



Full Length Article

The Feeding Behavior of the Cattle Egrets, (*Bubulcus ibis* L.) in Northeastern Arid Zone of Nigeria

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ABSTRACT

The cattle egrets (*Bubulcus ibis* L.) are historically and traditionally called the white birds of terrestrial foragers, foraging in pastures, farmlands and grasslands along side grazing livestock, capturing any disturbed insect prey. They nest in areas and territories, which are of little importance as food source, e.g., thorny *Acacia sayel*, *A. albida* and *A. meliferai* in Mbodewa, Jebra and Konduga sites during the rainy season (May- August), which is the period of nesting as food and water were abundant. Parents fed their young biparentally, through mouth to mouth, regurgitation of food boluses onto nest floor, from which chicks would peck and through bill grabbing and jerking pull on the parent bill, to receive food boluses obtained from foraging sites. Mean chick feeding visits were 3.9 daily, but mean feeding visits differed significantly by stage, four times for chicks, seven times for juveniles and three times for ages 30 days up-wards. Food delivery to offspring were highest from age 22 days (three weeks) to 42 days (seven weeks) in all sites and corresponded to high growth rate during the same period. The mean weight of crop content per gram weight of the body of the birds showed the content to food delivery and growth rate. Males took more time to care for chicks after hatching (75%) as against females (25%). Boluses delivery (71.3%) as against (28.7%) for females and was confirmed by the female skewed sex ratios at foraging sites, as males took greater portion of the day for attendance. Orthopterans being the most abundant insects in the arid zone, topped the consumption figures per bird in all stages of the birds development (50.8%) per day and showed similar results when analyzed for its economic importance in agriculture (51.1%) as it helps control 88.7% of insect with pest-status in the agricultural fields. Feeding success among chicks was directly correlated to age and success in fight and competition among siblings; because increases in body weights (g) were also directly correlated to food supply and age. Chicks left nests as juveniles at the age of 56-60 days as young adults to fend for themselves, because at this age parents found it difficult to meet their food demands. They became independent at the age of 70 days after hatching, foraging in flock, in pairs or as single birds in foraging sites. Bird samples for study were obtained through hand picking and double barrel shot gun where observations were by using binoculars, video and still cameras.

Key Words: Regurgitation; Bill grabbing; Stabbing; Pecking; Agonistic feeding; Jerking pull; Terrestrial foragers

INTRODUCTION

The Cattle egrets, restricted in migration and nomadic behaviour (Maddock, 1990) are insectivorous with almost 98% reliance on orthopterans in terms of prey occurrence in the guts, the proportions of total bulk prey weight and proportions of the weight of the boluses in which they occur (Baxter & Fairweather, 1989). Interestingly, the presence of any one insect prey in the guts either by proportion, weight or volume gave credence to its relative abundance in the ecosystem, where the egrets fed. Nesting Cattle egrets parents forage and capture any available insect to feed their off-springs (biparental care), thus making it easier to infer the diet of adult egrets from those of the chicks (Jenni, 1973). However, this may not be the same with other

ardeids, e.g., the grey herons, *Ardea cinerea*, selects smaller prey to feed their young nestlings, despite the disadvantages of such foraging to them (Moser, 1986). Biparenting in mammals and aves is a natural phenomenon, which seems to be stereotype in natural organisms so created to propagate bisexually. In the ardeids, caring, protection and guarding the off-springs in the nest are natural activities and behavior practiced and without which the off-springs may be exterminated before reaching strong, agile and active independent stage (Hafner, 2000; Hilaluddin *et al.*, 2003). Biparenting is favored among wading birds and therefore, a normal manifestation of cooperative behaviour among the ardeids (Trivers, 1972; Winkler, 1987), where feeding pattern is homogenous. Gowaty (1983), discussed biparental care in Eastern Blue birds (*Sialia sialis*), where the

potentials for evolutionary conflict between sexes, which is as common as monogamy among birds, because their external eggs and chicks require great deal of protection to develop was emphasized. Both the parents are capable of carrying out such breeding investment to a successful finishing. Male and female desertions according to Ridley (1978) leaves the other mate to take the responsibilities as a single parent to raise the chicks alone (uniparental desertion) and is a drawback on a successful biparental investment in raising off-springs. Such single parent may change feeding behaviour and nest care investment, with a tendency to intentionally reduce brood size (infanticide) to a size, which can be catered for (Mock & Parker, 1986; Fujioka, 1987).

Seasonal changes, affect insect-prey population, particularly in this arid zone, with many species of insect-prey disappearing after the rain. This has also affected the feeding behaviour and ecology of the Cattle egrets as they change their ecosystem to some marshy and dry swamps by the end of the rains and roost in towns and villages (Elgood, 1979). Such seasonal changes, which also make scarce the availability of seasonal insect-prey species, influence the prey species (types) consumed by the Cattle egrets. The absence of some wet season predilected insects e.g., the elate Isopterans, suggest that the presence of drier conditions could not favor the multiplication of such insects. Siegfried (1971), reported similar situation when 85% of the gut contents of the egrets were earthworms in winter, but none was found in summer periods.

The variation in the diet of the egrets, which witnessed the presence of vertebrates (fishes, frogs, lizards) also suggested the diversification in the types of prey consumed by the egrets (Sharah, 1998). They catch any available prey, which comes across their ways during the course of foraging activities. This also suggests that these vertebrate preys were searched and caught in the dry parts of the swamps, because it has not been reported or observed in this study, when Cattle egrets forage in water ponds, catching life preys. There has been little or no information published on the feeding behavior of the cattle egrets in the arid zone of Nigeria. Therefore, this paper presents the feeding behaviour, including prey search, catch, kill, tear, swallow and move to search for more. Observations were specifically made on parental care of chicks up to independence. It was also seen whether the cattle egrets had predilection for specific ecology e.g., niche, environment or ecosystem during the course of displaying their feeding activities and what spurs them to stick to such areas.

MATERIALS AND METHODS

The study was carried out at three sites; Jebra (11°24'N, 13°54'E) and Konduga (11°67'N, 13°43'E) in Borno State, and Mbodewa (12°24'N, 11°36'E) in Yobe State of Nigeria. These were permanent nesting sites used by these birds for over twenty years. Foraging behavior were observed to be in singles, pairs and flocks in

farmlands, grasslands, along side grazing livestock as they search, catch, kill, tear and swallow their preys. Sex ratios of the foraging and nesting bird populations were determined, using single and double lens binoculars. The sexes were separated using the bill tip and foot colors, because their plumages could not be used to distinguish them as they were similar in both sexes. Aggressiveness in foraging and nest feeding among chicks and adults, when two or more egrets attempts to catch a single flying prey and flight pattern to and from foraging sites were all observed.

Total of 288 (chicks, juveniles, nesting & roosting adults) were selected and separated into two sets of 144, to determine diet type, prey quantity consumed and economic importance of feeding behaviour to agriculture. This was also to infer and compare diet type per developmental stages and determine the prey-pest-status. Chick feeding was observed from the first day after hatching to independent stage and was used to determine parental investment in chick-rearing during nesting period to serve as an index to nest attendance, nest guarding, defence and protection.

Three nests one meter apart were selected to study feeding and its behavior and growth rate of the chicks on weekly basis and means determined. Chicks were tied to the nest post using a thin nylon thread for easy access when taking measurements. One meter separation (alley) was to allow for easy observations and not to miss any action on any of the nests. Video clips and still camera were used to capture some actions for use in analysis and reporting. Data capture was done from 6 a.m. to 6 p.m. to record the feeding visits per nest per day until chick independence and means determined per week.

Three separate nests were again selected about a metre apart from the twelve nests earlier marked and placed under general observation on parent feeding activities. Feeding activities of parents at foraging sites were observed through binoculars and physically watching all activities as they search, catch, kill, tear and swallow their prey. On the nests however, the feeding activities were observed from 6 a.m. to 6 p.m. daily to record the time of feeding visit per nest per day until chick independence. Analysis of variance of the data was performed (Sokal & Rohlf, 1981).

RESULTS

Foraging and nesting ecology. Cattle egrets were observed to forage for insect-preys in various and different types of ecosystem, such as farm-lands, grasslands, dry river and lake beds and banks, along the roads and when moving along side grazing livestock, picking various species of insects disturbed by these animals.

The egrets also had predilection for thorny trees such as *Acacia albida*, *A. melifera*, *A. sayel*, *Balanitis aegyptica* and *Azadiractha indica* as alternative, where the former four did not exist as nesting colony trees. They place their nests in fork-shaped branches to hold fast the nests from being blown off by windstorms and rainstorms.

Table I. Mean daily frequency of food boluses delivered to chicks in three nests. Data collected over a period of ten weeks at weekly intervals at Konduga in 2002 and 2003 seasons

Chick age in days	Feeding visits	Mean bolus Delivered per day	Reingested boluses	Feeding Scores (Bill grabbings)	
Nest 1				Chick 1	Chick 2
1-7	4	5.7	3.0	65 (0)	45(0)
8-15	4	8.3	-	60(0)	72(0)
16 - 22	6	8.4	-	35(28)	40(22)
23 - 29	7	13.7	-	40(27)	60(28)
30 - 36	8	13.9	1	61(15)	43(40)
37 - 42	2	13.0	-	61(16)	48(42)
43 - 49	4	5.7	1	33(16)	32(17)
50 - 56	3	2.6	1	28(28)	41(22)
57 - 63	3	2.6	-	34(29)	38(28)
64 - 70	2	1.4	-	32(30)	32(31)
Mean daily rate	4.3	7.53	0.6	44.9	45.1
Mean hourly rate	0.36	0.63		Mean clutch = 2	
Nest 2				Chick 1	Chick 2
1-7	5	5.0	1	64 (0)	46(0)
8-15	4	5.1	1	62(0)	71(0)
16 - 22	8	6.6	-	40(10)	39(20)
23 - 29	5	11.7	1	41(15)	62(40)
30 - 36	7	12.8	2	66(60)	45(45)
37 - 42	2	10.9	2	65(51)	49(42)
43 - 49	2	8.4	-	32(31)	31(30)
50 - 56	2	8.0	-	25(24)	41(41)
57 - 63	3	5.1	1	36(36)	30(30)
64 - 70	1	4.4	-	30(28)	36(32)
Mean daily rate	3.9	7.80	0.8	46.1	40.5
Mean hourly rate	0.33	0.65		Mean clutch = 2	
Nest 3				Chick 1	Chick 2
1-7	4	4.7	1	66 (0)	45(0)
8-15	2	4.9	2	61(0)	62(0)
16 - 22	8	8.0	2	50(15)	40(12)
23 - 29	6	10.3	1	41(22)	48(21)
30 - 36	7	10.6	1	65(30)	42(38)
37 - 42	2	9.7	1	64(60)	49(48)
43 - 49	2	5.4	1	32(15)	42(31)
50 - 56	3	2.9	-	22(10)	41(28)
57 - 63	4	2.6	1	36(30)	26(20)
64 - 70	1	1.9	-	22(20)	36(32)
Mean daily rate	3.5	6.10	1.0	45.9	43.1
Mean hourly rate	0.29	0.51		Mean clutch = 2	

Foraging behaviors. The birds forage in single, pairs and in flocks, searching, running and flying after preys to catching them. They penetrate thick gamba grasses, shrubs, farm crops and wild runners to search for preys. Large vertebrate preys caught were killed using the sharp robust, long bill by smashing them on the ground, tore them into shreds and the pieces ingested. Egrets spent up to ten minutes without catching any prey in this part of the zone due to prey scarcity and unavailability. Combat fights were common among foraging egrets than on nest sites, because they grapple for preys in foraging sites.

Feeding visits and bolus delivery to chicks. Feeding visits by parent egrets and food boluses delivered at each visit is presented in Table I each of the three nests had two clutches one meter apart to ensure detailed observations on the feeding visits. Food demand was high as from week four to six and declined as the chicks grew older. Mean feeding visits were four times a day for chicks, seven times for juveniles and three times for ages 30 days and upwards and were significantly ($P < 0.05$) different by stages. Daily nest feeding visits were 4.3 in nest 1, 3.9 in nest 2 and 3.5 in nest

3 and were not significantly ($P > 0.05$) different by nest and mean bolus delivery were also not significant. Bill grabbing were not observed in young chicks of one and two weeks old after hatching, but increased sharply as from week three up to week seven but declined again before independence. Feeding scores for the three nests were however, not significantly ($P < 0.05$) different.

Comparing growth rate to food delivery (Table II) gave similar trends, with significant ($P < 0.05$) difference with age but not with nests. The trend in Fig. 1 displayed the similarities and dependability of the growth rate on food supply. Reverse trend was observed when mean gram weight of food per grain of body weight were plotted against age in weeks (Fig. 2) and the trend was significantly different ($P < 0.05$) with age as food consumption per body decreased with age.

Parental investment in chick-care. Three sites were used to observe the parental chick-care investment as both parents came into feed chicks, displaying similar (the same) “thog” sound to wake up the all day sleepy chicks, which immediately and vertically raise their heads with bills wide

Table II. Mean daily food bolus delivery to chicks and daily growth rate with age, observed for three sites in 2002 and 2003 seasons

Ages of chicks in days	Daily bolus Delivery			Daily growth rate(g)		
	Mbodewa	Jebra	Konduga	Mbodewa	Jebra	Konduga
1 - 7 days	5.7	5	4.7	5.5	5.3	5.1
8 - 15 days	8.3	5.1	4.9	9.7	10.4	10.6
16 - 22 days	8.4	6.6	8	8.5	7.8	8.3
23 - 29 days	13.7	11.7	10.3	5.1	4.8	3.9
30 - 36 days	13.9	12.8	10.3	5.3	5.8	7.6
37 - 42 days	13	10.93	9.7	3.1	3	2.4
43 - 49 days	5.7	8.4	5.4	2.8	0.7	0.3
50 - 56 days	2.6	8	2.9	0.7	3.6	2.6
57 - 63 days	2.6	5.1	2.6	0.01	0.7	1.6
64 - 70 days	1.4	4.4	1.9	0.4	0.7	0.5
Mean	7.33	7.8	6.1	4.11	4.27	4.29
Significant	*	*	*	*	*	*

Table III. Individual parental investment in chicks – care during the ten weeks nesting period in three sites

Age in Days	Mbodewa		Jebra		Konduga	
	Male	Female	Male	Female	Male	Female
1-7	2 (15)	2 (10)	4 (20)	2 (14)	4 (15)	2 (6)
8-15	3 (16)	2 (5)	4 (22)	1 (6)	4 (10)	2 (3)
16 - 23	4 (13)	2 (6)	4 (8)	3 (4)	5 (9)	2 (7)
24 - 31	5 (23)	1 (5)	3 (15)	2 (6)	5 (20)	3 (3)
32 - 39	3 (22)	1 (7)	5 (20)	1 (5)	5 (22)	2 (4)
40 - 47	4 (24)	2 (5)	4 (12)	2 (3)	4 (11)	1 (7)
48 - 55	5 (4)	2 (3)	4 (8)	2 (7)	3 (8)	2 (3)
56 - 63	4 (2)	1 (2)	3 (8)	2 (6)	3 (3)	3 (2)
64 - 70	2 (3)	1 (1)	3 (4)	2 (4)	2 (3)	1 (2)
71 - 77	3 (3)	1 (1)	3 (5)	1 (3)	1 (2)	1 (1)
Total	35 (125)	14 (45)	37 (122)	13 (58)	36 (103)	19 (38)
Total male bolus delivery			350 (71.3%)			
Total Female bolus delivery			141 (28.7%)			
Total male feeding visits			108 (75%)			
Total female feeding visits			36 (25%)			

open expecting food to be dropped into them. The parents drop boluses one by one into each open bill depending on clutch size and each drop is counted as a bolus. It took up to twenty minutes to feed a clutch of two chicks per nest at each feeding visit and such feeding continued for eight days.

Parents began regurgitating food onto nest floor, when chicks jockeyed to position themselves between parent's feet moving towards the nest age and leaving nest floor empty to allow parents place food boluses. The chicks would peck and gape the parent's bill with closed bill until the parents regurgitate boluses to nest floor from which the chicks would now peck, stab and pick to swallow. Feeding from nest floor ceases immediately chicks were able to grasp the whole bill of the parents into their mouth. Ten times parents were observed to stab the juveniles, which charged on them in feeding quest.

Male feeding visits were 75% as against 25% for females, while males bolus delivery was 71.3% as against 28.7% for females (Table III). The feeding visits were significantly ($P < 0.05$) different with parents and age of chicks, but were not significantly ($P > 0.05$) different with

Fig. 1. Rate of food delivery to chicks and rate of growth with age observed for three sites in 2002 and 2003 seasons

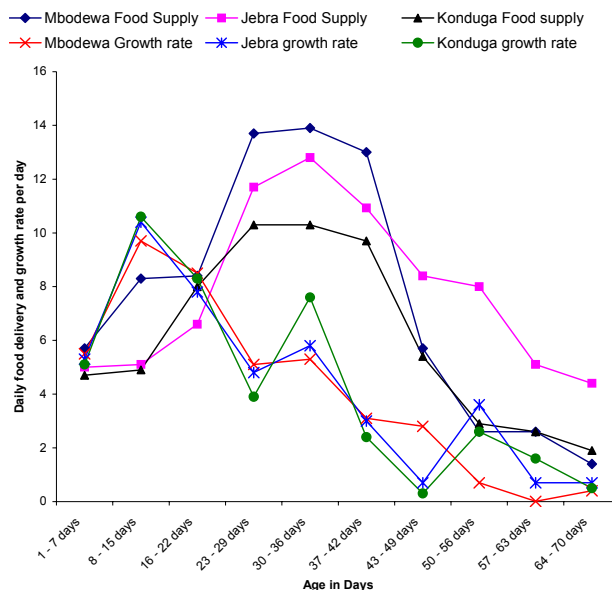
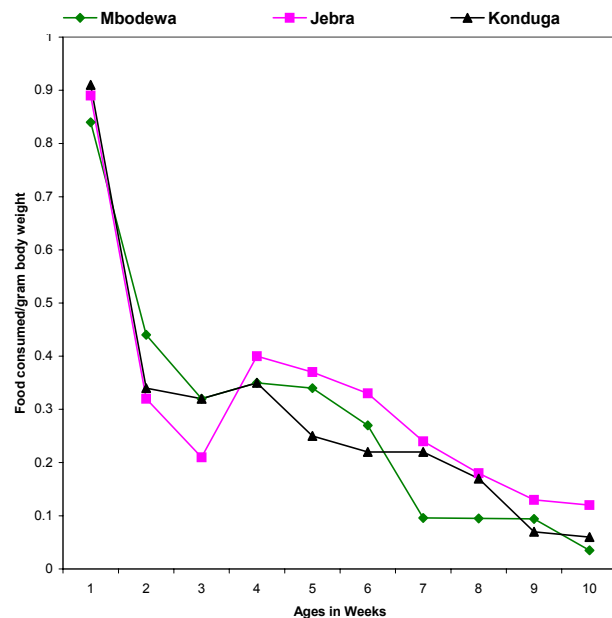


Fig. 2. Mean weight of crop content per gram weight of a bird at weekly consumption rate in three sites in 2002 and 2003 breeding seasons



site.

To confirm the dominating behavior of males in chick-care investment, adult sex ratio was determined at foraging and nest sites and presented in Table IV. Males were found at breeding site more than females in the ratio of 3:1 and 1:2.45 in foraging site in Mbodewa, 4.44:1 in breeding site and 1:2.45 in foraging site in Jebra and 2.56:1 in breeding site and 1:3.67 in foraging site in Konduga site. This confirms that males either shuttle between foraging sites and

Table IV. Sex ratio of foraging and breeding cattle egrets, as observed using binoculars at foraging sites and the breeding sites in the 2002 and 2003 seasons, after chicks were hatched. Observations were made from 6 am to 6 pm on the days of observation

Site	Sex	Mbodewa		Jebra		Konduga	
		Foraging	Breeding	Foraging	Breeding	Foraging	Breeding
1	Male	4	8	2	10	1	9
	Female	6	2	8	0	9	1
2	Male	5	10	2	10	2	8
	Female	5	0	8	0	8	2
3	Male	2	8	3	8	3	7
	Female	8	2	7	2	7	3
4	Male	3	9	4	7	1	6
	Female	7	1	6	3	9	4
5	Male	1	10	4	8	2	7
	Female	9	0	6	2	8	3
6	Male	6	5	5	7	6	6
	Female	4	5	4	3	4	4
7	Male	2	7	3	7	2	6
	Female	8	3	7	3	8	4
8	Male	2	4	3	6	2	9
	Female	8	6	7	4	8	1
9	Male	3	6	1	8	1	8
	Female	7	4	9	8	9	2
10	Male	1	8	1	9	3	5
	Female	9	2	9	1	7	5
Total male		29	75	29	80	21	69
Total female		71	25	71	18	77	27
Male: Female		1:2.45	3:1	1:2.45	4.44:1	1:3.67	2.56:1
Significant		*	*	*	*	*	*

Table V. Comparison of mean choice of prey types consumed per bird for each of the four developmental stages in 2002 -2003 breeding seasons. 36 birds were separately obtained per stages for the study and for each season

Prey Type	Chicks	Juveniles	Breeding	Roosting	Mean	SD	SE	CV%	P = 0.05
Vertebrate	19.22	27.39	43.78	39.03	32.36	11.14	5.57	17.21	*
Orthopterans	211.63	173.31	332.75	362.39	270.02	91.71	45.85	16.98	*
Other Invertebrate	71.89	48.34	127.61	218.56	116.60	81.80	40.90	35.08	*
Isopterans	114.19	99.84	145.90	0.00	89.98	23.57	11.78	9.82	*
Acacia	3.25	4.22	5.58	8.08	5.28	2.10	1.05	19.84	*
Vegetable	2.36	3.69	6.67	0.51	3.31	2.59	1.30	39.18	*
UIDAR	4.14	42.06	22.14	5.44	18.45	17.75	8.88	48.10	*
Total	426.68	398.86	684.43	634.01	536.0	140.71	70.36	13.10	*
Mean	60.95	58.59	97.78	90.57	76.97	20.13	10.05	13.06	
SD	78.94	60.81	118.23	151.72	97.18				
SE	29.84	22.98	44.68	61.94	36.73				
CV%	48.96	39.23	45.70	68.39	47.72				
P = 0.05	*	*	*	*	*				

UIDAR= Unidentified Animal Remains

Table VI. Mean prey Quantity consumption by four developmental stages of the Cattle egrets. 36 birds per stage and four each season were used during the 18 days observation period. Is used to determine prey pest -status. UIDAR= Unidentified animal remains

Prey type	Chicks	2002 Season				2003 Season				Total Consumption	% Total Consumption	% Pest Status
		Juvenile	Breeding Adult	Roosting Adult	Chicks	Juvenile	Breeding Adult	Roosting Adult	By prey Category			
Vertebrate	784	1016	5906	1105	692	986	5987	1105	17581	5.8	2.0	
Orthoptera	7769	6449	50861	13046	7619	6284	50302	13046	155376	51.1	51.1	
Other invertebrate	2788	1815	21212	7868	2588	1564	8283	7868	53986	17.7	15.3	
Isoptera	4133	4438	18823	-	9111	4208	18815	-	59528	19.9	19.9	
Acarina	1131	197	955	381	117	152	957	201	4091	1.4	0.4	
Vegetables	113	155	908	213	85	133	910	200	2717	0.9	-	
UIDAR	135	1549	3457	202	149	1514	3465	190	10711	3.5	-	
Total	16903	15619	102122	28815	20361	14841	88725	22610	303996	100.5	88.7	
% of Total	5.56	5.13	33.59	7.51	6.870	4.88	29.19	7.44				
Mean	469.52	433.86	2836.72	633.75	426.69	412.53	2464.42	628.06				
	*	*	*	*	*	*	*	*				

Total consumption per season: 2002 = 39004 Ns

2003 = 3931.70 Ns

* = Significant

nest sites or foraging in different sites with females thus reducing their numbers at the foraging together with females but increasing their numbers at nest sites to guard the nest contents and attend to the chicks.

Diet type and diet consumption per stage. Thirty-six birds per developmental stages (144) were obtained to determine diet type and prey quantity consumed at various Cattle egrets breeding stages. Consumption was higher (684.43 prey) per bird per day in nesting birds, which needed such quantity for chick rearing (Table V). Roosting birds consumed 634.01 prey per birds, which also needed such quantity for nutrient and energy reservation towards the next breeding stage. Chicks of age 1-20 days consumed 426.68 preys per chick, while juveniles of 21-40 days old had only 398.85 preys per bird. The low quantity in young juveniles suggest that feeding the young adults were difficult since they were highly involved in parents bill grabbing and threatening feeding quest, as such most parents had to avoid by flying away. The results of the prey type and quantity consumed per birds were significantly ($P < 0.05$) different among developmental stages.

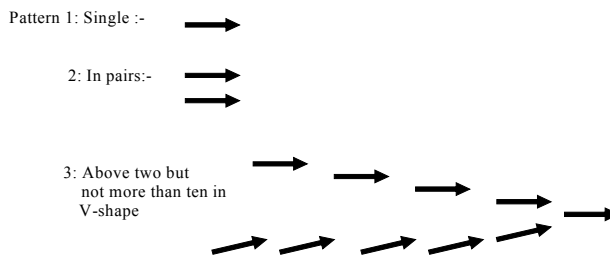
The daily diet type consumption showed that orthopterans topped at all stages with a mean of 270.02 (50.38%) preys per gut content, other Invertebrates 116.60 (21.75%), isopterans 89.98 (16.79%), vertebrates 32.36 (6.04%), unidentified animal remains (UIDAR) 18.45 (3.44%), acarina 5.28 (0.98%) and plant materials 3.31(0.62%) and were also significantly ($P < 0.05$) different with prey type consumed per bird.

Economic importance of feeding behavior to agriculture in the arid zone. Another set of 36 birds from each developmental stages and per season were randomly collected to study the economic benefits of these birds to the environment (Table VI). For 18 days of intensive observations a total of 303,996 insect preys were consumed and categorized into seven species of preys. Consumptions by season showed no significant ($P > 0.05$) difference but there was significant ($P < 0.05$) difference in prey categories (type) and developmental stages. Out of the total consumptions, analysis showed 88.7% were of pest-status (orthopterans 51.1%, isopterans 19.9%, other invertebrates 15.3%, vertebrates 2.0% & Acarina 0.4%). This suggested that Cattle egrets removed 88.7% insect/vertebrate pests from the resource poor-farmers field out of every 100 preys consumed, saving 158,361.54 ha of farmlands in one season by estimation, when 232,487 were allowed to feed uninterrupted for 365 days a year (i.e., saving 18.4 m² per day per bird).

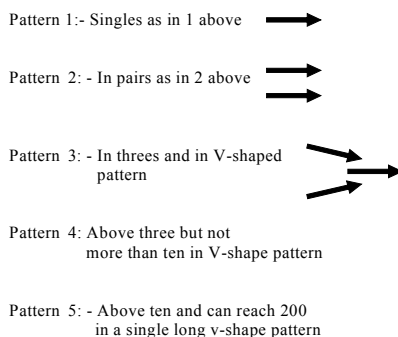
Flight pattern to and from foraging sites. Cattle egret is one of the ardeids (wading bird) with a recognized stereotype flight pattern, which are not displayed by any other ardeids. These flight patterns vary depending on the time of the movement. For instance and as observed in this study, flight patterns can be in single, pairs, three-v-shaped, above three but not more than ten v-shaped and above ten to 200 in single long v-shaped forms (Fig. 3). The size of the

Fig. 3. Flight Patterns of Cattle egrets to and from the foraging sites in the morning, afternoon and evenings

A. To foraging sites



B. From foraging Sites



v-shape pattern suggested that egrets must have foraged in singles, pairs or in large numbers in one foraging site and had to move back to site at the same time at the end of the foraging period (day), thus making such pattern inevitable.

DISCUSSION

The cattle egrets do not have predilection to any specific ecosystem in the process of foraging, for they are found all over the world with different weather, niche, ecosystems or environment. Because of the difficulty in searching for prey, they prefer to follow along side grazing livestock to catch any disturbed preys. Their predilection for thorny and thick Acacia trees for nesting was for security purposes, while foraging close by in grassland, farmlands and dry swampy prey infested ecosystem (Fogarty & Hetrick, 1973).

The hard, robust and sharp bills enabled the egrets to easily catch and kill its prey at an instant, despite the size of the prey by smashing against the ground. The birds can easily penetrate into thick grasses and bushes, because of its streamlined body to search out prey in areas where there are no grazing livestock. The search, catch, kill, tear and swallow style developed by these birds using highly developed skills and behaviors made them to thrive even in the prey scarcity zone such as the arid environment where this study have been conducted (Maddock, 1990).

Bolus (food) delivery to chicks and growth rates followed similar trend because they are inter-dependent. The higher the food supplied the higher the rate of increase

in growth and the two are affected by age of the chicks to a negative correlation as chicks get older. The number of feeding visits does not necessarily mean food boluses are delivered to chicks. It could also be as guarding visit and for nest security. Chick feeding styles were observed to be generally and basically of three types- mouth to mouth when chicks are only one to seven days old, pecking and stabbing from nest floor when chicks are from eight to three weeks old and bill-grabbing (redirected food begging activity). These styles are all dependent upon age of chicks after hatching (McKilligan, 1990).

Parent investment in chick-care gave credence to the males, which visit the nests three times more than female and deliver food boluses 2.5 times more than females which also served as a ploy against enemies, guard nest contents and cuckoldry behaviors. Feeding behaviour of the Cattle egrets did not show any preference for prey species, as the prey occurrence and prey weights were skewed towards relative availability of any single prey species in the ecosystem where the egrets fed. Orthopterans and other invertebrates, the most abundant insect species in the arid zone, were the highest in their diet taking 84.91% of each gut content.

The feeding behavior of the Cattle egrets, which took orthopterans and other invertebrates taking the major insect preys were mostly of insect-pest of agricultural crops with 88.7% pest status. The egrets therefore are resource poor – farmer friendly and biological control agent against crop pests in this arid zone. This provokes us to advocate protection against poaching, encourage environmental conservation, which could provide security for the birds and increase their multiplication.

Observations on the sex ratios of male to females in foraging and breeding sites was expected, as observed in the feeding visits and boluses delivery, where more males were observed at breeding sites in a show of high investment in attending to and guarding nest contents than females. Females were more at foraging sites than males, foraging to replace depleted nutrient and food reserves used up during egg-laying and incubation thus leaving the chick-care, nest attendance and guarding of nest to the males for most of the post- incubation period.

Cattle egrets generally have a common and organized flight patterns to and from foraging sites. There are five prominent styles, excluding those patterns, which sometimes result in unorganized and scattered forms. This makes the Cattle egrets unique in its flight behavior, which are stereotype and only typical of the Cattle egrets.

CONCLUSION

The Cattle egrets have organized and stereotype foraging styles and feeding behavior in whichever ecosystem they may be feeding with various methods of searching, catching, killing, tear and swallow. Diet type of the egrets depends on the relative abundance of a single

prey species in the feeding sites and there is no difference in the chick and adult diet. Growth rate and food supply were directly related but negatively correlated to age of the growing birds as they move towards independence. Male invest more time than females in chick-care and nest guarding. It is an agriculturally important bird, which takes off 88.7% of destructive pests from resource poor –farmers land in the arid zone ecology.

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