

Symbiotic relationship of cattle and cattle egret (*Bubulcus ibis*)

SUMMARY OF THESIS

BABASAHEB
BHIMRAO
AMBEDKAR
UNIVERSITY



• LUCKNOW •
प्रज्ञा शील करुणा
ESTABLISHED 1996

SUBMITTED IN FULFILMENT FOR THE AWARD OF THE
DEGREE OF

Doctor of Philosophy

IN

APPLIED ANIMAL SCIENCES

SUPERVISOR

Dr. V. ELANGO VAN

(PROFESSOR)

SUBMITTED BY

MANISHA

ENROLLMENT NO.- 584/15

**DEPARTMENT OF APPLIED ANIMAL SCIENCES
SCHOOL FOR BIOSCIENCES AND BIOTECHNOLOGY
BABASAHEB BHIMRAO AMBEDKAR UNIVERSITY**

(A CENTRAL UNIVERSITY)

VIDYA VIHAR, RAEBARELI ROAD

LUCKNOW-226025

2021

SUMMARY

The study was planned to investigate the symbiotic relationships between cattle and Cattle egret, their diet selection and diet composition with the effect of food on reproductive behaviour of *B. ibis*. The Cattle egrets (*Bubulcus ibis*) is a species of African origin historically and traditionally called the white birds, which is now cosmopolitan living in multiform of natural habitats such as foraging in pastures, farmlands and grasslands alongside grazing livestock. It is recognized as an invasive bird species whose progression was considerably enhanced during the last 50 years through an increase of its distribution area as of its local populations across its global range. In the ecosystem different types of organisms grows together in close symbiotic relationships that indicates about the presence of animals, plants species or population occurs within the same geographical areas. Cattle egrets (*Bubulcus ibis coromandu*) belongs to the family Ardeidae, lives together in the same community which are commonly referred as terrestrial foragers for potential interaction as they pick, disturb insects like invertebrates, amphibians and reptiles alongside grazing livestock, without causing any inconveniences or disturbances to the livestock .

For avian species, term of survival and reproduction is one of the most important activities. In herons, especially the Cattle egrets associates with grazing animals to support their symbiotic relationship for gaining the more feeding benefits and grazers gets slightly benefit from such relationship. The herons mostly feed themselves or take care of brooding mate or young hatchlings and spend their time in foraging related activity. In temperate zone seasonal changes generally affect the insect prey population such as appearing of many insect species in rainy season and in summer make the scarce

that influence the diet composition of Cattle egrets. In terrestrial habitat, the egrets consume vegetative as well as animal diet. Cattle egrets found to feed mainly on larvae of insect in aquatic habitats.

A wide range of food utility suggests that it would consume whatever could be captured by its primary tactile foraging method .Therefore; foraging strategies adapted by birds are the major interesting fields of the study. Factors affecting distribution of Cattle egrets and its breeding biology are discussed in previous studies. Studies done on breeding, distribution, status and conservation with the information on colonial nesting birds in India. However, in certain parts of Uttar Pradesh in India, the breeding biology of Cattle egrets is less exposed excepting for information on some aspects.

Colonial tree-nesting water birds appears to be most adaptive of all, possibly due to its versatile feeding behaviour and non-specificity of the nesting environment and are dependent upon aquatic habitats for both nesting and foraging. In rural as well as urban environment, Cattle egrets are known to build nest in aquatic ecosystems depend upon safe nesting places, food availability and other environmental factors. A good nesting site generally provides support to the nest and gives protection against predators and access to feeding sites within foraging areas. The nesting sites also support positive rearing of chicks and the hatching success that is imperative for species survival. Water birds can serve as bioindicators, as they reflect the health of the landscape and wetland. Investigations regarding eco-biology of herons contribute in increasing knowledge on reproductive ecology, diversity, foraging as well as conservation of cattle egrets in the region.

Such studies can certainly help in developing conservation programs of avifauna as well as wetlands in India. Foraging habits of Cattle egrets make them important biological control agents and primarily insectivorous birds as they consume some insects of public health importance as well as agriculture pest that play a significant role in a variety of ecosystems. Since, there is a lacuna on the behavioural ecology of cattle egrets, particularly on symbiotic relation with cattle, food selection and reproductive behavior. The whole study was carried out between 2016 to 2019 at the different sites in Lucknow district i.e. grassland, marshy land and agriculture land and this constitute the areas of approx. up to 40 km around. The sites were used for reproductive study, acquiring urban, semi urban and rural areas. The geographic coordinates of Lucknow are 26°51'0.0000"N longitude and 80°56'59.9892"E latitude and the temperature ranges between 25-45°C in summers, 2-20°C in winters. According to Indian metrological department, 2018 the mean annual rainfall is approx. 35.28 inch. The symbiotic relationships and diet selection was assessed through periodical field visits categorized as at grassland marshy land and agriculture land. The data collected lasted between 0600 hrs - 1800 hrs through visual observations, digital video camera and binocular celestron up close G2, 6.8°/35FT/118M (10x50X). The feeding behaviour of *Bubulcus ibis* was studied with the cattles i.e. cow, buffalo, horse, bull and mule on the basis of number of host steps, *B. ibis* steps, number of attempt success and the number switches count of egrets with cattle, 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. To avoid the distracting avian behaviour at all feeding habitat, the host species availability was determined at their presence within 200 – 300 meters by counting up to 30 individuals of

each species in all three habitats were observed to determine the suitability of host. Association foraging was considered when *B.ibis* forages near the host within two to three meters to avoid the pseudo-replication method with slight modification. The swallowing behaviour was observed after capturing the prey to count the capture success rate. Host preference and foraging success were analyzed by the previous methodology described with slight modification. The attempt success rate and the relationship between the speed of both hosts and *B.ibis* were analyzed through Spearman Rank Correlation Test (SPSS version 21). The switches count per hour was calculated using Average number of switches/Average time of observation x1/60. Availability of prey items was recorded by the help of two sweeps of a long handled net from the foraging area, within 5m² range and the fishes were collected with the help of local fisherman, all was done by following the similar method. Besides it, regurgitated food items were collected and preserved in a 70 % ethanol for identification of the taxa. Food consumed and different foraging behaviour was recorded at every 15 minute interval from dawn to dusk and noted carefully from a distance of approx. 30-40 meters with a help of binocular. The nomenclature of foraging behaviour was used on the basis of previous studies. The whole study period was divided in to three seasons, summer (March to June), monsoon (July to October) and winter (November to February). Non-invasive method was avoided. The food consumed success rate was identified by the characteristic of i.e. Head-jerk, swallowing behavior. “Shapiro wilk test” method was used for “Normality test of the data” where (P>0.05) therefore, prey items consumed and availability of prey items were analyzed through Krushkal Wallis-H analysis (SPSS version 21), (P>0.05). Periodic surveys were undertaken for one year from 2018 from March to August in order to record

the various reproductive aspects of Cattle egrets. Some qualitative data was also collected by interviewing the local peoples around the breeding sites. The ecology of breeding habitats was studied by observing the size of breeding territory, distance of water resources and prey availability during field visit. All the investigations were carried out without disturbing the nesting pairs and non-invasive methods were used in monitoring the colony. Different breeding aspects i.e. nesting behaviour, courtship display, egg laying, incubation, hatching success, breeding success and parental care period in urban, semi urban and rural areas were recorded on the basis of direct visual observation by digital video camera and binocular. The nests in colony were counted as per point count method Nesting and hatching success were also calculated. Nesting success was calculated as $NS / (NS + NU) \times 100$, where NS is the number of successful nest (i.e. nest in which at least, one nestling survived beyond 10 days of age) and NU is number of unsuccessful nests. Hatching success was calculated as: $\text{Number of egg hatched} / \text{total number of eggs laid or clutch size} \times 100$ and the breeding success rate was calculated by using the formula $(\text{Number of fledglings survived}) / (\text{Number of eggs laid} \times 100)$. Difference in prey consumed was analyzed Krushkal Wallis-H test analysis (SPSS version 21). Temperature and humidity was recorded by using hygrometer and the mean and standard deviation of prey items were also carried out by using (SPSS version 21). In this study, the foraging association of the Cattle egrets with cattles, was observed in grassland, marshy land and agriculture land with the total no. of 634 hosts of cow, buffalo, bull, horse and mule. In association with cattles, the percentage was highest in grassland (36.10%), marshy land (32.10%) and agriculture land (30.68%). The percentage of egrets showed the little seasonal variations in agriculture land. *B. ibis*

showed the highest frequency of association with cattle in afternoon and low association in the early morning and late in the evening and they usually fed near the front leg or back leg or middle. In evening, small groups return from foraging areas often congregated in flocks of hundreds of individuals as they left roost in small groups to disperse in the different areas. In the attempt success correlation rate, the buffalo was the best suitable host for *B. ibis* in comparison with the others and horse was the unsuitable host. The correlation rate was 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. *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 its 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*. Above results shows that, *B. ibis* shift hosts when the hosts 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 the host speed. In case of high feeding success rate, the foraging with cattles showed a number of steps of *B. ibis*, which was about (49.94 ± 16.84) 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 and 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 the decreasing order, suitability of hosts are as follows buffalo > cow > bull > mule > horse. Feeding habitat preferred according to the seasonal changes, *B. ibis* feed at

all types of habitat in all seasons whether it was grassland, marshy land or agricultural land. The number of population of birds will decrease or increase accordingly all seasons. Grassland proved to be more profitable than marshy land and agriculture land and plays a complementary role for *B. ibis* foraging. The foraging success of Cattle egrets in two different feeding modes i.e. Cattle egret forage with cattles and without cattles. Present study conclude that the Cattle egret obtained more feeding success when it feeds with cattles or alongside cattles (62.65) as compared to feed alone or without cattles (46.36). The Cattle egrets are the highly insectivorous as they preferred to consume 18 orders from five phyla of prey items during the study period, which includes twelve orders of Insects, three orders of Pisces, and Anura from Amphibia, Opisthopora order of Annelids and Squamata order of Reptilia. In this study four types of prey items were identify and considerable variation was found among the prey species. Insects size was divided into four categories (0.5-1cm, 2-5cm, 5-10cm and 10-20cm). Cattle egrets chooses 0.84-17.05 cm insects and the body weight was measured 0.04 ± 0.006 to 32.75 ± 6.65 . In this study mainly three types of Pisces were captured by *B. ibis*, their size varied from 5.65 – 6.25 and body weight of Pisces 10.10–17.91gm. In case of Amphibia, Annelida and Reptilia and only one type of species was captured by it, their size were observed i.e 5.62 ± 2.52 , 11.55 ± 4.38 16.75 ± 3.30 . Body weight was measured 30.67 ± 11.02 , 27.5 ± 6.85 and 65.12 ± 54.11 . Moreover, in 13 different common feeding behaviour of herons, the 10 behaviour i.e. walk slowly , stand and wait, walk quickly, standing fly catching, neck swaying, fly scanning and resting were observed in all habitats. Foot stirring and probing were observed only in the wetlands, while searching and pecking behaviour was not found in wetlands. Rest of three i.e. Leap frog feeding, hopping and canopy feeding behaviour of herons were not present in

anyone of the feeding habitats. The descriptive study of diet and feeding behaviour is important to study the feeding ecology of the Cattle egrets. According to the study, the diet of cattle egrets is influenced by the habitat where they feed, rather than on specialized food and it is concluded, that Cattle egrets in Lucknow area are carnivorous. This study suggests that Cattle egrets showed a dietary flexibility and habitat adaptability and the food of Cattle egrets at the grasslands and agriculture sites were mainly restricted to insects, Odonata, Orthoptera and Coleopteran however, in aquatic habitat, the Cattle egrets fed on varieties of prey including insects and amphibians. The prey consumed by Cattle egrets is in grassland and agricultural land and the feeding priority shows that the Cattle egrets are playing major role in determining the ecological conditions of the habitats. The descriptive aspects of each behaviour and knowledge of the occurrence of various behaviours in cattle egrets shall be beneficial to understand more about the foraging ecology of Cattle egrets. The percentage of breeding success was high in rural area (85.10 %) compared to semi-urban (81.69 %) and urban (66.66 %), in which the total egg laying was observed is 52, 71, 47. The total observed nest was 18 in urban area (Lucknow), 17 in semi urban area (Barabanki) and 12 in rural area (Unnao). 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. Breeding biology of Cattle egret was found in different habitats and the time of reproductive behaviour of Cattle egret varies according to the local environment of nesting habitat. 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. Regurgiated food pellets of Cattle egrets were collected from the three different nesting trees. These nesting trees are located at a distance of 30 to 50 km

between each other. *Ficus virens* nesting tree were present on the road side in the urban area. *Pithecellobium dulce* nesting tree are present in semi urban area and *Vachellia nilotica* found at the rural area. The diet of the Cattle egrets as revealed by regurgitated food pellets is given in. Insecta, (odonata and orthoptera) were found to be the most observed prey items constituting 18 and 25 % of the total prey. And other in annelidia, the opisthoptera was found to be 14 %. Availability of food or environmental conditions explain the variance in number of individuals along with breeding by both within and among colonies. Present study suggested that the anthropogenic changes affect the breeding colonies. The damage rate of eggs and chicks was observed high in the urban area. As the nesting tree is located on the side of road, the breeding success rate could be affected by the human disturbance according to the observation and the residential area around the tree is increasing due to construction of more buildings day by day.

The temperature and humidity plays a major role in incubation period of eggs. The results of this study suggest that the mortality of eggs and fledglings probably varies according to the local environmental conditions. Location is the major factor which affects the survival rate and at regular breeding habitat urbanization is the main threat to the local egrets nesting colonies, as seen in Cattle egrets. The maximum temperature was recorded on agriculture land during summer (40.35 ± 4.09) followed by grass land (35 ± 2.73) and marshy land in monsoon (33.32 ± 2.87). With temperature, humidity was recorded in such a way to be maximum (92.75 ± 21.63) on marshy land in winter, followed by grass land (78.5 ± 13.94) in monsoon and agriculture in summer

(69.6±22.01). The constant ambient temperature was recorded throughout the years in all the habitats (36.68 ± 015) in summer, but these were partial fluctuated (32.3 ± 3.95), (33.09 ± 2.77) and (33.15 ± 2.66) in grass land, marshy land and agriculture land respectively in monsoon. Moreover humidity was highly fluctuated in all habitats which was lowest on marshy and (35.3 ± 9.98) in summer and maximum on agriculture (78.5 ± 18.52) in monsoon. Mean temperature of all the breeding habitats was recorded between 32 °C to 37 °C. (Haftorn, 1988) has reported about mean temperature of 34°C for the birds for breeding success. July to August was the 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, the temperature was (32.25 to 37.25 °C) and humidity was found (80 to 84) and at the rural area in May to June temperature was 36.25°C to 35.27°C) and humidity was (82 to 84%). As a result, it concludes the temperature and humidity does not play any role in the diet and host selection of Cattle egrets while in reproductive activity it plays a major role. This summary may help in future study of the foraging behaviour and provides a common background of Cattle egret, *B. ibis*.