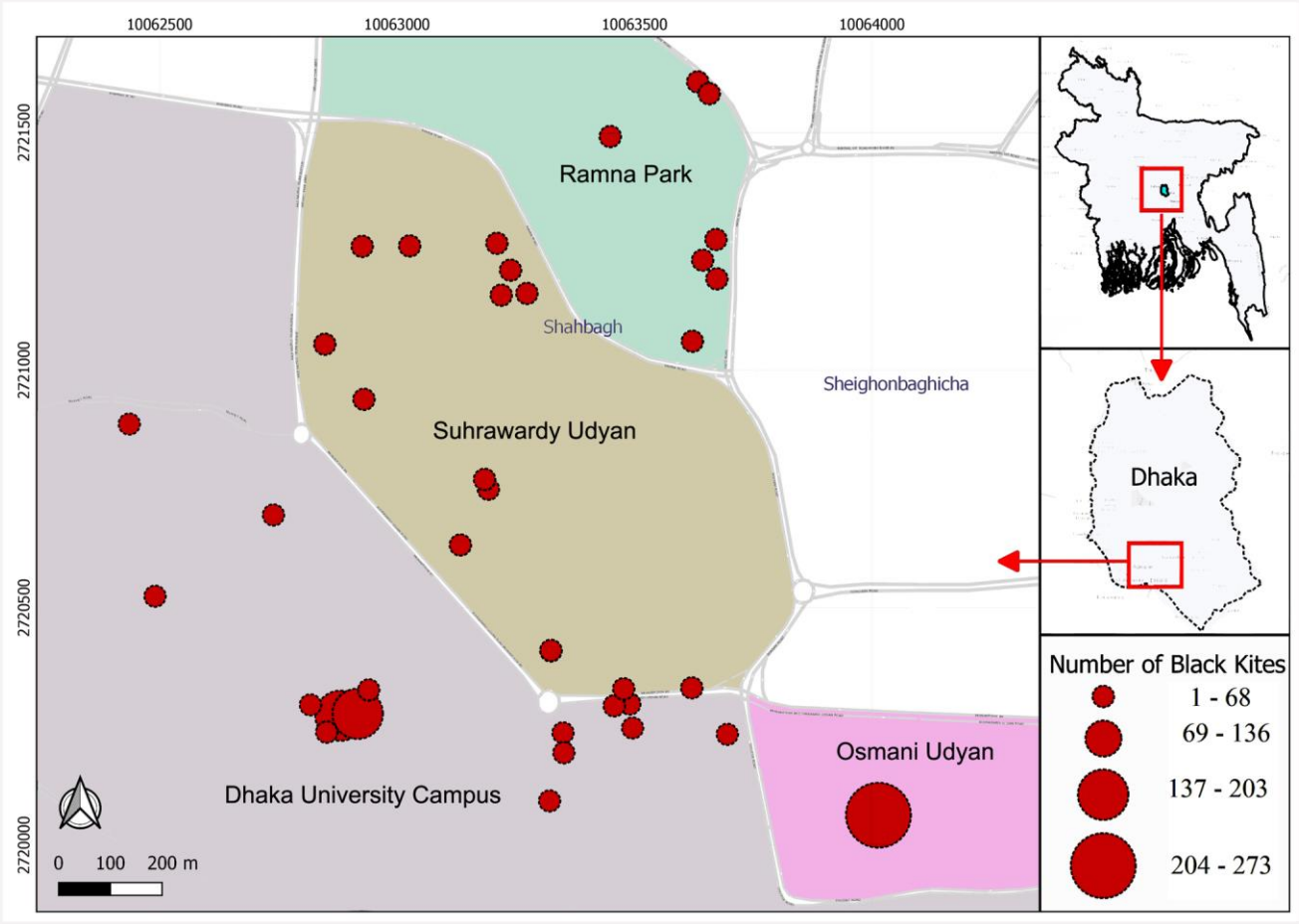

Figure 1. Studied roosting sites of black kite in Dhaka Metropolis, Bangladesh

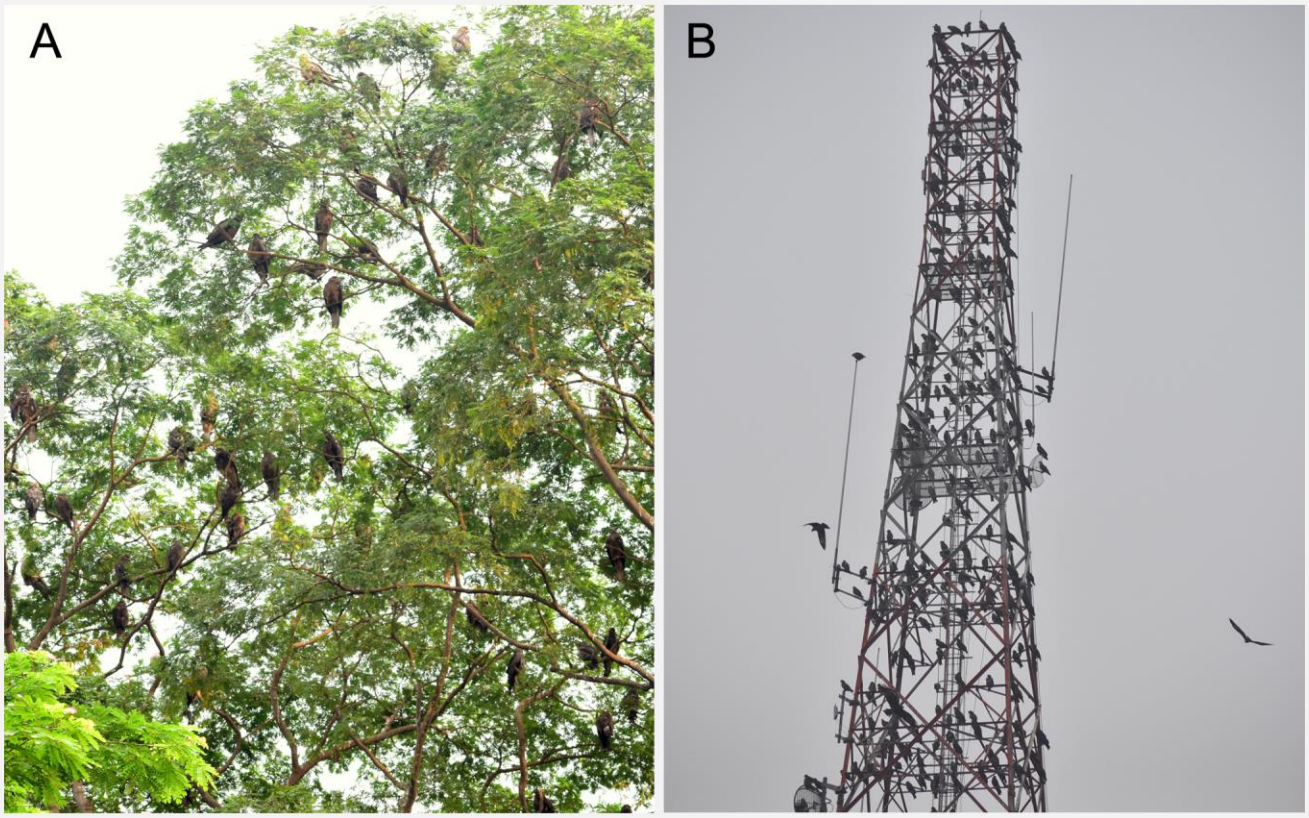

Figure 2. Black kite roosting sites: **(A)** Rajloroi, *Albizia richardiana* (Fabaceae), as the most preferable roosting tree and **(B)** a telecommunications tower

Table 3. Characteristics of roosting trees recorded in the study

	Tree species	Roosting frequency	Height (m) (average±sd)	DBH (m) (average±sd)	Canopy coverage (m^2) (average±sd)	No. of black kites observed
1	Earleaf acacia (*Acacia auriculiformis*)	1	25.8	0.52	309	5±1
2	Java olive (*Sterculia foetida*)	2	25.7±0.1	0.58±0.01	118.5±23.5	13±1
3	Indian fir (*Polyalthia longifolia*)	3	19.4±1.8	0.67±0.05	41.8±25.2	7±1
4	river red gum (*Eucalyptus camaldulensis*)	7	21.8±1.3	0.61±0.17	173±108.4	70±8
5	Rajloroi (*Albizia richardiana*)	17	23.3±1.5	0.88±0.16	269±102.4	437±54
6	Hoop pine (*Araucaria caunninghamii*)	1	19.8	0.71	17.5	1±1
7	Indian almond (*Terminalia catappa*)	1	23.8	0.86	259	1±1
8	Malay Padauk (*Pterocarpus indicus*)	2	25.1±0.8	1.74±0.28	174.0±83.4	8±1
9	Rain tree (*Samanea saman*)	1	23.8	1.5	1295	2±1

***Roosting site disturbance*.** To avoid disturbance, black kites prefer tall roost sites. Osmani Udyan scored a high disturbance frequency (n=8), where a tall man-made structure used instead of trees. Dhaka University was scored the lowest disturbance frequency (n=4) and 2 out of 19 roosting sites were man-made structures. The number of kites using trees as roosting sites was negatively correlated with disturbance (r=-0.75; p=0.20) (Table 4). Black kites only prefer to roost on man-made substrates if they have to do so to avoid disturbance.

Table 4. Disturbance rating and black kite numbers at tree roost sites

Study site	Disturbance rank		No. of black kites
	by vehicles	by humans	
Ramna Park	4	1	36
Dhaka University Campus	2	2	394
Suhrawardy Udyan	4	2	113
Osmani Udyan	4	4	0

Discussion. Previous studies had shown that the roosting site selection of Black Kite does not depend on imprinting (Hilden 1965) or early experience (Klopfer 1963). It depends on the structural characteristics of roosting sites and the distributions of feeding grounds (Meghwal & Soni 2017). Roost height appeared to be the most important factor influencing the number for kites at roosts. Canopy area and tree DBH were also correlated with tree height. The species clearly preferred trees with wide canopy coverage and a large DBH. Similar findings were reported by Meghwal & Soni (2017) for the black-winged kite, *Elanus caeruleus*. Sound pollution and human crowds appeared to force 8% of kites in the Dhaka Metropolis to use man-made substrates instead of available trees. Only 3% of kites of the Kolkata Metropolis used man-made substrates (Mazumdar *et al.* 2017). Black kites prefer the high canopy of large trees as their roosting sites as do other raptors (Ferguson-Lees & Christie 2001). This study found that the native Rajloroi trees were most important for black kites because of their open canopy structure and taller growth than most other species in the area. We recorded nine roosting tree species whereas Mazumdar *et al.* (2017) reported 21 roosting tree species from Kolkata, India.

Kites in this study showed an avoidance of sound pollution and human crowds, and selected roosting trees where threat scores were low. This observation is supported by both field observation and analyses. In the Dhaka University Campus, Ramna Park, and Suhrawardy Udyan, most of the kites used trees as their roosting sites although high telecommunications towers were also present in those areas. But in Osmani Udyan, kites only

roosted on a tower despite the availability of various large trees. Rajloroi was observed as a common roosting tree in three sites but, in Osmany Udyan, this species was present but not used as roost sites. We conjecture that high numbers of people and sound pollution from vehicles led them to prefer to roost higher in the telecommunications tower in this area.

The kites started arriving at roost sites in the evening about 45 minutes to one hour prior to sunset, although a few individuals were present throughout the day resting in the trees and foraging nearby. Prior to roosting, kites circled in large flocks, this continued until sunset. In the meantime, birds that used both common and different roosting sites in the study area joined the same circling. This behavior is termed pre-roosting display and is generally performed silently as also reported by Mahabal & Bastawade (1985). About 10 to 15 minutes after sunset, all the kites settled down at their roosting sites. Black kites roosted in the inner canopies of trees and perched close to one another. Few individuals (3.25%) took more time (up to 1 hour) to come back to roosting sites. Some black kites roosted up to one hour after sunset. Mazumdar *et al.* (2017) observed last arrivals 30 minutes after sunset in winter. Single and mixed species roosts were used by kites in this study as previously observed by (Mazumdar *et al.* 2017).

As most kites used trees for roosting, protecting tall trees with wide canopy coverage would help to maintain urban black kite abundance. Although rapid urbanization destroys the habitat of many raptors as well as other birds and animals, the presence of tall trees in parks and many historic places in Dhaka Metropolitan City supports roosting kites and probably other wildlife. Thus, conservation of tall trees is necessary to protect raptors and other wild animals in urban areas. In Dhaka, a clear dependence of kites on less disturbed areas and big trees is seen. This should be considered in urban planning and before cutting down trees. Moreover, long-term monitoring and research will be necessary to assess trends in urban wildlife for greener and sustainable future cities.

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Literature cited

Akash, M., M.A. Hossain, G.W. Chowdhury, H. Mahmud, and M.A. Islam (2013). Status of avifauna in Curzon Hall premises University of Dhaka, Bangladesh. *Ecoprint*, 20: 1–8.

Banu, M.F.A., M. Akash, G.W. Chowdhury, and M.A. Hossain (2016). Status and seasonal occurrence of birds in Dhaka University campus. *Journal of Biological Sciences*, 25: 27–37.

Cramp, S. and K.E.L. Simmons (1980). *The Birds of the Western Palearctic.* Volume 2. Oxford University Press: 696pp.

Delibes, M. (1975). Alimentación del Milano Negro *Milvus migrans* en Doñana (Huelva, España). *Ardeola*, 21: 183–207.

Dey, T.K. (2009). *Useful Plants of Bangladesh.* The Ad Communication, Dhaka: 1056pp.

Duhla, T.R., A. Guenther, and D. Helmig (2012). Estimating urban vegetation cover fraction using Google Earth® images. *Journal of Land Use Science*, 730: 311–329.

Eiserer, L. A. (1984). Communal roosting in birds. *Bird Behavior*, 5: 61–80.

Elkins, N. (1988). *Weather and bird behavior.* 2nd Edition. T & AD Poyser, London: 240pp.

Ferguson-Lees, J. and D. A. Christie (2001). *Raptors of the World.* Christopher Helm, London. 320pp.

Gadgil, M. (1972). The function of communal roost: relevance of mixed roosts. *Ibis*, 114: 531–534.

Hilden, R. (1965). Habitat selection in birds: A review. *Annales Zoologici Fennici*, 2: 53–75.

IUCN Bangladesh (2015). *Red List of Bangladesh: A Brief on Assessment Result 2015*. IUCN, Bangladesh Country Office, Dhaka: 25pp.

Khan, M.M.H. (2008). *Protected Areas of Bangladesh: A Guide to Wildlife.* Nishorgo Program, Bangladesh Forest Department, Dhaka: 304pp.

Khan, M.M.H. (2018). *Photographic Guide to the Wildlife of Bangladesh.* Arannayk Foundation, Dhaka: 488 pp.

Klopfer, P. (1963). Behavioural aspects of habitat selection: The role of early experience. *Wilson Bulletin*, 75: 15–22.

Mahabal, A. and D.B. Bastawade (1985). Population ecology and communal roosting behaviour of pariah kite *Milvus migrans govinda* in Pune (Maharashtra). *Journal of the Bombay Natural History Society*, 82: 337–346.

Mazumdar, S., D. Ghose, and G.K. Saha (2017). Communal roosting behaviour of the black kite (*Milvus migrans govinda*) in an urban metropolis. *Ethology*, 35: 269–277.

Meghwal, M.L. and K.C. Soni (2017). Roosting behaviour of black-winged kite (*Elanus caeruleus*) inhabiting the arid zone of Rajasthan. *Annual Research & Review in Biology*, 17: 1–11.

Monkkonen, P. (2008). Using online satellite imagery as a research tool: mapping changing patterns of urbanization in Mexico. *Planning Education & Research*, 28: 225–236.

Orta, J., J.S. Marks, E.F.J. Garcia, and G.M. Kirwan (2020). Black kite (*Milvus migrans*). *In*: del Hoyo, J., A. Elliott, J. Sargatal, D.A. Christie, and E. de Juana (*eds*.). *Handbook of the Birds of the World Alive*, Lynx Edicions, Barcelona

Rajia, S., M.M. Alam, G.W. Chowdhury, M. Akash, and M.A. Islam (2015). Status and diversity of birds of Ramna Park, Dhaka, Bangladesh. *Bangladesh Journal of Zoology*, 43: 291–301.

Richner, H. and P. Hebb (1996). Communal life: honest signaling and the recruitment center hypothesis. *Behavioral Ecology*, 7: 115–118.

Siddiqui, K.U., M.A. Islam, S.M.H. Kabir, M. Ahmad *et al*. (2008). *Encyclopedia of Flora and Fauna of Bangladesh*. Volume 26: Birds. Asiatic Society of Bangladesh, Dhaka: 230pp.

UN (2018). *World Urbanization Prospects: The 2018 Revision*, Online Edition. United Nations, Department of Economic and Social Affairs, Population Division.

VinÄuela, J. and J.P. Veiga (1992). Importance of rabbits in the diet and reproductive success of black kites in southwestern Spain. *Ornis Scandinavica*, 23:132–138.

Ydenberg, R.C. and H.H.T. Prins (1984). Why do birds roost communally in winter? *In*: Evans, P.R., J.D. Gess-Custard, and W.G. Hale (*eds*.). *Coastal Waders and Wildfowl in Winter*. Cambridge University Press: 123–139.

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Section Editor: Sampath Seneviratne

S. Hasan[1], A.M.M.K. Abedin[1], A.K.Sarker[1] & H. Naher[1,2]

[1] *Department of Zoology, Faculty of Life & Earth Sciences, Jagannath University, Dhaka, Bangladesh*
[2] *E-mail: likhi.habibon@gmail.com*