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***Research Article** [Open Access]*

REPRODUCTIVE BEHAVIOUR AND HABITAT USE OF CATTLE EGRET (*BUBULCUS IBIS*) IN LUCKNOW, UTTAR PRADESH

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ABSTRACT
The most sensitive bio-indicator of avifauna is the reproductive behaviour that influences the population, community and ecosystem. This study was carried out to investigate the effect of environmental factors on, egg laying, hatching success, nesting success and survival rate of cattle egret in urban, semi-urban and rural areas in Lucknow, Uttar Pradesh. Reproductive parameter, data were recorded during breeding season, and was visually observed using a binocular during study period. Breeding behaviour of cattle egret was found varied with different habitats. The reproductive activity was observed from mid-June to the end of August in urban area, March to mid-May in semi urban and mid-April to end of June in rural area. A total number of 18 nests from urban, 17 nests from semi-urban and 12 nests from rural area used for the experiment. The Percentage of breeding success was high in rural area (85.10%) compared to semi-urban (81.69%) and urban (66.66%). The outcome of the study shows that, the urbanization does effect negatively on reproductive biology of cattle egret.

Keywords: *Cattle Egret, Habitat, Reproductive Behaviours, Urbanization*

INTRODUCTION
Heron are the aquatic birds, and are indicating species for wetland areas. Cattle egrets, *Bubulcus ibis* belongs to the order Ciconiformes and family Ardeidae (Ali, 1996). They are small, white and widely distributed herons, they usually nests in large colonies. Conservation of aquatic birds is an extensive understanding of their eco biological requirements. (Fellowes *et al*., 2001; Li *et al.*, 2016). It Prefers habitat near water bodies and feeds in grassland, pastureland, freshwater marshes, salt marshes, rice fields, river and estuaries (Taylor and Schultz, 2008). Egrets are good subject for breeding study as they are large, abundant and consume easily identified prey. Availability of food and feeding environments influences the selection of habitat by the birds (Samraoui *et al*., 2007). Many studies (Robert *et al*., 2000) shows that, The environmental changes does effects in motivating them in their distribution, habitat use, reproductive parameters and foraging behaviour. They are also the best indicators of pollution (Lowe Mc Connell, 1967; Kazantzidis and Goutner, 1996; Kushlan and Hafner, 2000; Goutner *et al*., 2001) food is believed to be one of the main resources for the survival and reproduction of all living organisms. Cattle egrets show dietary elasticity and adaptability in feeding on varieties of prey in a suitable environment (Mckilligan, 2005). Numbers of studies have shown that the diet of Cattle egrets keeps changing according to the seasons, time period of the day, prey availability and abundancity (Ducommun *et al*., 2008). They also feed in flocks on insects at freshly ploughed fields (Patankar *et al*., 2007). As its insectivorous behaviour, cattle egret is considered as a biological pest control agent in an agro-ecosystem (Thomas *et al*., 2004). The cattle egret is the best-known social bird that feeds in close association with cattles. Such as, cow, buffalo, horse, bull etc. and also with some other domestic and wild host. In breeding ecology of these birds, especially the phenology, relates to climatic conditions (Jakubas, 2011). The climatic changes does effects the arrival dates and the breeding time of birds (Parmesan and Yohe, 2003). Such information could be used as an indicating tool and impact assessment on the breeding ecology of the bird. This bird has been described to nest in agro-ecosystems, in both urban and rural environment, it depends upon safe nesting places, food availability, and other environmental factors (Abdullah, 2016).A good nesting site generally provides protection against predators, necessary support in making the nest, and access to feeding sites within foraging areas (Rao, 2004). Nesting sites also support in hatching success and positive rearing of chicks for species survival (Ludwig *et al*.,1994).Well known theory in ecology known as the “Food availability breeding time” hypothesis suggests, that for the effectual survival , it is very important that, birds

breed at the most advantageous time of the year for upbringing their offspring . Favourable time of the year constitute the supportive environment factors like, optimal temperature, photoperiod, availability of nest sites. The selection of habitat and environmental requirements of cattle egret as well as breeding parameters of the species were studied i.e. egg laying, hatching success, nesting success and survival rate of cattle egret in urban, semi-urban and rural areas .The outcome of this study provides the survival rate of the birds on the basis of habitat use, additionally effect of urbanization on reproductive biology of cattle egret.

MATERIALS AND METHODS

The study was carried out in Lucknow and its associated areas, within in 40 km distance .The Site I was in Khuajapur: Urban area (*Ficus virens*) nesting tree in Lucknow, Site II in Deva :Semi urban area (*Pithecellobium dulce*) nesting tree in Barabanki and Site III at Bichiya: Rural area (*Vachellia nilotica*) nesting tree in Unnao. In order to record various eco-biological aspects of cattle egrets periodic surveys were undertaken for one year 2018 from March to August. Some qualitative data was also collected by interviewing the local peoples around the breeding sites. The ecology of breeding habitats was studied during field visit by observing the size of breeding territory, distance of water resources, prey availability. This makes the site attractive for breeding (Patankar *et al.*, 2007). Non-invasive methods were used in monitoring the colony; therefore all the investigations were carried out without disturbing the nesting pairs. Different breeding aspects of bird appearance, nesting behaviour, courtship display, egg laying, incubation, hatching success, breeding success and parental care period were based on the direct visual observation by digital video camera and binocular Celestron up close G2, 6.8°/35FT/118M (10x50X) (Joshi and Shrivastava, 2012; Kour and Sahi, 2013). Urban area have a population of at least 1500 person per sq. km ,semi urban area, which have at least 300 person per sq. km and rural area, consists mostly low-density per sq. km according to (Chandramouli, 2011). The nests in colony were counted as per point count method (Dodd, 1995). Nesting and hatching success were calculated by following the method of (Fazili, 2002). Nesting success was calculated as NS/ (NS+NU) X100, where NS is the number of successful nest (*i.e.* nest in which at least, one nestling survived beyond 10 days of age), NU is number of unsuccessful nests.

Hatching success was calculated as: Number of egg hatched/ total number of eggs laid or clutch size X100. Breeding success was calculated by the formula (Number of fledglings survived) / (Number of eggs laid X 100) (Vijayan, 1980; Jehle *et al*., 2004). Food items consumed by a cattle egret were recorded on the basis of direct observation while feeding. The contents of regurgitated food from the nests was collected and preserved in a 70% ethanol for identification of taxa (Chapman, 2013). Availability of prey items was recorded by the help of 2 sweep of a long handled net from the foraging area, with in 5x5 metre range, fishes were collected with help of fisherman (Chaskda *et al*.,2018).Difference in prey consumed was analysed by Krushkal Wallis-H test analysis (SPSS version 21). Temperature and humidity was recorded by using hygrometer. Mean and standard deviation of prey items were also carried out by using (SPSS version 21).

RESULTS AND DISCUSSION

Table 1: The reproductive event performance by cattle egret during reproductive season at three distinct habitats such as urban, semi urban and rural in 2018 with the number of sample and percentage

Nesting Variable	Urban (n=23)		Semi urban (n=19)		Rural (n=12)	
	No. sample	%	No. sample	%	No. sample	%
Abandoned nest	5	21.73	2	10.52	0	0
Successful nest	18	78.26	17	89.47	12	100
Total no. of eggs laying	52	-	71	-	47	-
No. of damaged eggs	12	21.56	10	10.34	5	8.51
Hatching success	40	78.43	61	85.91	43	89.36
No. of die fledglings	6	11.76	3	4.22	2	4.25
Breeding success	33	66.66	58	81.69	40	85.1

Table 2: Reproductive behaviour performance by cattle egret during breeding season in three distinct habitats i.e. urban, semi-urban and rural in 2018

Reproductive events	Urban	Semi- urban	Rural
Plumage	26-May-18	13-Mar-18	3-Apr-18
Nest construction	17-June-18	28-Mar-18	20-Apr-18
Egg laying and incubation	23-Jul-18	13-Apr-18	16-May-18
Hatching	15-Aug-18	7-May-18	8-June-18
Parental care	18-Aug-18	13-May-18	17-June-18

Table 3: The mean and SD of prey item consumed by cattle egret in three distinct habitats, urban, semi-urban and rural, whereas Kruskal Walish H test of statistical value at 0.05 level.

Habitat	Prey item	Month						Statistical value	
		March	April	May	June	July	August	H	P
Urban	Insects	10.75 ± 6.02	13.25 ± 7.84	5.75±4.57	7.75±6.29	14.25±3.40	22.5±5.97	11.908	0.036
	Annelidians	-	-	-	-	4.25±3.40	2.75±3.09	19.011	0.002
	Amphibians	-	-	-	-	1.75±1.70	2.25±1.70	14.992	0.01
	Reptilians	2.5 ± 1.91	4.5 ± 2.38	3.75±3.59	4.25±3.20	3.5±2.5	3.25±3.86	2.286	0.808
	Pisces	-	-	-	-	-	-	-	-
Semi urban	Insects	11.5 ± 3.69	13.5 ± 6.75	3.75±2.75	7.5±7.72	16.5±5.25	21.75±4.27	13.582	0.018
	Annelidians	3.75 ± 3.86	-	-	3.5±4.35	9.75±2.98	14.75±10.59	16.485	0.006
	Amphibians	0.75 ± 0.96	-	-	1.75±0.95	8.25±3.30	9.5±6.02	20.495	0.001
	Reptilians	1.5 ± 1.29	2.75 ± 2.5	0.25±0.5	0.75±0.95	2.75±3.09	1.75±2.36	5.094	0.404
	Pisces	3.25 ± 2.98	-	-	2.5±2.64	9.45±9.53	12.75±8.26	13.886	0.016
Rural	Insects	22.25 ± 3.5	16.5 ± 9.57	8.25±3.40	17.5±9.11	20.25±8.30	24.5±3.10	13.039	0.023
	Annelidians	5.75 ± 4.25	-	-	4.75±5.61	13.25±3.68	17.5±4.65	18.631	0.002
	Amphibians	3.75 ± 2.5	2.25 ± 2.87	-	-	10.25±5.73	11.25±5.56	18.555	0.002
	Reptilians	2.25 ± 2.06	1.25±0.95	2.25±0.95	3.5±2.38	4.25±2.36	2.75±3.09	4.072	0.539
	Pisces	4.5 ± 5.31	3.5 ± 2.88	-	2.75±2.75	10.5±4.04	13.25±4.27	16.238	0.006

Table 4: The prey taxon collected from foraging ground in three habitats i.e. urban, semi-urban and rural. Whereas (-) absent, (+) 10 % (++) 20%, (+++) 50% observation.

Habitat	Taxon	March	April	May	June	July	August
Urban	Pisces	_	_	_	_	_	_
	Amphibians	_	_	_	+	++	++
	Insects	++	+	+	+	++	+++
	Annelidians	+	_	_	+	+	++
	Reptilians	+	+	+	+	+	+
Semi-urban	Pisces	+	_	_	+	++	++
	Amphibians	+	_	_	+	++	++
	Insects	++	++	++	++	+++	++++
	Annelidians	+	_	_	_	++	+++
	Reptilians	+	+	_	+	+	+
Rural	Pisces	+	+	+	+	+++	+++
	Amphibians	+	_	_	+	++	++
	Insects	+++	++	++	++	+++	+++
	Annelidians	+	_	_	+	++	+++
	Reptilians	+	+	+	+	+	+

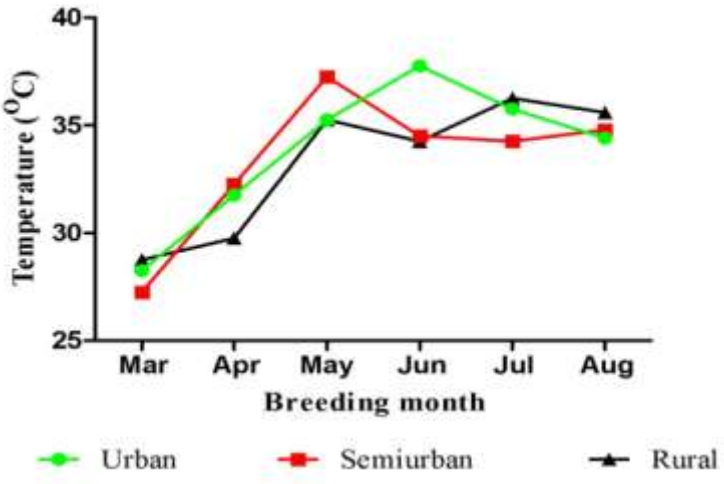

Figure 1: Ambient temperature of three distinct habitats including urban, semi-urban and rural.

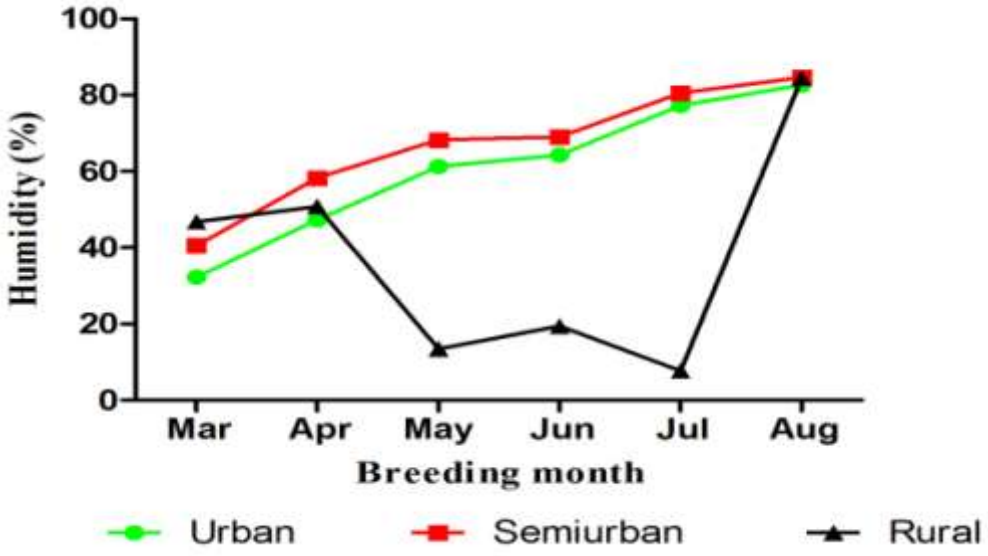

Figure 2: Ambient humidity of three distinct habitat including Urban, semi-urban and rural area.

Results

The total observed nest were 18 in urban area (Lucknow), 17 in semi urban area (Barabanki) and 12 in rural area (Unnao).In which total egg laying was observed is 52, 71, 47. Rate of egg destruction was found 12 number in urban, 10 egg damaged in semi urban and 5 egg were damaged in rural area. Chick destruction rate in urban was 6, in semi urban 3 and 2 were in rural site. The Percentage of breeding success was high in rural area (85.10%) compared to semi-urban (81.69%) and urban (66.66%) (Table 1).

Breeding biology of cattle egret was found varying different habitats. The overall reproductive activity was observed from mid-June to the end of August in urban area, March to mid-May in semi urban and mid-April to end of June in rural area. Time of reproductive behaviour of cattle egret vary according to the local environment of nesting habitat. (Table 2).

Prey items

Breeding success is apparently depends on the quality of prey items in the diet, mainly during the peak of their development period (Kazantzidis *et al*., 1996).Growth of Reproductive behaviour was highly influenced from the prey consumed by egret and availability of prey items at reproductive sites. As the high prey availability of insects increases in the prey consumed rate and high prey consumption provides the healthy reproductive growth in cattle egret. In this study cattle egrets diet was observed, i.e. that Reptilians have no significant difference at different habitat and in different month. The availability of reptilians did not decrease or increase according to month or habitat is recorded. Insects occupied 30 to 40% part in diet of egret, as the availability was high as compare to Pisces, Amphibians, Annelida's and reptilians (see Table 3 and 4). In urban area Pisces was absent in diet and availability too. While Amphibians, Annelidians and Pisces number was found increased, in both availability and in consumption during month of (rainy season) July and August (20 to 30%) (Table 3 and 4) at all three breeding habitats. Because of monsoon season started from last week of June in Lucknow region. The Pisces, Amphibians, Insects and Annelidians were observed with having significant difference in availability and consumption throughout the breeding time at all breeding habitats. While overall prey items was highly available in semi urban area, of which the influence was recorded, The breeding activity in semi urban area started much earlier than in rural and urban area. The first juvenile was observed in the month of May. While in urban and rural area it was observed in August and June.

Temperature and humidity

Mean temperature of all breeding habitats was recoded between 32 °C to 37 °C. (Haftorn, 1988) has reported about mean temperature of 34°C for birds in general for breeding success. July to August was incubation time in urban area, temperature was (35.25°C to 34.4°C) and humidity was (77 to 82%). In April to May at semi urban area temperature was (32.25 to 37.25 °C) and humidity was found (80 to 84).at rural area in May to June temperature was 36.25°C to 35.27°C) and humidity was (82 to 84%)(Figure 1and 2)

Discussion

In semi urban and rural area, nesting tree was observed is *Pithecellobium dulce* (18.918m height ,6.7m dbh)and *Vachellia nilotica (*9.52m height ,4.5m dbh).Apart from these nesting tree different species of nesting were also found like *,Arecaceae , Vachellia nilotica,and Ficus racemosa* . Source of water was the pond, present with in the 500m range in both sites. While in urban area only one nesting tree was observed in fact, at this site only one nesting was found i.e. *Ficus virens (*22.94 m height, 7.5 m dbh). Source of water was not present with in the 500m range.

Availability of food or environmental conditions may explain variance in the number of individuals breeding both within and among colonies (Brown *et al*., 1990). Anthropogenic changes do affect the breeding colonies in the study of bird species, as (Frederick and Collopy, 1989).

The damage rate of eggs and chicks die was observed high in urban area. According to observation the breeding success rate, could be affected by the human disturbance. As the nesting tree is located on the side of road. And the residential area around the tree is increasing due to construction of more buildings day by day.

Breeding season

In general the breeding season of cattle egret was observed from March to August, while various studies in India supports that, breeding period of cattle egret vary according to seasons and locations, as the (Patankar *et al*., 2007) in Vadodara, Gujarat reported that breeding month was April to July. And in Jammu, India (Kour and Sahi, 2013) reported from March to July was breeding month. And in present study the overall breeding month was considered from March to July. This study agreed with (Joshi and Shrivastava, 2012; Abdullah, 2016), that in non-breeding season Orange colour plumage was completely disappears. Whole body appears in white colour, bill becomes yellow; legs were black in both male and female birds. In breeding season, the orange colour plumage is appeared on head, neck and back of the bird, however bill and legs becomes yellow reddish in colour. The breeding plumage are used mainly in courtship behaviour and were absent in non-breeding season.

Nest Construction

The process of nest construction was observed in the month of June in urban area, in March at semi urban area and in April at rural area. However, the practice of nest repairing was seen to be continued even after eggs laying, incubation and hatching. Although the activity of nest construction was slowly decreased, also reported by (Kour and Sahi, 2013). It was observed that cattle egrets formed their colonies where water sources are present nearby trees and at the edge of the village area, road side and human vicinity. It was observed at each study site I, II, III, both male and female birds build the breeding territory. Nest construction were typically started in second week of June in urban area, fourth week of March in semi urban area and in rural area third week of April.

Nest was made up of rough sticks, shrubs and twigs retained in wedge of branches in trees. Egrets started constructing the nest much earlier of their mating. They were observed to collect nesting materials from the nearby fields, from old nest and other branches from same nesting trees. Nests were found completed in 8 to 10 days in all the three breeding habitats. Nesting colonies were observed in this study were polyspecific with pond heron, snowy egret (Ali and Ripley, 1968; Maccarane and Parsons, 1988).

Courtship behaviour

Courtship behaviour of egret was observed after they had completed their nests in the fourth week of June in urban, second week of March in semi urban and in first week of May in rural site. In all sites egret mating was observed near the nesting sites. All study was done from one to five meter range distance of the nest (Mackilligan, 2005; Kour and Sahi, 2013).In the present study mating was observed mostly in the morning and at the middle of day.

Egg laying

Egg laying behaviour were seen after mating activity in second week of July at urban, fourth week of March at semi urban and in first week of May at rural site. Female birds were seen sitting in nest or around the nest whole day. After egg laying, the male egret takes care in maintaining nest. Eggs were medium in size, oval in shape and light blue in colour, (Kour and sahi, 2013) also reported similar characteristics of eggs.

Incubation period

The incubation periods started with the laying of first egg and during incubation, one of the two partners sat on the eggs, but mostly the female was noticed. The variation in incubation period was observed from 24-26 days in urban site. (Joshi and Shrivastava, 2012; Kour and Sahi, 2013) has also reported about incubation periods from 21-24, in both semi urban and rural sites.

Clutch size

The clutch size was observed at all breeding sites after 4 to 5 days of egg laying. Results revealed, that the clutch size was (Mean ± SD) (4.17±1.38) in semi urban area, (3.91±1.37) in rural area and (3.27±1.17) in urban area. The range of the clutch size was observed as 02 to 06 eggs (n=), 03 eggs being the common and exceptionally 06 (Table).

Hatching

Hatching time of eggs differs according to the time of egg laying. At site (urban, semi urban) it was observed in third week of August and first week of May and in site (rural) it was observed in second week of June.

Parental care

Parental care was started just after hatching of eggs, it vary nest to nest. Cattle egrets searches food to their chicks from nearby areas after hatching, the parent birds starts to bring the regurgitated food to their chicks and teach to eat regurgitated food in their partly opened beak. The chicks grew their feeding method regularly to change from nest feeding to ground feeding. Over all parental care was observed for three to four week at each site respectively. During parental care chicks make an effort to fly within the branches of nesting trees or around the nests. After the age of four weeks, juveniles were found able to fly.

Availability of aquatic organisms in food is one of the main factors for breeding success of cattle egret. In urban area the Pisces and Amphibian were absent in the diet of egret. This may be the reason of reducing of clutch size. The food resources availability also an effect on the time of breeding season begins. As many of study reported that the fishes and aquatic organisms are the rich source of nutrition for the herons. According to (Si Bachir *et al.*, 2000) study indicates that the difference between the clutch sizes, nestling survivorship depends on the food availability at different sites.

Conclusion

This study highlights the basic breeding ecology of cattle egrets. Availability of food resources and foraging environments influence the selection of habitat by the cattle egret. The results of this study suggest that the mortality of eggs and fledglings probably varies according to the local environmental conditions, especially the temperature and humidity plays a major role in incubation period of eggs. Nest location is the major factor which affects the survival rate, as seen in cattle egret. The urbanization at regular breeding habitats is the main threat to the local egrets nesting colonies.

REFERENCES

Abdullah M, Khan RA, Rafay M, Hussain T, Ruby T, Rehman F, Khalil S and Akhtar S (2016). Habitat ecology and breeding performance of cattle egret (*Bubulcus ibis*) in Faisalabad, Pakistan, *Pakistan Journal of Zoology*, **49**(5) 1863-1870.

Ali S (1996). *The book of Indian birds*, Ist edition. Oxford University Press, New Delhi.

Ali S and Ripley SD (1968). *Hand book of the birds of India and Pakistan*. Oxford University Press, Bombay,pp.66-68.

Brown CR Stutchbury BJ and Walsh PD (1990). Choice of colony size in birds. *Trends in Ecology and Evolution* **5**(12) 398-403.

Chandramouli C (2011). Census of Rural urban distribution of population India. *Ministry of home affairs.*
Chapman RF, Simpson SJ and Douglas AE (2013). The insects structure and function, Fifth edition. *Cambridge University Press.*
Chaskda AA, Iniunam IA, Dami DF, Mwansat GS (2018). Foraging success of the cattle egret Bubulcus ibis in relation to insect abundance, herd and flock size. *Journal of Research in Forestry,Wildlife and Environment* ,**10**(1)41-47.
Dodd MG (1995). Accuracy and precision of techniques for counting Great Blue Heron nests. *Journal of Wild Life*. **59** 667-673.
Ducommun M, Dela P, Quirogaa MA, Beltzera AH and Schnack JA (2008). Diet of cattle egrets (*Bubulcus ibis*) in the flood valley of the Parana River, North, Argentina. *Avian Biology Research*, **1** 145-151.
Fazili M F (2002). *Studies on annual cycle of some birds of Wular Lake Kashmir*. Ph.D. thesis submitted to University of Kashmir.
Fellowes JR, Fang Z , Shing LK , Hau BC , Lau MW, and Lam VW(2001). Status updates of white eared night heron gorsachius magnificus in south China. *Bird Conservation International*, **11** 101-111.
Frederick PC and Collopy MW (1989). The role of predation in determining reproductive success of collonially nesting wading birds in the Florida Everglades. *The Condor*, **91** 869-867.
Goutner V, Furness R and Papakpostas G (2001). Mercury in feathers of squacco heron (*Ardeola ralloides*) chicks in relation to age, hatching order, growth and sampling dates. *Environmental Pollution*, **11** 107-115.
Haftorn S (1988). Incubating female passerines do not let the egg temperature fall below the 'physiological zero temperature' during their absences from the nest. *Ornis Scandinavica*. **19** 97-110.
Jakubas D (2011). The influence of climate conditions on breeding phenology of the grey heron Ardea cineria L. in northern Poland. *Polish Journal of Ecology*, **59** 179-192.
Jehle G, Adams AAY, Savidge JA and Skagen SK, (2004). Nest survival estimation: a review of alternatives to the Mayfield estimator. *Condor,* **106** 472-484.
Joshi P and Shrivastava VK (2012). Breeding biology and nest site selection of cattle egret (*Bubulcus ibis)* in Tawa Reservoir and surrounding area of Hoshangabad District (M.P). *Asian Journal of experimental biological Sciences,* **3** 525-530.
Kazantzidis S, Hafner H and Goutner V (1996). Comparative breeding ecology of Little egrets Egretta garzetta in the Axios Delta (Greece) and the Camargue (France). *Reve Ecologie* (*Teree et Vie*) **49** 53-62.
Kour DN and Sahi DN (2013). Aspects of breeding biology of cattle egret, *bubulcus ibis coromandus* (boddaert) in Jammu, India. *International Journal of environmental Science,* **3** 1547-1561.
Kushlan JA and Hafner H (2000). *Heron conservation*. Academic Press, London, UK.
Li X , Xian Z , Xinrong X , Shicheng L, Yongqiang Z, Danxi C, Chenxi H, Bingyao C and Guang Y (2016). Bird diversity in the buffer zone of the largest coastal nature reserve of China and conservation implications. *Pakistan Journal of Zoology,* **48** 1193-1199.
Lowe-Mc Connell RH (1967). Biology of the immigrant cattle egret *Ardeola ibis* in Guyana, South America. *Ibis International Journal of Avian Biology,* **109** 168-179.
Ludwig E, Vanicsek L, Torok J and Csorgo T (1994). The effect of nest height on the seasonal pattern of breeding success in blackbirds, *Tardus merula*. *Ardea,* **83** 411-418.
Maccarone AD and Parsons KC (1988). Differences in flight patterns among nesting ibises and egrets. *Colonial Water bird,***11** 67-71.
McKilligan NG (2005). Herons, egrets and bitterns: Their biology and conservation in Australia. *CSIRO Publishing*, pp. 144.
Parmesan C and Yohe G (2003). A globally coherent fingerprint of climate change impacts across natural systems. *Nature,* **421** 37-42.
Patankar P , Desai I , Shinde K and Suresh B (2007). Ecology and breeding biology of the cattle egret (*Bubulcus ibis*) in an industrial area at Vadodara, Gujarat. *Zoos' Print Journal,* **22** 2885-2888.
Rao VV (2004). *Egrets and their role in environment*. International Conference on Bird and Environment, Haridwar, India, pp. 40.
Roberte, Bennetts, Fasola M, Hafner H, and Kayser Y (2000). Influence of environmental and density-dependent factors on reproduction of little egrets. *The Auk,* **117**(3) 634-639.

Samraoui F, Menaï R and Samraoui B (2007). Reproductive ecology of the cattle egret (*Bubulcus ibis*) at Sidi Achour, North-Eastern Algeria. *Ostrich*, **78** 481-487.
SiBachir A, Hafne Hr, Tourenq JN and Doumandji S (2000). Structure de l'habitat et biologie de reproduction du Héron Garde-bœuf, *Bubulcus ibis*, dans une colonie de la vallée de la Soummam (Petite Kabylie, Algérie). *Reve Ecologie* (*Teree et Vie*), **55** 33-43.
Taylor IR and Schultz MC (2008). Breeding season diets of egrets in Southeast Australia: implications for future population viability. *Waterbirds*, **31** 593-601.
Thomas J, Chellappan M and Bhaskar H (2004). *Role of insectivorous birds in rice pest management*. International Conference on Bird and Environment, Haridwar, India.
Vijayan VS (1980). Breeding biology of bulbuls, Pycnonotus cafer and Pycnonotus luteolus (Class: Aves, Family: Pycnonotidae) with special reference to their ecological isolation, *Journal of the Bombay Natural History Society*, **75** 1090–1117.