Bulletin of Pure and Applied Sciences
Vol.40A (Zoology), No.1,
January-June 2021: P.6-14

Print version ISSN 0970 0765
Online version ISSN 2320 3188
DOI 10.5958/2320-3188.2021.00002.4

Content Available online at: https://www.bpasjournals.com/zoology

Original Research Article

Foraging Behaviour and Host Selection of Cattle Egret (*Bubulcus ibis*) Among Different Host Species in Lucknow (Uttar Pradesh)

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Article Info:
Received on 22.09.2020
Accepted on 01.01.2021
Published on 15.06.2021

ABSTRACT:
Objective:
The main focus of the study was to investigate the host selection behaviour in the foraging strategy of *Bubulcus ibis* with their feeding rate.
Methods: Study was carried out to analyze the host steps rate, *B. ibis* steps rate, attempt success rate and the number of switches, with different host at different lands i.e. grassland, marshy land and agriculture land in the associated areas of Lucknow from 2018 - 2019, was recorded through visual observations, digital video camera and binoculars. The host steps rate, *B. ibis* steps rate and the attempt success rate was analyzed by the Spearman correlation (SPSS version 21) and the number of switches per hour were calculated by using the formula an Average number of switches/Average time of observation x1/60
Findings/Application: *B. ibis* with Buffalo showed highly significant positive correlation in steps and attempt success at all three lands with less number of switches per hour. In agriculture land with horse it's showed less significant correlation in steps and attempt success with high number of switches per hour. Results show that foraging success could be the reason for good association between cattle and *B. ibis*

Keywords: Attempt success, Foraging behaviour, Host selection, Switches, Steps of hosts, Steps of *B.ibis*.

INTRODUCTION

Cattle Egret (*Bubulcus ibis*) has a worldwide distribution in the tropics, subtropics and warm temperate regions. In India, it is very common in varieties of habitat especially grassland, marshy land and in some wetlands such as paddy fields, marshes and mangroves, etc. They are the part of the environment and nature belongs to the family Ardeideae, which are small white herons of approx. 50 cm tall at standing position. They play an important role in the food chain in the ecosystem. *B. ibis* is a diurnal feeder commonly foraging around grazing

How to cite this article: Verma, M., Elangovan, V., Dwivedi, A., Kumar M. (2021). Foraging Behaviour and Host Selection of Cattle Egret (*Bubulcus ibis*) Among Different Host Species in Lucknow (Uttar Pradesh).*Bulletin of Pure and Applied Sciences-Zoology,* 40A (1), 6-14.

animals in the wild or domesticated livestock. (Del Hoyo et al., 1992; Kushlan and Hancock, 2005)

In the late 19th century, such species became established in South America (Turner, 2011) and the present century has established itself in Australia, Asia, New Zealand, North America and Europe. It plays a significant role in a variety of ecosystems with their foraging habits and makes them efficient as an important biological control agent. Such insectivorous birds consume insects like grasshopper, cricket, flies, moths, spiders and some insects of public health as well as agricultural pest. (Doumandji et al., 1992; Telfair and Raymond, 2006).*B. ibis* is an opportunistic predator feeding on an abundant and accessible prey (Kushlan and Hafner, 2000).

B. ibis is the best known bird that feeds in close association with cattles. The capability of foraging mostly seen in the close association with cattles (Dinsmore,1973; Thompson et al.,1982; Wahungu et al., 2003; Kamler et al., 2008) such as, cow, buffalo, horse, bull etc. and also with some other domestic and wild host. *B. ibis* support symbiotic relationship through foraging association with cattles in gaining more benefits of feedings (Rand, 1954 and Siegfried, 1978).

At inter specific levels, host selection of egrets are most effective with the host species such as cow, buffalo, horse, bull, wildebeest, zebra, hippopotamus and other ungulates in various habitats (Burger and Gochfeld, 1993; Kour and Sahi,2012; Ogutu et al., 2014).

B. ibis feeds with cattle, captures more food than those are feeding alone. The birds appear to exploit their beating effect whereby insects and other prey disturbed by the cattle and hence are easier to detect or capture (Heatwole, 1965). However, the strategy implemented by egrets for improving the success rate was examined (Grubb, 1976; Burger and Gochfeld, 1999).

The *B. ibis* follow animals specifically because they move and flush prey items. This method is effective for the egret that they must follow the animals closely (Burger and Gochfeld, 1981). In India (Kour and Sahi, 2012; Seedikkoya et al., 2005) have reported about the factors influencing preferences of the host by cattle egret and the characteristics of certain cattle, as "suitable host". The term attempt success rate is the number of food items obtained and swallowed by the *B. ibis* per five minutes (Burger and Gochfeld, 1981).

B. ibis keeps feed near the cattles until the cattle ignore its presence otherwise it starts tail wagging and shakes the head to remove the *B. ibis* (Burger and Gochfeld, 1993). The activity of switching counts of *B. ibis* means the time duration of association and disassociation counts with the host (Burger and Gochfeld, 1981).

The present study was aimed to investigate the relationship between speed, capture success rate and different aspects of host preference i.e. attempt success rate and switches of host. Both concepts have been referred to as success rates, time of association i.e. "time spent by the *B. ibis* in foraging with cattle.

MATERIALS & METHODS

The study was conducted weekly between 2018 to 2019 in the sites of Lucknow district and its associated areas up to 40km i.e. grassland, marshy land, and agriculture land. The geographic coordinates of Lucknow are 26.8470°N and 80.9470°E (Seedikkoya et al., 2005; Kannaujiya et al., 2013). And the temperature ranges between 25-45°C in summers, 2-20°C in winters. According to India metrological department, 2018 mean annual rainfall is approx. 35.28 inch.

The study was assessed through periodical field visits at Grassland (an area which included ecosystem where grasses and forbs were dominant), Marshy land (wetland associated with lakes, swampy) and agriculture land (including intensively managed or grazed wet meadow or pastures) (Grobicki, 2016).

The collection of the data lasted between 0600 h - 1800 h through visual observations, digital video camera and binocular Celestron up close G2,

6.8°/35FT/118M (10x50X). *Bubulcus ibis* feeding behaviour was studied with the cattle i.e. cow, buffalo, horse, bull, mule on the basis of number of host steps, *B. ibis* steps, number of attempt success, foraging time and the number of time *B. ibis* switching, which was recorded for five minutes and in some cases it was for one or two minutes due to the fast foraging movements by most individuals at different locations and habitats. Host species availability was determined at each present within 200 – 300 meters by counting to avoid distracting avian behaviour at all feeding habitat. Up to 30 individuals of each species at each habitat were observed to determine the host suitability. Association foraging was considered when *B. ibis* for age near the host within two to three meters to avoid the pseudo-replication method (Chaskda et al., 2018) with slight modification.

Swallowing behaviour was counted after capturing the prey as the capture success rate of egret, identified. Host preference and foraging success were analyzed by the previous methodology described by with slight modification (Heatwole, 1965; Dinsmore, 1973; Grubb, 1976; Scott, 1984).

The relationship between the speed of both hosts and *B. ibis* with the attempt success rate was analyzed by Spearman Rank correlation test (SPSS version 21). The switches count per hour calculated by Average number of switches/Average time of observation x1/60.

RESULTS

In the present study, the foraging association of the cattles was observed with the total no. of 634 hosts of cow, buffalo, bull, horse and mule in grassland, marshy land and agriculture land. In association with cattles, the percentage was highest in grassland (36.10%), followed by marshy land (32.10%), agriculture land (30.68%). The percentage of egrets associated with cattle showed the little seasonal variations in agriculture land. In afternoon, *B. ibis* showed the highest frequency of association with cattle and low association in early morning and late in the evening (Aboushiba et al., 2015). In such association, they usually fed near the front leg or back leg or middle (Kour and Sahi, 2012).

They left roost in small groups to disperse in the different areas. In evening, small groups return from foraging areas often congregated in flocks of hundreds of individuals. The buffalo was the best suitable host for *B. ibis* in the attempt success correlation rate in comparison with the others and horse was the unsuitable host as compare to another host. The correlation rate is significant at the ($p < 0.01$) level. Based on such study the increasing order of the suitability of the host are as follows, buffalo<cow<bull<mule<horse.

Foraging behaviour with cow:
B. ibis showed significant positive correlation in steps of cow. *B. ibis* with the number of switches per hour in such a way was about (r=0.451**, 4.1) in grassland, (r=0.379**, 4.8) in marshy land and (r=0.434**, 4.2) in agricultural land. The attempt success resultant showed the cow was a satisfying host to *B. ibis* with the significant positive correlation i.e. in grassland (r=0.774**), (r=0.481**) in marshy land and (r=0.619**) in agriculture land (Table 1, 2 and Figure 1).

Foraging behaviour with buffalo:
The feeding association relationship of *B. ibis* with buffalo, steps showed significant positive correlation and switches per hour was very low in grassland (r=0.546**, 3.3), marshy land (r=0.297**, 3.6) and in agriculture land (r=0.559**, 3.2)(Table 1 and fig.1), hence the resultant attempt success showed highly significant positive correlation and reaches maximum range of feeding success i.e. (r=0.761**), (r=0.678**) and (r=0.811**) (Table 2). Therefore, it is concluded that buffalo was the best suitable host to *B. ibis.*

Foraging behaviour with bull:
In foraging behaviour with bull grassland and agriculture land steps showed significant positive correlation and switches per hour were as (r=0.411**, 6.8) and (r= 0.212**, 7.2) (Table 1) therefore, *B. ibis* attained attempt success rate (r=0.503**, r=0.488**) (Table 2) and also showed the significant positive correlation, which was approximately fifty percent feeding success in grassland and agriculture land. While in marshyland

this feeding association showed lowest steps correlation rate and high number of switches per hour (r=0.272**, 7.3) (Table 1). Therefore, in marshy land, *B. ibis* achieved less attempt success rate (r=0.334**) (Table 2), accordingly it is concluded that feeding association relationships of *B. ibis* with bull was less satisfying association.

Table 1: Foraging behaviour of *B. ibis* with different host

Habitats	Host	Step rate of host	Step rate of *B. ibis*	R-Value
Grassland	Cow	36.09±19.2	46.71±18.11	0.451**
	Buffalo	41.1±14.06	53.71±14.59	0.546**
	Bull	41.90±13.02	55.98±14.55	0.411**
	Horse	41.74±12.54	53.52±17.23	0.283**
	Mule	29.64±20.20	37.94±17.31	0.099
Marshyland	Cow	39.51±15.57	52.69±15.88	0.379**
	Buffalo	40.80±13.26	53.36±15.95	0.297**
	Bull	39.57±13.46	57.05±14.78	0.272**
	Horse	40.00±13.74	57.09±17.39	0.220**
	Mule	35.23±15.10	46.17±13.98	0.233**
Agricultureland	Cow	39.83±13.17	53.83±16.72	0.434**
	Buffalo	37.23±13.38	49.94±16.84	0.559**
	Bull	36.82±11.66	52.18±13.82	0.212**
	Horse	55.92±21.89	43.10±16.20	0.169**
	Mule	37.47±11.92	51.69±15.11	0.219**

R-value: Spearmean Rank correlation value between steps of host and steps of *B. ibis* Steps was recorded at per five minute.
**. Correlation is significant at the 0.01 level (2-tailed).

Table 2: Foraging success of *B. ibis* with different host

Habitats	Host	Attempts	Success	R-Value
Grassland	Cow	18.63±9.15	9.35±6.74	r=0.774**
	Buffalo	17.10±8.05	8.50±5.79	r=0.761**
	Bull	18.02±7.63	7.461±4.87	r=0.503**
	Horse	16.18±8.05	7.28±5.67	r=0.548**
	Mule	18.92±8.19	6.29±4.81	r=0.363**
Marshyland	Cow	20.47±7.12	8.39±5.76	r=0.481**
	Buffalo	18.46±6.60	10.63±5.49	r=0.678**
	Bull	18.83±8.45	7.42±5.15	r=0.334**
	Horse	17.55±8.56	6.01±4.69	r=0.409**
	Mule	18.92±8.19	6.34±4.80	r=0.346**
Agricultureland	Cow	21.64±8.88	10.5±6.70	r=0.619**
	Buffalo	15.94±7.90	7.98±5.57	r=0.811**
	Bull	20.31±6.95	9.81±7.39	r=0.488**
	Horse	18.79±8.49	7.30±5.02	r=0.131*
	Mule	18.77±8.67	6.51±4.51	r=0.419**

R-value: Spearman Rank correlation value of attempt success rate of *B. ibis.* Attempt success was recorded at per five minute.
**. Correlation is significant at the 0.01 level (2-tailed).
*.Correlation is significant at the 0.05 level (1-tailed).

Foraging behaviour with horse:
In foraging behaviour with horse in agricultureland, steps showed significant positive correlation (r=0.169**, *P*<0.01) (Table 1) and the switches per hour was high (12.6) (Figure 1) hence, *B. ibis* attained (r=0.131*, *P*<0.05) (Table 2) attempt success rate. *B. ibis* with horse achieved lowest attempt success rate as compared to other hosts. The attempt success and switches per hour in grassland were higher with horse in comparison to the other hosts such as (r=0.283**, *P*<0.01, 9.0) and in marshy land it was (r=0.220**, *P*<0.01, 8.7) (Table 1, Figure 1). Therefore, it attained attempt success rate (r=0.548**and r=0.409**) (Table 2). Based on the step correlation, switches and attempt success rate in this relationship was less than satisfying.

Foraging behaviour with mule:
In foraging behaviour with a mule in grassland not showed significant negative correlation in steps, while attempt success showed a significance positive correlation i.e. (r=0.099), (r= 0.363**). In marshyland and agriculture land, steps and attempt success both showed the significant positive correlation i.e. (r= 0.233**), (r=0.219**) and (r=0.346**), (r=0.419**) and the switches per hour were (7.7) in grassland, (7.1) in marshyland and (8.5) in agriculture land (Table 1, 2 and Figure 1). Based on the steps correlation, switches and attempt success, this relationship was less than satisfying.

Switches:
In Figure 1, *B. ibis* showed the lowest switches per hour with buffalo at all the three feeding habitats in comparison to all other hosts i.e. grassland(3.3/hour), (3.6/hour) marshyland and (3.2/per hour) in agriculture land. In respect with horse, it shows the highest switches per hour at all the three lands such as (9.0/hour, 8.7/hour and 12.6/hour).

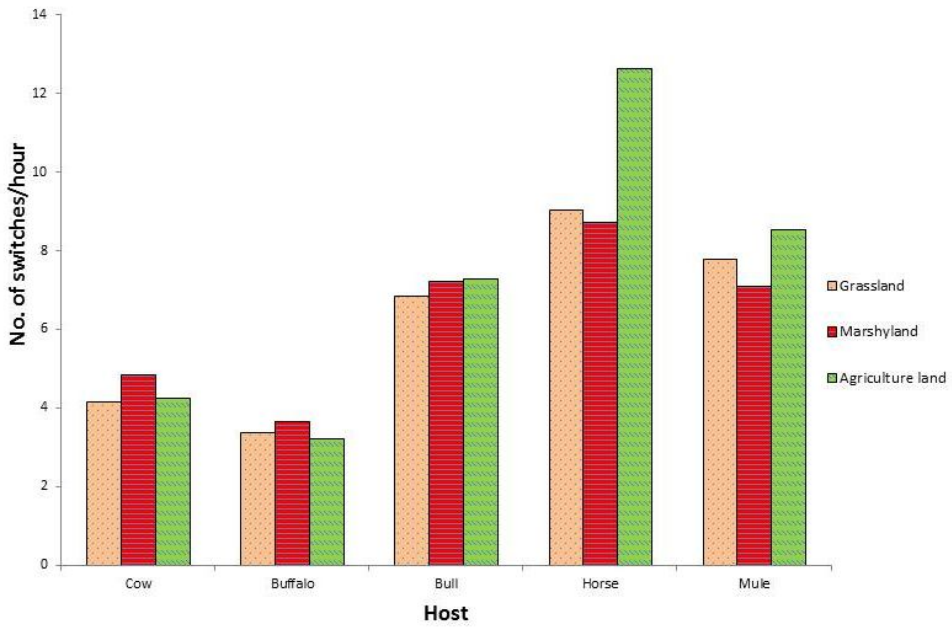

Figure 1: Number of Switches of *B. ibis* with different hosts at different habitats

DISCUSSION

The host preferences by *B. ibis* are more effective to gain their opportunity to capture more prey. They prefer to select the host species which moves neither too much fast nor too much slow. If the host moves very slow or rapidly the egrets switch their hosts. The steps of hosts affect the steps of egrets simultaneously (Itzkowit and Makie, 1986).

The capture rate depends on the optimal speed of the host steps as well as egret steps (Burger and Gochfeld, 1993).

When *B. ibis* associated with large bodied cattle over small bodied as the large bodied cattle disturbs more prey (Mikula et al., 2018) so, they caught prey items at a faster rate and spent less energy to achieve this, as has been noted in other studies on this Species (Heatwole, 1965; Grubb, 1976).

In this study, it was observed that *B. ibis* usually showed feeding association relationships with cattle on grassland, marshy land and agriculture land (Anastasios et al., 1997).

According to an analysis of all the variables, buffalo seems profitable and best suitable host to *B. ibis.*

Steps of hosts and *B.ibis*:
B. ibis showed highest attempt success relationship with buffalo (r=0.811**), lowest with horse (r=0.131**) (Table 2). As we know buffalo was grazing with slow speed (37.23 ± 13.38) compare to horse (55.92 ± 21.89) at per five minute (Table 1), as a result steps of egret with buffalo (49.94 ± 16.84) and with horse (43.10 ± 16.20) was differed. *B. ibis* showed less switches with buffalo (3.3/hr) compare to other hosts as well as horse i.e. (12.63) (Figure 1). Due to its ignorance behaviour towards *B. ibis.* Overall switches count with horse was very high than other hosts, as it starts tail wagging and shakes the head to remove the *B. ibis* (Kour and Sahi, 2012). And when its moves too fast, *B. ibis* usually makes switches or ignore them, or takes stand and wait position. Based on increasing order, the switches counts hosts are as follows, buffalo<cow<bull<mule<horse.

B. ibis forage in single, pairs and flocks by searching, running and flying after catching the prey. *B. ibis* occasionally feeds with donkey or goat but do not spend so much time to forage with them. During the study period, *B. ibis* was present regularly in grassland as the prey was present throughout the observation period and due to the less human disturbance with the fixed time of cattles grazing. Therefore, this shows the high percentage of birds association in grassland. Marshy habitat was followed by few numbers of vegetation. Grass was present only at the edge of habitat with a number of pits were present. In summers, as the temperature increases the marshy land dried out and it converted into dry land (Bauder, 1989) therefore, cattle were not preferred much grazing in such habitat because of low vegetation. But in monsoon season, the marshy habitat converted into wetland due to the water logging, rushes and grasses over the whole land.

Hence, the cattles start grazing in marshy land during monsoons as it shows the less percentage of association of birds comparatively than grassland. Buffalo preferred such area of low wetland and grazes comfortably for the long time than other grazers such as cow, horse and bull.

Therefore *B. ibis* obtained more feeding success with buffalo than others. In agriculture land, at the time of uncultivation we observed a good percentage of association and the number of birds. In cultivation period, from middle of December - February last we observed very less association feeding of *B. ibis*.

The availability of bird populations in habitat varies depending on the requirements of the bird species and conditions offered by the habitat. However, the trapping way in habitat studies revealed the uncultivated fields offers more prey to predatory birds, especially *B. ibis* (Mohammedi et al., 2015). *B. ibis* regularly foraged in agriculture land

During the study all host cattle showed a good correlation in steps and attempt success rate with *B. ibis* except horse and mule (Rao, 2004). Horse and mule prefer

grassland for grazing (Sheehy and Martin, 1996) and other cattles such as buffalo, cow and bull grazes so comfortably as the grasses was less as compare to the crops. Horse and mule need to move faster in searching of more green grass that result the percentage of switches goes high and the time of association becomes less (Burger and Gochfeld, 1981).

B. ibis can forage without cattles, when hosts are not available or are in resting phase (Siegfried, 1971). It was observed that the *B. ibis* get more food items with host at per five minutes than, those of feeding alone. Switching and association time is a basic factor of *B. ibis* foraging with cattle's, i.e. allowing birds to repeatedly prefer host with more suitable movement. The high number of switches and less time of association indicates the low foraging success. We found that about 90% of the egrets switched the hosts, which is an important factor that influences the foraging success of *B. ibis.* In foraging success our result revealed that of *B. ibis* does not select hosts randomly but they prefer the host which seems to be tolerant along with easy and long association. It was observed that in all sites the *B. ibis* feeds mainly orthopterans insects (Siegfried, 1972).

Cow is the most selected host by *B.ibi* (Burger and Gochfeld, 1981). While this study showed that the buffalo is the most appropriate and selected host due to the widespread distribution than other hosts in the study areas. The walking steps of the cow as well as buffalo were in an optimal feeding range of *B. ibis*.

CONCLUSION

Above results shows that, *B. ibis* shift hosts when the host's movements are within their optimal foraging range, they do not randomly select hosts. *B. ibis* could avoid or leave hosts that moved too fast by losing its accuracy of capturing the prey with increasing host speed. In case of high feeding success rate, foraging with cattles showed a number of steps of *B. ibis,* which was about (49.94 ± 16.84) at per five minutes and for cattle it was (37.23 ± 13.38). The high number of switches and less time of association indicates the low foraging success.

Thus, the buffalo is a suitable host for *B. ibis*. Based on decreasing order, the suitability of hosts are as follows, buffalo>cow>bull>mule>horse. The high number of switches and less time of association indicates the low foraging success. Feeding habitat preferred according to the seasonal changes, *B. ibis* feed at all types of habitat in all season whether it was grassland, marshy land or agricultural land. The number of population of birds will decrease or increase accordingly. Grassland proved to be more profitable than marshyland and agricultureland plays a complementary role for *B. ibis* foraging

Acknowledgement

Statistical data analysis was done by the help of Dr. Subhash Kumar Yadav (Assistance professor) of biostatistic department of BBA University, Lucknow. Research work is not funded by any National and International bodies.

REFERENCES

1. Del Hoyo J, Elliiot A, Sargatal J. (1992). Handbook of the Birds of the World. Ostrich to Ducks.
2. Kushlan JA, Hancock J. (2005). The Herons. Oxford University Press.
3. Turner D. (2011). Checklist and status of herons in East Africa. *Journal of Heron Biology and Conservation*. 1, 1-9.
4. Doumandji SE, Doumandji-Mitiche B, HamadacheH. (1992). Places des orthopteres en milieu agricoledans le regime alimentaire du Heron grade en Grand Kabylie (Algerie). *Mededelingen van de Faculteit Land bouwweten schappen. Rijksuniversiteit Gent*. 58(2a), 365-372.
5. Telfair II, Raymond C. (2006). "Cattle Egret (*Bubulcus ibis*)". The Birds of North America online (A. Poole, Edition.) Ithaca. *Cornell lab of ornithology*. 2006; 1-13.
6. Kushlan J A, HafnerH. (2000). The Heron conservation. Academic Press. London.
7. Dinsmore JJ.(1973). Foraging success of Cattle egrets, *Bubulcus ibis*. *American Midland Naturalist.* 89, 242–246.
8. Thompson CF, Lanyon SM, Thompson KM. (1982). The influence of foraging

benefits on association of cattle egrets (*Bubulcus ibis*) with cattle. *Oecologia.* 52, 167-70.

9. GM Wahungu, EN Mumia, D Manoa. (2003).The effects of flock size, habitat type and cattle herd sizes on feeding and vigilance in cattle Egrets (*Ardeola ibis*). *African Journal of Ecology*. 41, 287–288.

10. Kamler JF, TN Suinyuy, W Goulding. (2008). Cattle Egret and Common Ostrich associations in South Africa. *Ostrich*. 79, 105–106.

11. Rand AL. (1954). Social feeding behavior of birds. *Fieldiana Zoology*. 36, 1-71.

12. Siegfried WR. (1978). Habitat and the modern range expansion of the cattle egret. National Audubon Research Report 7. 315-324.

13. Burger J, M Gochfeld. (1993). Making foraging decisions: Host selection by Cattle Egrets (*Bubulcus ibis*). *Ornis Scandinavica.* 229-236.

14. Kour D N, Sahi D N. (2012). Studies on the community ecology of Cattle Egret (*Bubulcus ibis*) coromandus (Boddaert) in Jammu (Jammu and Kashmir), India. *International Journal of Biodiversity & Conservation*. 4, 439-445.

15. Ogutu JO, Owen Smith N, Pieoho HP, Said MY, Kifugo SC. (2014). Herbivore dynamics and range contraction in Kajiado country Kenya: climate and land use changes, population pressures, governance, policy and human wildlife conflicts. *The Open Ecology Journal*. 7, 9-31.

16. Heatwole H. (1965). Some aspects of the association of Cattle Egrets with cattle. *Animal Behavior*. 13, 79–83.

17. Grubb TC. (1976). Adaptiveness of foraging in the cattle egret. *The Wilson Bulletin*. 88, 145-148.

18. Burger J, Gochfeld M. (1999). The foot-in-the-door compliance procedure: a multiple-process analysis and review. *SAGE Journal*.

19. Burger J, Gochfeld M. (1981). Discrimination of the threat of direct versus tangential approach to the nest by incubating herring and great black-backed gulls. *Journal of Comparative and Physiological Psychology*. 95, 674–676.

20. Seedikkoya K, Azeez PA, Shukkur EAA. (2005). Cattle Egret, *Bubulcus ibis*habitat use and association with Cattle. *Forktail*. 21,174-176.

21. Kannaujiya A, Kumar A, Kushwaha S. (2013). Diversity of waterbirds in Lucknow Districts, Uttar Pradesh, India. *International Journal of Science and Research*.862-866.

22. Grobicki A. (2016). An introduction to the Ramsar Convention on Wetlands. Ramsar hand book 7th edition. Ramsar convention Secretariat Rue Mauvernery 28 Switizerland.

23. Chaskda A A, Iniunam I A, Dami D F, Wansat MGS. (2018) Foraging success of the cattle egret bubulcus ibis in relation to insect abundance, herd and flock size. *Journal of Research in Forestry, Wildlife & Environment*. 10(1), 41-47.

24. Scott D. (1984). The feeding success of cattle egrets in flocks. *Animal Behavior*. 32, 1089-1100.

25. Aboushiba ABH, Ramli R, M S. (2015). Foraging behavior of five egret species in pome pond area at carey island, peninsular Malaysia. *The journal of Animal & Plant Science*.23 (1), 129-135.

26. Itzkowitz M, Makie D. (1986). Food Provisioning and foraging behavior of the Snowy egret, *Egrettathula .Biology of Behavior*. 11, 111-115.

27. Mikula P, Hadrava J, Albrecht T, Tryjanowski P. (2018). Large-scale assessment of commensalistic–mutualistic associations between African birds and herbivorous mammals using internet photos. *The Journal of Life and Environmental Sciences*. 1-23.

28. Anastasios, Dimalexis, Myrtopyrovetsii, Stefanos S. (1997). Foraging ecology of the Grey heron (Ardeacinerea), Great egret (Ardeaalba) and little egret (*Egrettagarzetta*) in response to habitat. *Colonial waterbirds*. 20 (2), 261-272.

29. Bauder ET. (1989). Drought stress and competition effects on the local distribution of *Pogogyneabramsii*. *Journal of Ecology*. 70, 1083-1089.

30. Mohammedi A, Doumandji S, Ababou A, Koudj M, Rouabhi A. (2015). Impact of predation by cattle egret bubulcus ibis l. on wildlife of farmlands in chlef region, Algeria. *Lebanese Science Journal*. 17 (2), 117-129.

31. Rao VV. (2004). Egrets and their role in environment. International

conference on Birds and environment, Haridwar, India. (Unpublished)

32. Sheehy DP, Vavra M. (1996). Ungulates foraging areas on seasonal range land in north eastern. Oregon. *Journal of the University of Arizona*. 49,16-23.

33. Siegfried WR. (1971). The food of the Cattle egret. *Journal of Applied Ecology*. 8(2), 447-468.

34. Siegfried WR. (1972). Aspects of the feeding ecology of cattle egrets (*Ardeola ibis*) in South Africa. *Journal Animal Ecology*. 41, 71-78.