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Foraging Behaviour and Feeding Preference of Cattle Egret (*Bubulcus ibis*) in Udaipur Region, Rajasthan, India

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Abstract: An ecological study was performed on foraging behavior and food choice of cattle egrets (*Bubulcus ibis*) at Udaipur, Rajasthan. According to the findings, cattle egrets foraged most at first morning and last evening hours and their diet mainly consisted of insects; grasshoppers and other small vertebrates like frogs and lizards. Thus, the presence of the grazing livestock improved their foraging ability, which showed that the birds and these livestock are interdependent. Diurnal variations were not clearly observed in feeding though the animals relied more on terrestrial and aquatic prey during the wet season as compared to dry season. Based on findings of this study, it may be concluded that cattle egrets rely upon livestock production systems for foraging, and that these birds act as biocontrol agents in agro-ecosystems and agricultural settings.

Keywords: Agro-ecosystems, Cattle egret, Feeding preference, Foraging Behaviour, Livestock, Seasonal variation

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Introduction

Cattle egret (*Bubulcus ibis*) belongs to the family Ardeidae of order Pelecaniformes (Issa, 2019). The cattle egret is a cosmopolitan species (Rasmussen and Anderton, 2005) and found all over India (Ali and Ripley, 1968). It is well known that from 19th century, the cattle egret has extended its breeding range from Africa to Europe, Asia, America and Australasia (Parejo *et al.*, 2010). Cattle egrets are often found associated with cattle and occasionally with buffalo, cow, pigs, goats, and

horses, and also with moving vehicles such as tractors during cultivation to feed upon insects (Seedikkoya *et al.*, 2005). Their association with grazing cattle helps increase their prey captures and utilizes less energy than those of solitary feeders (Mullarney *et al.*, 2001). Self-feeding poultry solely depend on the available livestock thus making the cattle egret a foraging bird with ecology and specialized role in agro-systems (Talbi *et al.*, 2023). It is most commonly feeding in

syntony with herds of cattle, horse, or other similar slow animals (Verma *et al.*, 2021). Cattle egrets are flexible members of the ankle boot guild whose foraging mode and diet selectivity depend on physical and ecological characteristics as well as the availability of cattle and other prey (Meena *et al.*, 2023).

Cattle egret appear to suggest a social component to foraging when several animals are available to offer protective cover and enhance the search through 'information transfer', or merely to increase the likelihood of prey detection (Kannan and Babu, 2022). Albeit this, the use of livestock as a way to approach insects can be hazardous to the cattle egret. As reported by Talbi *et al.* (2023), this bird like to follow the movement of cattle while grazing in the grasslands to benefit from insects in the process of herding them, the egret catches them. This behaviour is exhibited in the agro-ecosystems in northern Israel, where the cattle egret feeds along with grazing cattle; a situation seen in similar ecosystems all over the world (Gavish *et al.*, 2023). This is well illustrated by the food analysis conducted by Talbi *et al.* (2023) for cattle egrets which identified the high percentage consumed reptiles while feeding in their nesting colonies.

Understanding foraging behaviour of cattle egrets, therefore, remains vital in outlining their ecological value as well as evaluating their capabilities as potential biocontrol agents in agriculture fields. The objective of this study is to examine the Feeding habits of the cattle egrets in the area of Udaipur, Rajasthan and identification of feed preference and types available and the environmental conditions suitable for foraging behaviour of cattle egrets.

Materials and Methods

Study Area

The current work was an experimental survey conducted in wetland and agro ecosystems of Udaipur, Rajasthan, India. Udaipur includes the southern part of Rajasthan which consists of agricultural area, marsh area and pastures. These

habitats used by a number of birds including the cattle egret that hunts mainly around cattle. Artificial bio-reservoirs, such as, Fateh Sagar Lake support localized wetland systems where birds might be able to find small fish, frogs, etc. for food offerings (Fig. 1).

Data Collection Methods

Foraging Observations

In order to investigate the foraging behaviour of cattle egrets, we used direct observation method that involved the use of binoculars and cameras. Observations were conducted over a period of 3 months during both the dry and wet seasons, from early morning (6:00 AM). They are best photographed early in the morning (from around 6:30 am) to mid-afternoon (up to 5:00 pm) because of the variation in daylight required to locate cattle egrets.

In each observation session, each cattle egret was observed for 5 min where particular interest was given to the bird's movements, foraging behaviour and interaction with the cattle. The position of each bird, its activity (roaming, pecking and standing still), and the availability of prey were recorded closely. Figure 2 shows feeding with cow movement upon small grasshopper, near Vidhi hostel, MLSU, Udaipur. The study was done from an observing distance of 20-50 meters in order to avoid influencing the birds' normal activities (Kannan and Babu, 2022).

Feeding Rate and Time Interval Analysis

Feeding rate was determined by the number of preys taken by the bird in every 5 min spent observing the bird. Any successful capture (i.e when a bird peck at the ground/water and takes an item into its bill) was counted. The duration between consequent captures was also recorded to determine the effectiveness of the bird's foraging activities. These metrics offer useful information on how cattle egrets use resources particularly prey in different areas of their preferred habitat and in variable conditions. Feeding rates were obtained by dividing the total captures by the total observation time and



Fig.1: Cattle egret feeding with buffalo movement at Rani Road, Fatha Sagar Lake, Udaipur.



Fig. 2: Cattle egret feeding with Cow movement upon small grasshopper, near Vidhi Hostel, MLSU, Udaipur.

then averaging the values.

Feeding Preference Analysis

Feeding preference was determined by taking samples at feeding sites such as prey remains in the form of exoskeleton of insects, broken parts of reptiles and small vertebrates and soil samples. Direct observation in research was also used to find out the kinds of prey that cattle egrets were hunting for. During sample collection, invertebrate and small vertebrate prey were identified by comparing specimens against standard taxonomic keys in the laboratory (Bhatnagar *et al.*, 2008).

Environmental Variables

During all observation activities, environmental conditions were documented to give an account of the impacts of these factors which may have on the foraging behaviour. Observed parameters relating to the temporal slot (morning, midday, afternoon), climatic conditions (sunny, cloudy, and rainy) and the presence of grazers (cattle, horses,

and sheep) were also recorded for each observation run.

Distance of Observation

To reduce the impact of the disturbance and interference of their activities, the observations were carried out at 20-50 m from the birds.

Results

Foraging Behaviour

Clear trends in the time of day, prey capture rate, and foraging strategies were observed in the foraging behaviour of cattle egrets in Udaipur, Rajasthan. In accordance with ideal feeding conditions, observations showed that cattle egrets were most active in the early morning (6:00 am to 9:00 pm) and late afternoon (4:00 pm to 5:00 pm). These periods shown the highest levels of feeding activity from the birds, most likely as a result of better climatic circumstances, such as cooler temperatures and less direct sunshine, as well as increased prey availability. 1.2 prey captures per 5

min observation period was the highest rate recorded during these hours.

Cattle egrets used a range of behaviours when foraging. The most popular foraging strategies were lunging at prey, pecking, and sprinting. The most commonly seen behaviours were running and pecking, in which the birds would swiftly travel over the ground while pecking at the foliage or soil to catch insects. Although it was less common, lunging was seen when the bird was pursuing tiny reptiles or vertebrates like frogs. These behaviours were regularly observed in conjunction with grazing animals, which probably made prey more accessible by upsetting tiny vertebrates and insects.

Feeding Preferences

The diet preference of cattle egret was found and the type of feeding was subject to variations from the kind of habitat and from the season it belonged. In wetland habitats to which they are mostly restricted in terms of food habits, they mainly prey on fish and amphibians but they are just as efficient at foraging in the agricultural tracts where invertebrate food becomes the major benefit (Meena *et al.*, 2023). All the prey captured and consumed by these birds, insects especially grasshoppers forming 65% of the diet belonged to the Orthoptera order. Other insects which are frequently consumed included the beetle and crickets, which were consumed during the dry season in which insects were plentiful. Frogs, lizard and ground-dwelling small vertebrates comprised 20% of diet. The food items noticed in the present study showed similarity with previous studies (Yu-Seong *et al.*, 2016; Asma *et al.*, 2018; Manisha *et al.*, 2020; Fadila *et al.*, 2020; Imam *et al.*, 2020; Talbi *et al.*, 2023). The cattle egret caught these vertebrates mainly around the wetland after the onset of wet season probably implying that the bird feeds on prey depending on the season and the type of habitat it occupies.

Environmental Correlation

It also established that grazing livestock had a strong influence on cattle egret foraging efficiency.

Locations where grazing cattle herds were found had increased prey encounters compared to the regions that had no cattle. Cattle egrets were found to foraging more often around cattle probably because the cattle churn up the soil and unearth some of the insects and small vertebrates that the birds feed on. Variability in foraging success was also observed, and the highest rates of prey capture during the wet season because guenons feed critically on creatures like frogs and small fish that emerge in wetland areas during the wet season. Seasonal variation in prey base density is one of the main factors in the external environment influencing cattle egret feeding habits (Bhatnagar *et al.*, 2008). Also, relative to a clear sky or hot and sunny conditions, overcast conditions or cool temperature enhanced foraging efficiency values; thus, indicating that extreme heat may act as a foraging deterrent.

Discussion

The observation of foraging behavior of cattle egrets in Udaipur confirms that prey abundance and the availability of grazing cattle plays a major role in foraging activity. The observations with the highest cover and activity occur at dawn and dusk, which also coincide with times of intensive prey activity and preferable environmental conditions in zones containing cattle. In agro-ecosystems, the presence of live stocks increases the chances of successful foraging since the; egrets can easily locate the prey, especially where the live stocks are grazing (Gavish *et al.*, 2023). This confirms that the prey refining ability through livestock by disturbing insects and small vertebrate is important.

Apparently, diet choice including insects like grasshoppers and small vertebrate organisms like frogs are determined ecological and environmental variables. Depending with availability of food, their diet varies and thus it was noted that throughout the wet season the cattle egrets feed mostly on aquatic preys which supports the observations noted by Fadila *et al.* (2020) that these birds are very adaptable to different environment in terms of feeding.

The findings of this study regarding cattle and cattle egret mutualism is in agreement with similar findings observed earlier showing that grazing hosts make foraging simpler by exposing prey. This interaction has positive implications on biological control of pests in agro-ecology since the cattle egrets decrease the insect load mainly in cultivated fields. This implies that cattle egrets hold very important pest control functions alongside holding balance of ecological systems within agricultural land types.

Conclusion

Some of the pertinent findings of this investigation related to the foraging behaviour of cattle egrets and their feeding choices in Udaipur are presented as follows: The gregarious birds observed the highest foraging activity in the early morning and during the late afternoon because of higher prey abundance and optimal conditions. Preference of cattle egrets was insect especially grasshoppers and small vertebrate particular frogs and lizards. The birds mostly preferred those areas where there was presence of grazing cattle. Here the cattle moving through the pastures and wetlands seem to augment feed quest of the egrets since the cattle disturb prey, hence, there is mutual interaction between the two species.

The present study provides significant insights into the issue of conservation and agro-ecosystem management. If the conservation agenda could link ecosystems services, specifically pest control by cattle egrets, with livestock management approaches especially in facilitated grazing then it might facilitate conservationist to adopt policies that enhance livestock grazing as a means towards supporting biodiversity conservation.

Ethical Statement

No animal or microbes have been sacrificed for this study, hence Ethical Approval not required.

Author Contributions

Each author has contributed equally to the study's planning, analysis, writing, and editing. All authors

have read and agreed to the published version of the manuscript.

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Conflict of Interest

The authors declare no conflicts of interest.

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