

Gut Content of Cattle Egrets (*Bubulcus ibis*) in Three Distinct Habitats in the Accra Metropolitan Area, Ghana

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Cattle egrets are considered as some of the most successful bird species globally. They are opportunistic with respect to both habitat type and availability of food resources. This study was carried out in three distinct habitat types (Grassy habitat, Landfill site and Silted waterway) in the Accra Metropolitan Area of the Greater Accra Region of Ghana to assess the preferred food items of cattle egrets. As 'wholly protected' birds in Ghana, permission was granted by the Wildlife Division of the Forestry Commission to use six cattle egrets. Gut contents of two cattle egrets from each habitat type were analysed. Cattle egrets at the landfill and silted drain sites fed mainly on insects particularly dipteran larvae. Birds at the landfill site fed predominantly on houseflies (Muscidae) and blue bottle flies (Calliphoridae) larvae which dominated in both weight (74.3 %) and number (84.3 %). While cattle egrets at the silted waterway fed on Syrphidae (51.4 % and 71.3 % by weight and number respectively). Those at the grassy habitat consumed a variety of prey including anurans which constituted 35.5 % by weight. This study revealed that cattle egrets are important biological control agents in the ecosystem. Without predation on the dipteran larvae (Syrphidae, Calliphoridae, Muscidae), they would metamorphose into adults and further exacerbate public health problems to neighbouring communities.

Key words: Cattle egret, gut content, dietary diversity, Accra Metropolitan Area, biological control.

INTRODUCTION

Anthropogenic modification of ecosystems has an impact on the biology and ecology of animal species. A good foraging habitat is one that provides easy availability and accessibility to preferred prey at a reduced predation risk [1]. Availability of food resources and foraging habitats influence habitat selection by birds and a major determinant of the breeding success of cattle egrets [2, 3].

As one of the most terrestrial ardeids, cattle egrets exhibit dietary plasticity feeding on the most abundant prey in a given environment [4-9]. Various studies have indicated that the diet of cattle egrets varies with season, time of day, ontogeny, prey abundance and availability

and global region [6, 10-12]. The quality and quantity of cattle egret prey also varies both in space and time. Apart from invertebrates, cattle egrets feed on small vertebrates which include fishes, amphibians and birds. Reptiles like the gray snake (*Hemiapis damelli*) have been found in the diet of cattle egrets in Australia [9].

Cattle egrets play significant roles in a variety of ecosystems. Their foraging habits make them important biological control agents and as primarily insectivorous birds, they consume some insects of public health importance as well as agricultural pests. Information especially on the diet of cattle egrets is however inadequate in the West African sub-region although extensive dietary surveys have been undertaken in other parts of the world [13-18]. Cattle egrets in Ghana forage in several habitats such as lawns, pastures, croplands, silted drains and landfill sites [19]. Their preference for any of these habitats, in relation to the quantity and type

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of prey consumed has however not been investigated. This study into their diet provides an insight into the ecological significance of cattle egrets to the ecosystem.

MATERIALS AND METHODS

Study Sites: Two cattle egrets each were sampled from three distinct habitat types in the Accra Metropolitan Area in the Greater Accra Region of Ghana. These were grassy vegetation, (University of Ghana Main Campus: 05°38'N, 000°11'W), land fill site (Abokobi landfill site: 05°42'N, 000°11'W) and silted drain (Korle Lagoon: 05°32'N, 000°13'W).

Method: The cattle egrets were obtained by shooting them with a catapult while they were foraging between three to six hours after dawn and two to four hours before dusk. This was to ensure that food was present in the gut after foraging in the morning and also that the pre-roosting behaviour of the birds was not disturbed. The dead birds were weighed immediately while wounded birds were killed by chloroform before weighing.

Immediately after weighing, the specimens were dissected on the field, and the gut content from the gizzard of each bird was weighed and recorded. The gut contents were then preserved separately in 95 % alcohol, and labelled with the following information; (i) individual serial number, (ii) date and time of capture, (iii) capture locality, and (iv) weight of gut content. Samples were then transported to the laboratory and examined after cleaning off sand and plant debris. Each bird's gut content was spread between sheets of coarse blotting paper to remove moisture and reweighed. Food items in the gut were classified to the family taxonomic level. The number of each food item in each category of food was represented as a percentage of the total number of items represented in all the food categories. Weight of food items in each category was expressed as a percentage of total weight of the food [5].

Analyses of Data

Dietary data was subjected to analyses using the Plymouth Routines in Multivariate Ecological Research (PRIMER version 6) software to determine the diversity in the three habitats.

Diversity Indices calculations

Margalef's index $d' = (S-1) / \ln N$ (Margalef's diversity index), where S is the number of species and N is the number of individuals. This richness index standardizes the number of species present against the total number of individuals present in the gut.

Pielou's Evenness index: $J' = H^1/H^1_{\max}$, $H_{\max} = \ln S$ (S is

the total number of different species in the sample). It focuses on how uniformly the food items are distributed in the gut.

Shannon-Wiener index: H' , where $H' = -\sum p_i \ln p_i$. where 'pi' refers to the proportion of species 'i' in the sample (the relative abundance of that species $[N_i/N_{\text{tot}}]$). This index is species richness weighted. Shannon-Wiener measures the amount of uncertainty in predicting what family a prey item chosen at random from a diet would belong to. It also measures the effective number of families.

Percentage weight of the taxonomic families in the diet was calculated as weight of the specific prey item divided by the total weight of the prey items in the two guts $\times 100\%$. Percentage number of taxonomic families in the diet was calculated as the number of specific prey item divided by the total number of prey items in the two guts $\times 100\%$.

RESULTS

An analysis of gut contents of two cattle egrets obtained from the Korle Lagoon (silted waterway) revealed 101 food items dominated by Dipteran insect larvae within the family Syrphidae (hover flies) constituting 71.3 % of the total number. Insects of the family Tettigonidae (long-horned grasshoppers) constituted 1 % of the total number of organisms in the gut and was consumed the least by weight as well (Table 1).

A total of 347 prey items were obtained from the guts of two cattle egrets foraging at the Abokobi landfill site. All insects present were from the order Diptera, with larvae (maggots) of housefly (Muscidae) and blue bottle fly (Calliphoridae) dominating in both weight (74.3 %) and number (84.3 %) (Table1).

At the grassy habitat of the University of Ghana Main Campus, a total of 198 prey items were found in the two cattle egret guts analysed. These belonged to 12 insect families and amphibians of the order Anura, contributed 35.5 % of the weight of the diet. Formicidae (ants) contributed the highest by number (45 %) (Table1). Only Acrididae (short-horned grasshoppers) and Scarabeidae (scarab beetle) were common to both guts in this habitat.

Cattle egrets that foraged at the grassy habitat exhibited the highest dietary diversity ($H' = 1.62$), dominance (0.71) and species richness ($d = 2.27$) while those at the landfill site recorded the highest evenness ($j' = 0.99$). Cattle egrets at the silted drain recorded the least species evenness ($j' = 0.53$) (Table 2).

DISCUSSION

There were variations in the diet of the six cattle egrets obtained from the three habitat types. At the silted drain,

Table 1. Dietary Composition of Cattle Egrets in the Three Habitats.

Habitat Type	Food Item	% Weight (%)	% Number (%)
Silted Drain (Korle Lagoon)	Diptera		
	Calliphoridae	5.7	10.9
	Muscidae	8.7	8.8
	Syrphidae (larvae)	51.4	71.3
	Odonata		
	Liberllulidae	17.1	3.0
	Orthoptera		
	Acrididae	7.1	3.0
	Gryllidae	5.7	2.0
	Tettigonidae	4.3	1.0
Landfill Site (Abokobi)	Diptera		
	Calliphoridae (adult)	12.8	4.3
	Muscidae (adult)	12.8	11.4
	Larvae (Muscidae/Calliphoridae)	74.4	84.3
Grassy Habitat (University of Ghana Campus)	Hymenoptera		
	Formicidae	2.1	45
	Ichneumonidae	0.3	0.4
	Cicadelidae	2.8	1.2
	Aphididae	0.3	0.4
	Orthoptera		
	Acrididae	25.2	28.3
	Blattidae	22.0	6.3
	Tetrigidae	3.5	0.8
Grassy Habitat	Diptera		
	Muscidae (Larvae)	3.1	4.3
	Tabanidae	2.1	5.9
	Stratiomyidae	1.0	2.7
	Phoridae	0.7	0.4
	Coleoptera		
	Scarabeidae Amphibia	1.4	1.6
	Anura	35.5	2.7

dipterans dominated both in terms of weight and number probably due to its high accessibility to the egrets. Syrphid larvae constituted over 71 % of the diet of the egrets. Dipterans have been reported to be a second dominant food item in the gut of cattle egrets [6, 20] but Syrphidae does not appear to have been documented in literature. Syrphid larvae have no commercial value in Ghana but in some parts of the world, they are used in ice-fishing. Adult syrphids are also predators of

agricultural pests such as aphids and leafloopers (*Zeuctophlebia* spp.) and have been documented to cause intestinal myiasis in humans [21].

The other dipteran families in the diet (Calliphoridae and Muscidae) are also of public health importance as vectors of pathogens that cause diseases like salmonellosis, cholera, and dysentery. Cattle egrets may thus be important in the biological control of such pathogenic vectors.

Table 2. Dietary Diversity Indices of Cattle Egrets in the Three Habitats.

Habitat Types	Number of Families (S)	Diversity Indices		
		Magarlef Richness (d)	Pielou's Evenness (j')	Shannon- Wiener (H')
Silted Drain	7	1.28	0.53	1.03
Landfill Site	2	0.17	0.99	0.69
Grassy Habitat	13	2.27	0.63	1.62

Dipterans were the only prey items identified in the diet of the cattle egrets at the landfill sites. Larvae of Muscidae and Calliphoridae constituted over 70 % by weight and number of the diet. According to Kuranchie *et al.* [19], the mean successful strike rate recorded for a cattle egret foraging at a landfill site in Accra was 4.79 (min^{-1}) implying that an egret consumed an average of 287 maggots per hour of active foraging. This is indicative of the important role played by cattle egrets in controlling these dipteran populations.

Cattle egrets at the grassy habitat had a rather higher dietary diversity obtained from only two individuals. This was apparent from the diverse food items obtained from the gut contents, and the fact that only two families (Acrididae and Scarabeidae) were common to both guts indicating their abundance, availability and accessibility to the egrets in this habitat. High numbers of Formicidae and the diverse dipteran families recorded in both the diet and environments indicates the utilization of rich prey by these birds and confirms their opportunistic foraging behaviour. Frequent mowing (as in the grassy habitats) results in humus build-ups that are ideal for soil-dwelling invertebrates (such as termites and ants), hence the high number of ants in the diet [22].

The presence of waste bins on the University of Ghana main campus where some cattle egrets forage, may have resulted in the presence of dipteran larvae which are uncommon in grassy environment in the diet or the bird might have fed in other habitat types (landfill and drain) or on garbage in the hall of residents prior to culling. Other studies reported a dominance of orthopterans [6, 11-12]. This study recorded about 36 % of amphibians by weight, as also reported by other studies. Amphibians are commonly found in both aquatic and terrestrial foraging cattle egrets [12, 23].

According to the results, it can be deduced that cattle egrets in the Accra Metropolitan Area are omnivorous. From this study, it can be inferred that the diet of cattle egrets is influenced by the habitat in which they feed rather than on specialised food. There is the need to find out whether cattle egrets are habitat specific feeders.

Conclusion

Cattle egrets exhibited dietary plasticity and habitat versatility. The food of cattle egrets at the landfill site was monotonous (dipteran larvae) however, at the grassy

habitat, cattle egrets fed on a diversity of prey including insects and amphibians. At the silted drain, although dipterans dominated the food, orthopterans and odonates were also consumed. Cattle egrets at the landfill site recorded the highest Pielou's Evenness ($j' = 0.99$) and those at the grassy habitat recorded the highest dietary diversity ($H' = 0.62$). With regard to the type and amount of prey consumed by cattle egrets at the landfill sites and silted drain, these serves as major biological agents in the ecosystem.

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