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FORAGING SUCCESS OF THE CATTLE EGRET *BUBULCUS IBIS* IN RELATION TO INSECT ABUNDANCE, HERD AND FLOCK SIZE

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ABSTRACT

The success of foraging birds is attributed to a wide range of factors. For example, in the cattle egret Bulbulcus ibis, the presence of cattle, insects and other conspecifics is widely reported to enhance foraging success. However, few studies have considered the combined effect of insect abundance, herd and flock size on such commensalistic relationship particularly under the nomadic cattle management system practiced across West Africa. Thus, this study, compared cattle egret foraging success (prey capture rates and time interval between successive prey captures) between egrets foraging within cattle and those foraging solitary during the mid-wet season (June to July) 2013. Also, foraging success was related to insect abundance as well as herd and flock size. Study populations were randomly selected across 13-sites in Jos-east and north Local Government Areas of Plateau State, Nigeria. A total of 100 cattle egrets were studied using the focal observation technique. Abundance of insect prey per site was quantified using both sweep net and direct counts. Irrespective of the number of cattle at a site, cattle egrets foraging within cattle, significantly captured more prey and spent less time between successive prey captures than those feeding solitarily. Also prey capture rates increased significantly (P<0.05) with insect abundance for the non solitary egrets. However, there was no significant relationship between foraging rates with flock size (P>0.05) and insect abundance (P>0.05) for solitary feeding birds. These observations agree with previous studies that proximate benefits in terms of enhanced foraging success could be the reason for the strong association between the two organisms.

Keywords: cattle egret, foraging success, herd size, flock size

INTRODUCTION

The Cattle egret (*Bubulcus ibis* Linnaeus, 1758) is an insectivorous bird which is completely covered with white feathers but gets adorned with buff plumes during the breeding season (Paton *et al.*, 1986; Krebs *et al.*, 2004). It belongs to the heron family (Ardeidae) and is distributed in the tropics, sub-tropics and warm temperate regions of the world. The bird is a diurnal feeder commonly foraging around grazing mammals in the wild or domesticated livestock (del Hoyo *et al.*, 1992; Kushlan and Hancock, 2005).

The cattle egret can be encountered often around shallow waters and grassy habitats. The bird relies greatly on terrestrial insects and small vertebrae prey (Mukherjee, 2000; Mullarney *et al.*, 2001; Seedikkoya *et al.*, 2005). Often, Cattle egrets could be seen foraging solitary when grazing mammals are not available within an area. However, previous studies reports that cattle egrets have higher foraging success when feeding near a grazing mammal than when feeding solitary (Grubb, 1976; Thompson *et al.*, 1982). Its performance is reported to be similar when it follows farm machinery, but it is forced to move faster (Dinsmore, 1973; Mukherjee, 2000). The foraging success of the bird when feeding around cattle is attributed to the frequent flushing of prey

by the movement of grazing animals (Rand, 1954; Heatwole, 1965; Dinsmore, 1973; Grubb, 1976; Devasahayam, 2009).

Similarly, individual birds also take advantage of prey movement influenced by conspecifics when they forage away from grazers. Such solitary foraging may be done by individuals at varying flock densities (Siegfried, 1971; Metz *et al.*, 1991). Previous studies which enhanced understanding of Cattle egret foraging behaviour have been predominantly outside of West Africa under significantly different weather conditions and well advanced livestock management practices or around grazing animals in wild environments. In this study, Cattle egret foraging success (prey capture rates and time interval between successive prey captures) was compared between egrets foraging within cattle and those foraging solitary. Also, foraging success was related to insect abundance as well as herd and flock size under the nomadic cattle management system practiced widely in Nigeria with a view to revalidating or refuting previous findings on the foraging behaviour of the bird.

MATERIALS AND METHODS

Study Area

The study was carried out on the Jos Plateau, north-central Nigeria. The state has an average altitude of 1,280 m a.s.l. and has a semi-temperate climate as a result of the high altitude. Temperature ranges between 15.5 °C to 30.5 °C while the mean annual rainfall varies from 131.75 cm in the southern part to 146 cm on the plateau (Payne, 1998).

The study was carried out across 13 sites where open grazing was carried out by nomads in both Jos-East and Jos north Local Government Areas of Plateau state (Fig. 1). These sites were mostly grassy plains with widely dispersed trees and shrubs.

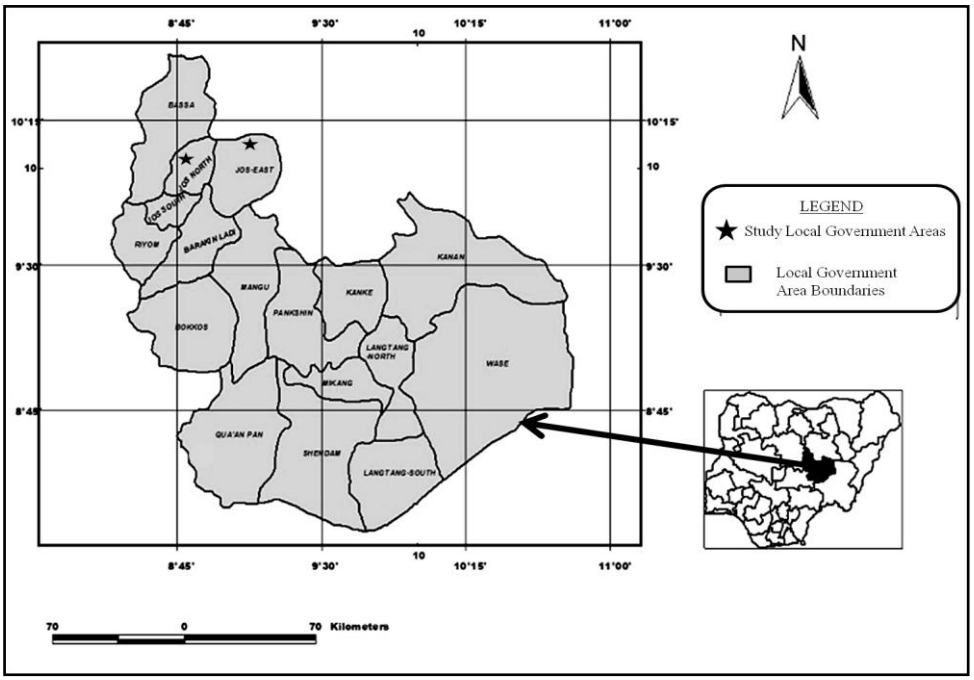

Figure 1: Map of Plateau State showing location of Local Government Areas where study was conducted.

Study Period

The study was conducted during the rainy season for two weeks (15th June to 1st July, 2013). The vegetation was generally green with frequent rains and cloudy days. Data collection lasted between 10:00 am to 4:00 pm each study day. These hours were chosen so as to synchronise with the period that shepherds bring out their cattle for grazing.

Cattle Egret Feeding Behaviour

Cattle egrets were studied under two feeding conditions as explained below:

i. Feeding within cattle: this denotes feeding activities carried out by individual cattle egrets within cattle or up to a distance of 5 m from cattle.
ii. Solitary feeding: this was considered when cattle egrets fed on their own without the presence of grazing animals around them.

In each case, individual cattle egret's where sampled at random and observed using a pair of binoculars (Trekka 10 x 42 field of view). Any target individual was observed over a period of 5 min. (due to fast foraging movements by most

individuals). Feeding rates and time interval between successive prey captures where quantified for each individual; feeding rate was defined as the number of times an egret captured a prey while time interval between prey captures is the time between successive prey captures. A total of 100 individual birds where sampled across 13 sites; 50 each were observed within cattle and solitary. The least distance between the sampling sites was about 100 m to reduce pseudo-replication. Observer distances from target birds ranged between 20-50 m to avoid distracting avian behaviour.

Insect Abundance at Foraging Sites

Insect abundance at foraging site was carried out in two ways:

Sweep Netting

at each site were cattle egret foraging behaviour was observed, 30-sweeps were made at two separate locations to sample aerial insects. This was carried out using a sweep net of 35 cm in diameter. Trapped insects were kept in sample bottles containing 70 % ethanol and were later enumerated in the laboratory.

Grasshopper Flushing

Due to the inefficiency of the method above to sample grasshoppers which are regarded to constitute a major part of cattle egret diet (del Hoyo *et al*., 1992; Seedikkoya *et al*., 2005) grasshoppers were further sampled separately as follows:

at each foraging site, 10 steps were made in each of the four cardinal directions (north, south, west and east) grasshoppers flushed in the process where counted and averages taken per site. To quantify insect abundance per foraging site (an index of food abundance) both flying insects collected by use of sweep net and the flushed grasshoppers were added together as index of food abundance per site.

Data Analysis

One sample kolmogorov-Smirnov test was used to test for normality of the data obtained while Levene statistic was used to test for equality of variance using the software package, SPSS (version 17.0, www.spss.com). The Independent Sample t-test was used to test both the difference in feeding rates and time between successive prey captures for cattle egrets foraging within cattle *vs*. Solitary. While the General Linear Model (GLM) was used to test the significance of the relationship between the dependent variables; feeding rate per site and average time interval between successive prey captures *vs.* the independent variables; insect abundance per site, herd and flock size per site. In both cases, the independent variables were treated as covariates.

RESULTS

Differences between Cattle Egrets Foraging within Cattle and Solitary

Mean prey abundance did not vary significantly (Independent Sample t-test, df = 16, t = 0.108, P = 0.915) between sites where cattle egrets foraged within cattle (28.0 $\pm$ 13.47; Mean $\pm$ SD) and areas where individuals foraged solitary (29.4 $\pm$ 34.52). However, there was a significant difference in foraging success between individual cattle egrets foraging within cattle and those foraging solitary (Independent Sample T test; t = 6.254, df = 74, P < 0.001); egrets foraging within cattle had higher foraging success in terms of prey capture as compared to solitary foraging cattle egrets (Fig. 2a).

Similarly, time interval between successive prey captures was significantly higher for cattle egrets foraging solitary than those foraging within cattle (t = 4.121, df = 55, P < 0.001; Fig. 2b).

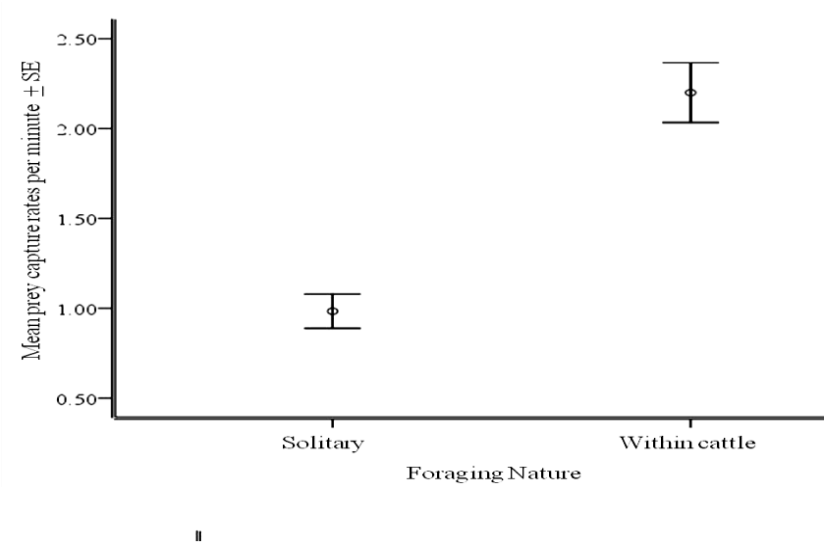

Figure 2a: Differences in prey capture rates between cattle egrets foraging within cattle and solitary.

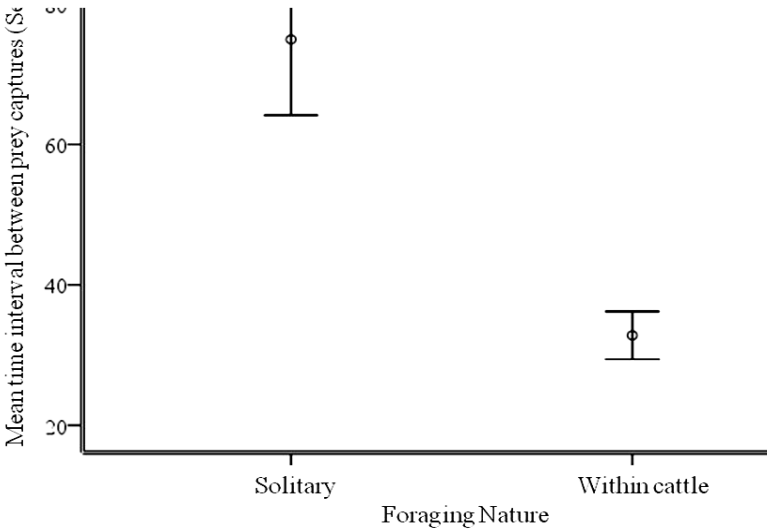

Figure 2b: Differences in average time interval between prey capture for cattle egrets foraging solitary and within cattle.

Effects of Prey Abundance, Herd and Flock Size on Foraging Behavior of Cattle Egrets Feeding Within Cattle and Solitary

The number of prey captured by cattle egrets foraging within cattle was influenced by the abundance of insect prey available at the foraging site and not by herd size (Table 1 and Fig. 3). However time between successive prey captures for this category of birds, was neither determined by prey abundance nor herd size (Table 2).

Conversely, prey capture rate by solitary foraging cattle egrets was not determined by both prey abundance per foraging site or flock size (Table 1). Similarly, there was no significant effect of prey abundance per foraging site, flock size per foraging site on average time spent between successive prey captures by solitary foraging cattle egrets (Table 2).

Table 1: Relationship between prey abundance, herd and flock size on prey capture rates of foraging cattle egrets (General Linear Model)

Nature of foraging	Independent variables	R-squared (%)	F	P
Within cattle	Insect abundance per site	73.1	**11.107**	**0.021**
(n=8 sites)	Herd size per site		0.041	0.847
Solitary	Insect abundance per site	20.8	3.548	0.118
(n=10 sites)	Flock size per site		0.403	0.553

Dependent variable: Prey capture rate per site
Bold highlight = significant at 0.05 level

Table 2: Relationship between prey abundance, herd and flock size on average time interval between successive prey captures of foraging cattle egrets (General Linear Model)

Nature of foraging	Independent variables	R-squared (%)	F	P
Within cattle	Insect abundance per site	27.2	0.458	0.529
(n=8 sites)	Herd size per site		1.838	0.233
Solitary	Insect abundance per site	28.0	0.444	0.535
(n=10 sites)	Flock size per site		1.579	0.264

Dependent variable: Average time interval between successive preys captures per site

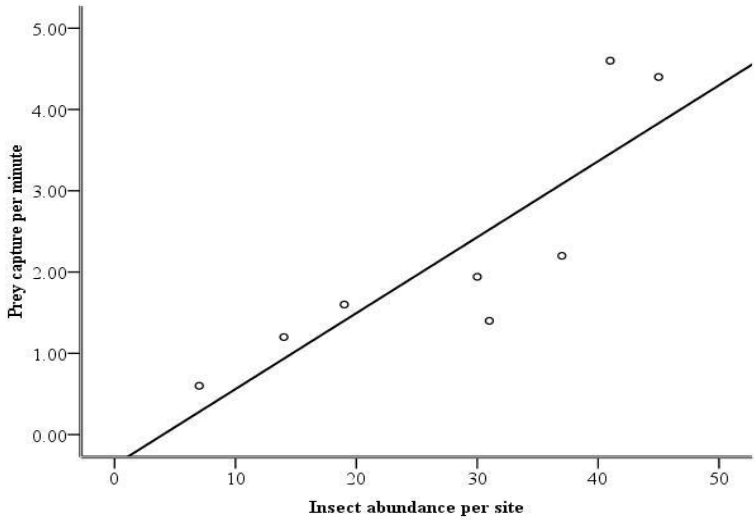

Figure 3: Prey capture rates of cattle egrets foraging within cattle and insect abundance per foraging site

DISCUSSION

In terms of prey abundance, the sites where cattle egrets foraged solitarily and within cattle had similar insect prey abundance. However, despite their similarities, cattle egrets that foraged within cattle had far more success in capturing prey and had shorter time intervals between successive prey captures than those that foraged solitarily. These greatly suggest that the foraging success of non-solitary cattle egrets may be as a result of the presence of cattle at the area where they foraged. This is possible as the two sites did not differ in terms of insect abundance and neither did flock size had significant relationship with either prey capture rates and time interval between successive prey captures for solitary foraging cattle egrets. It is also obvious from the study, that herd size (i.e. number of cattle grazing at a site) is not a significant predictor of cattle egret's prey capture rate. Perhaps what matters is the presence of cattle

in the foraging area than their numbers per area. The grazing movement of even a few cattle is sure to flush insects from their niches leading to easy detection by foraging cattle egrets around them. Possibly, this could have been the reason for the non significant relationship between prey capture rates with herd size per site for cattle egrets that foraged within cattle.

These observations are in agreement with several previous studies such as Rand (1954), Heatwole (1965), Grubb (1979), Mukherjee (2000) and Seedikoya *et al.* (2005) although, studies by Scott (1984) found a positive relationship between prey capture rates and flock size in contrast to the non significant relationship observed in this study. However, in all the other cases, cattle egrets foraging success has been attributed to the grazing movement of cattle which renders insects to easy detection and/or capture when flushed. Supposedly, flock size should have had a similar effect on solitary foraging cattle egrets due to movement of conspecifics during foraging but this was not sufficient enough to neutralise the effect of cattle presence on foraging cattle egrets as observed in this study. Besides, solitary foraging egrets observed in this study, highly compete for insects flushed by conspecific movement or tend to feed opportunistically when a prey moves. Such feeding behaviour could lead to poor prey encounter rates and consequently poor feeding rates in comparison to cattle egrets foraging among cattle where insects are continuously being flushed.

CONCLUSION

This study has shown that cattle egrets are more successful at foraging when feeding within cattle than when they fed solitarily. Also, herd and flock size did not affect the feeding rates of cattle egrets. Perhaps what is most important is the presence of cattle at the foraging site that could flush insects from their niches for easy detection by foraging birds than the number of cattle at the site or flock size when feeding solitary. Also, insect abundance at a site also enhances foraging success by cattle egrets. These observations are in line with previous findings on the cattle egret – cattle relationship.

Recommendation

Although there is a growing national dialogue on the merits and demerits of the nomadic system of cattle management however, there appears to be some benefit on wild birds such as the cattle egret. Thus, a holistic approach that also considers the ecological aspects of the conflict particularly in terms of dispersal of wild plants by cattle and the symbiotic relationship between cattle and other organisms as studied here should be considered. Also, detailed studies on how the ranch system could maintain such symbiotic relationship in the absence of the nomadic system should be given consideration.

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