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EFFECT OF PHOTOPERIODIC CHANGES ON BREEDING ACTIVITIES AND WEIGHT OF SEX ORGANS IN CATTLE EGRETS (*BUBULCUS IBIS L*)

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Abstract

Fifty four (54) breeding Cattle Egrets of mixed sexes were collected by random shooting at three sites (Mbodewa in Yobe State, Jebra and Konduga in Borno State) of Northeastern Nigeria. Each bird was dissected and its primary reproductive organs (ovary, oviduct and testes) removed and weighed to determine how the breeding activities affected their weights during pre-laying, laying and post-laying stages of the breeding period. The results showed that mean weights of sex organs increased from the pre-laying to laying stages by 10% and decreased from the laying to post-laying stages by the same proportion. The changes in weight of organs did not differ significantly between sites. There was generally high mean weights of sex organs at laying periods (June –August), from a minimum of 0.6g in March to maximum of 9.9g in July for oviduct, 0.4g to 6.5g in July for ovary and 0.8g to 3.6g for the paired testes. Pooled mean weights indicated 38.1% increase in oviduct, 45% in ovary and 16% in paired testes over the breeding period. The pre-laying, laying and post-laying breeding stages coincided with photoperiodic changes associated with the seasons

Keywords: Laying, ovary, pre-laying, post-laying, weights, photoperiodic changes.

Introduction

Morphological changes in breeding vertebrates are generally said to have corresponding physiological changes in their internal organs. Young (1981) reported increases of up to 1000 times in the sizes and weights of the reproductive organs of a number of vertebrates studied during their breeding periods. The sizes of the reproductive organs of breeding birds and some other vertebrates were however, found to recede at the end of the breeding period (Eckert *et al.*, 1988; Colinvaux, 1993).

Photoperiod was found to be responsible for triggering sexual life cycles and development in *Passer domesticus* and *Bonasa umbellus* (Dawson 1991; Servello and Kirkpatrick 1988). Reproductive cycle in the cattle egret is once a year in the arid zone and begins only at the onset of rainy season (Maddock and Baxter, 1991).However, Maddock (1986) reported successful fledging success in the dry season in Australia. The rainy season have equal days and nights hours (equinoxes – June to September) after which day length shortens, the time when the egrets stop nesting and regression in gonadal maturation also begins, coinciding with photoperiodic changes as reported in Sparrows (Dawson, 1991).

Generally herons vary in their habits, diet and behaviour, however, they require some fundamental factors for nesting, particularly the ardeids. These include good nesting site, which provide protection against enemies, provide stable and adequate nesting materials, adequate

feeding (foraging) sites with abundant prey (Hafner, 2000). Such site must also be able to promote hatching and fledging success (Hilaluddin 2003), and successful rearing of offsprings (Maddock, 1986). Dusi and Dusi (1968, 1970) , reported that the cattle egrets needed nesting stimulus provided by early nesting ardeids which are called " nesting facilitation" and "breeding behaviour facilitation", because the cattle egrets were observed to begin nesting only when ardeids such as Blue herons, *Egretta caerula*; Snow egrets, *Egretta thula* and Black –crowned Night – herons *Nicticorax nicticorax* began nesting in the same colony site (Telfair 1981), which confirms the reports by Dusi and Dusi (1968, 1970)

Although the birds are of West African origin (Elgood 1979), they are now found all over the World (Siegfried 1978, Hemingway 1987, Maddock 1990), foraging in diverse habitats, and feeding on various species of orthopterans and other invertebrates, which constitute almost 98% of their diet (Baxter and Faitweather 1989). The bird, insectivorous in feeding habits, rear maximum of 3 chicks per nest (Siegfried 1972, McKilligan 1985). They normally find safe havens wherever there is open grasslands created by the crave for mechanized farming systems, similar to those African grasslands and wetlands providing favourable environments for insects prey multiplication (Siegfried 1978, Maddock 1990).

Birds history have revealed that the cattle egrets are terrestrial foragers, feeding along side grazing livestock, picking insects disturbed by the moving animals (Elgood 1979) and limited in migration and nomadic behaviour (Maddock 1990). Such insects include agricultural pests which are taken off the resource-poor farmers farms in thousands by the egrets (Baxter and Fairweather 1989) and this makes them important and beneficial to agriculture. The bird is a delicacy to humans and animals, which harvest the eggs and adults as source of protein during breeding periods, (personal observations). Predators like hawks, crows, alligator lizards and snakes, feed on eggs, chicks and adult carcasses at nest sites (McKilligan 1987).

Breeding and roosting cattle egrets, pollute the atmosphere by their hot smelly guano excretes, cause rusting and decay to roof tops, as they nest and roost in human habitations. Death of nesting colony trees up to 10% each nesting season was reported by Belzer and Lombardi (1989), due to stress on such perennial trees from pH oscillations and hyperosmolarity, created by the hot guano droppings, dead carcasses, rotten eggs and nesting materials falling to the nesting and roosting grounds. Guano coating also reduce photosynthetic activities in the colony trees when the leaves are covered with such hot excretes (Wise 1978), causing death of colony trees by 78 – 100% in quadrats, when nesting for three consecutive seasons (Belzer and Lombordi 1989).

There is little or no information on the development of sex organs before and after breeding in the Cattle egrets in Northeastern Nigeria, neither from any other part of the northern States. Therefore, this study was carried out to investigate the effect and changes which breeding activities (sexual display, copulation, egg-laying) have on the development of sex organs in breeding Cattle egrets. It is also to highlight the effect of photoperiodism on the breeding cycle of the cattle egrets in the zone.

Materials and Methods

Three sites (Mbodewa 12^0 54' N, 11^0 36' E in Yobe State; Jebra 11^0 24' N, 13^0 54' E ; and Konduga 11^0 67' N , 13^0 43' N in Borno State), were selected for a four-year (2000 - 2003) study on the changes in weights of sex organs of cattle egrets during breeding. Mbodewa lies in the Sahel Savannah in Dapchi Local Government Area of Yobe State, while Jebra and Konduga lie in the Sudan Savannah Vegetation Zone in Bama and Konduga Local Government Areas of Borno State, of Nigeria. Fifty four (54) mature male and female breeding Cattle Egrets were collected by random shooting from each of the sites in each year.

Six birds were collected and dissected per month (Oladele *et al.*, 2001), making a total of eighteen (18) birds for each of pre-laying (March-May), laying (June-August) and post-laying (September-November) breeding stages (Hotman, 1986). No observations were done in December to February during the four seasons of study, because by then the birds had abandoned their breeding sites for roosting sites, culminating the end of the breeding season as the rainy season had also ended. Sampled birds were immediately weighed fresh to determine the fresh body weight and tagged for easy identification. Detailed external morphological characters and other notable body marks were recorded for each bird before dissection. The dissections were undertaken in the laboratory and the isolated sex organs were weighed using an electric laboratory beam balance. Detailed structures and characteristics of each organ (ovary, oviduct and paired testes) were observed fresh and blood stains were removed with cotton wool. A magnifying lens was used to carefully make an incision so as to detach the reproductive organs from the other entrails (Mbinkar *et al.*, 2001).

The weights of the ovaries and oviducts, and widths of the paired testes were taken. The values were rounded up to the nearest gram and data compared for the three breeding stages and sites by Analysis of variance (ANOVA) (Sokal and Rahlf 1969), and were separated using least significant difference (LSD). Dry weights were also taken to further elucidate the breeding activities of the egrets.

Results

The results for weights changes of testes, ovary and oviduct during pre-laying, laying and post-laying breeding periods for the three study sites (Mbodewa ., Jebra and Konduga) are presented in Table 1. The table shows that during the pre-laying, breeding period, testes weight increased significantly ($P < 0.05$) between months, except for April and May in all the sites. The ovary weight increased significantly ($P < 0.05$) between the months for all the sites and oviduct weight also increased significantly ($P < 0.05$) between months, except March and April in all sites. There was no significant ($P>0.05$) difference in the weight increase of the three organs between sites during pre-laying. The mean values of oviduct, ovary and testes for Mboewa, Jebra and Konduga showed significant ($P<0.05$) difference with stage, but not significant ($P>0.05$) with site and birds.

During the laying period, there was an increase in the weight of the testes between months, though not significantly ($P > 0.05$) different for all the sites. The ovary increased in weight from May to July, but decreased significantly ($P< 0.05$) by three and half (3.5) times between July and August in all sites. The difference in

the organ weight during the laying period were not significant ($P > 0.05$) between sites.

The post-laying period was generally a recession period for all the organs in all the sites. The testes weight decreased significantly ($P < 0.05$) by10.5 times from August (last month of laying period) to September (first month of post-laying period), before maintaining constant weigh till November. A similar trend was observed in the ovary and testes during the post-laying period. Pooled weight changes of the organs for all the breeding periods in all the sites are presented in Fig 1. The figure clearly showed that observations were made for

Table 1: Mean weights (g) of reproductive organs for male and female Cattle Egrets from three (3) sites.

		Site								
		Mbodewa			Jebra			Konduga		
Breeding Stages	Time in month	Oviduct gm	Ovary gm	Testes gm	Oviduct gm	Ovary gm	Testes gm	Oviduct gm	Ovary gm	Testes gm
Pre-	March	0.7	0.4	0.8	0.7	0.4	0.9	0.6	0.4	0.8
laying	April	0.8	0.7	1.2	0.9	0.7	1.3	0.8	0.6	1.4
Period	May	2.4	1.7	1.2	2.6	1.8	1.3	2.1	1.5	1.2
Mean ± SD		1.3 ± 5	0.9 ± 2	1.06 ± 1	1.47 ± 4	0.9± 3	17 1 ± 3	1.17 ± 1	0.83 ± 2	1.13± .1
	June	8.9	5.9	3.3	9.5	6.6	3.6	9.1	5.0	3.6
Laying	July	9.2	6.3	3.4	9.9	6.5	3.6	9.2	5.9	3.6
Period	August	3.5	2.3	3.4	3.9	2.2	3.6	2.9	1.9	3.6
Mean ± SD		7.2 ± 3	4.83 ±1.5	3.67± 3	7.77±1.4	5.1±1.6	3.6±.3	7.07± 1.4	4.27± 1.5	3.6± 3
Post-	September	0.6	0.2	0.3	0.8	0.4	0.4	0.7	0.4	0.2
laying	October	0.4	0.2	0.2	0.5	0.2	0.2	0.4	0.2	0.2
Period	November	0.4	0.2	0.2	0.5	0.2	0.2	0.3	0.3	0.2
Mean ±SD		0.47± 4	0.2± 1	0.23± 1	0.6± 4	0.27± 2	0.27± 2	0.47± 3	0.3± 2	0.2± 1
Overall Mean ± SD		3.0 ±.4	2.13±.1	043± 5	3.2± 7	2.11± 7	0.91±.27	2.9±.6	1.84± 6	0.8± 17

pre-laying, laying and post-laying periods at monthly intervals for Fifty four (54) birds each year, for four (4) breeding Seasons (four years).

There was an increase in the weight during the laying period (June – August) for both the sexes. In terms of percentages the paired testes increased by 16.9%, oviduct by 38.1% and ovary by 45% from the pre-laying to the laying period. While there were decrease in the weights during the post-laying period (September to November) by 33.3% in the testes , 63% in the oviduct and 65% in the ovary.

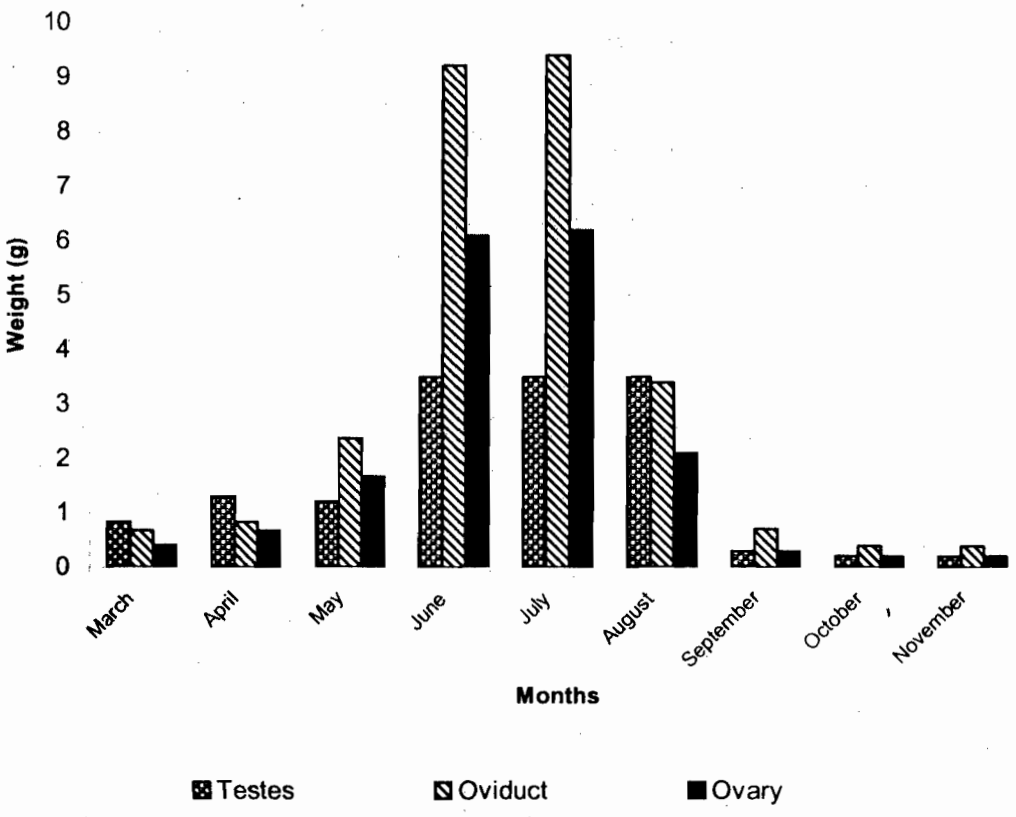

Figure 1. Pooled mean changes in weight of the reproductive organs of breeding Cattle Egrets during pre-laying, laying and post- laying for four (4) breeding seasons.

Discussion

The onset of rains and changes in environmental features were major factors observed to stimulate both sexes to start breeding – related activities. The mature and more experienced males did this by showing early changes in their external and internal reproductive indices and woeing of the females. This could have been the reason why the paired testes of the males changes size much earlier than the female organs (Young, 1981).

Morphological changes (McKilligan, 1985) in the birds were found to have corresponding changes in the sizes of the internal reproductive organs such as testes, ovary and oviduct. The changes in terms of weight and structure seemed to stimulate the birds to start searching for secure and protective physical features in the environment for nesting and subsequent rearing of their young.

Eckert *et al.* (1988) reported photoperiod can affect both physiological and morphological changes in the body of birds. This is common, particularly when days are longer than nights (March – May), and which corresponds to the pre-laying period of Cattle Egrets. This present study showed that the changes in the male reproductive organs started between March and April of each the year of study, when days were longer than nights. This is one of the important factors that trigger reproductive cycle (Young, 1981; Eckert *et al.*, 1988). This is also in conformity with the results of the studies

of Servello and Kirkpatrick (1988) and Colinvaux (1993) on Ruffed Grouse, *Bonasa umbellus*.

At pre-laying period, male organs (testes) started to increase in size and weight as from March, much earlier than the females. This suggest that the males may start to woe the females to stimulate them into pairing and courtship through the males courtship displays. The subsequent increase in size and weight of the male sex organs, which were significant between months and breeding stages, may suggest that the morphological and physiological characteristics of the birds are stereotyped during the breeding periods.

At laying period, there was a very high increase in the weight of the male organs from June to August, but was not significant ($P > 0.05$) by site and month . This shows that the male sex organs had developed and reached their peak at equinox when days and nights have equal lengths. The ovary and oviduct had sharp increases in weights from June to July and receded in August, because at this stage, egg-laying had been completed and, there was no more copulation nor incubation and some chicks had hatched while the parents were busy feeding the chicks. The attention of the parent birds were therefore, directed towards chick rearing rather than copulation, hence the temporary recession in the reproductive organs.

There was sharp drop in the weights in the three reproductive structures (paired testes, ovary, oviduct) at the post-laying period, though not significantly with months and sites. The weights remained almost constant, with a slight decrease between September and October but no weight change between October and November. This coincided with the period of longer nights than days which extended to February of the following year, when the weather was generally cool and the birds no longer occupy their breeding sites, because the parents had fledged their young and moved to roosting sites or migrated. Weights of the sex organs were not recorded during the roosting periods (December to February) due to the constancy of the weights attained by November. It was therefore, assumed that the constant weights would continue until another photoperiodic change occurred. The significant differences observed between the stages (pre-laying, laying, post-laying) in the weights of the sex organs (ovary, oviduct and paired testes), were obviously due to the photoperiodic changes that corresponded with the seasons. This finding was the same for all the sites under study, and is another proof of the stereotypic nature of the birds. It could be observed, that the pooled means are a general representation of all the weights of the organs for all sites. The sharp increase in weights of the organs during laying stages (June – August) is a manifestation of the physiological changes in the birds. The recession in the weights that followed, from end of the laying stage to the end of post-laying stage (August to November) was more drastic for the testes and ovary than for the oviduct, because the values were even below those of the pre-laying stage. This was a sign of the termination of the breeding period. That is why the cattle egrets can have only one breeding cycle in the year, as reported for House Sparrows (*Passer domesticus*) by Dawson (1991).

In conclusion, the enlargement of reproductive organs observed in the Cattle Egrets could be the sign of spermatogenesis and oogenesis that normally precede sexual reproduction in animals.

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References

Baxter, G.S and Fairweather, P.G. (1989). Comparison of diets of nestling Cattle Egrets and Interme-diate Egrets in the Hunter Valley, New South Wales. *Aust Wildl. Res.*16: 395-404.

Belzer, W.R. and Lombardi, J.R. (1989). Cattle Egrets Symbiosis and Heronry abandonment. *Colonial Water birds* 12(1) : 115 – 117.

Colinvaux , P . (1993). *Ecology 2. Centre* for Tropical Paleoecology Smithsonnian Tropical Research Institute Balboa , Republic of Panama , John Wiley and Son Inc. New York.

Dawson, A . (1991). Photoperiodic Control of testucullar regres-sion and moult in Male House Sparrows, *Passer domesticus, Ibis,*_ 133: 312-316. NERC Institute of Terrestrial Ecology, Huntingdon U K.

Dusi, J.L and Dusi, R.T .(1968). Ecological factors contribu-ting to nesting failure in a heron colony. *Wilson Bulletin* 80:458-466.

Dusi, J.L and Dusi, R.T .(1970). Nesting success and Mortality of nestlings in a Cattle Egrets colony. *Wilson Bulletin* 82:458-460.

Eckert, R, Randall, D. and Augustine, G. (1988).*Animal Physiolog Mechanisms and Adaptations*. 3rd Edition W . H Freeman and Oniye, Co. New York.

Elgood, J.A. (1979). *Birds of West Africa Towns and Gardens. West African Nat Handbook.* H.J. Savory (ed.), Longman GP. Ltd. London Wahcheony Printing Press Ltd Hong Kong, China

Hafner, H. (2000). *Heron nest site selection in Heron Conservation*, A.J. Kushlan and H. Hafner (Eds.), Academic Press USA: 201–215

Hemingway, J. (1987). An African birds makes its move around the World. Smithsonian: 60-69.

Hilaluddin, J., Shah, N. and Shawl, T.A. (2003). Nest site selection and breeding success by Cattle Egrets and Little Egret in Amroha, Utter Pradesh, India. *Waterbirds* 26(4): 444-448

Holman, W. L. (1986). Changes in body weight and Body composition of Breeding Ring- necked Ducks (*Aythya collaris). Auk* 103: 181-188.

Maddock, M. (1986). Fledging success of egrets in dry and wet seasons. *Corella.* 10(4) 101 – 107.

Maddock, M. (1990). Cattle egret: South to Tasmania and New Zealand for the Winter. *Notornis* 37:1-23

Maddock, M. and Baxter, G. S. (1991). Breeding Success of Egrets Related to Rainfall: a Six- year Australian study. *Colonial Water birds* 14 (2) : 134 – 139.

Mbinker , D . L ., Ezealor , A . U . and Oniye, S. J. (2001). Indices of Sexual dimorphism in Double– Spurred Francolins, *Francolinus bicalcaratus (L.). J. of Trop. Biosciences* , 1 (1); 134 – 137.

Mckilligan, N.G. (1985) . The Breeding Success of The Idian Cattle Egret, *Ardeola ibis* in Eastern Australia. *Ibis* 127 : 530 – 536.

Mckilligan, N.G. (1987). Causes of nesting losses in the Cattle Egret

Ardeola ibis in eastern Australia with special references to the pathognicity of the tick *Argas (Persicargas) robertsi* to nestlings. *Aust. J. of Ecol.* 12: 9 – 16.

Oladele, S. B., Ayo, J. O., Esievo , K . A . N . and Ogundipe, S . O. (2001). Seasonal Sex Variations in Packed Cell Volume , Haemoglobin and total Protein of indigenous ducks in Zaria, Nigeria. *J . of Trop. Biosciences.* 1 (1): 84 – 88.

Servello, F. A. and Kirkpatrick , R. L. (1988). Nutrition and Condition of Ruffed Grouse during the breeding Season in South-westernVarginia. *Condor* 90 : 836 – 842.

Siegfried, W.R. (1972). Breeding success and reproductive output of the *Cattle Egrets. Ostrich,* 43: 43 – 45.

Siegfried, W.R.(1978). *Habitat and Modern range Expansion of the cattle Egret.* In Ogden and Sprunt (Eds.), Wadina birds.

Sokal, R.R. and Rohlf, F.S. (1969). *Biometry. The principles and practices of statistics in Biological Research.* 2nd edition. W.H. Freeman, San Francisco.

Telfair, R.C. II. (1981). Cattle Egrets, inland heronries and the availability of crayfish. *Southern Naturalist*, 26: 37-41.

Wiese, J.H. (1978). *Heron nest site selection and its ecological effect.* In: Wading Birds Research Report No.7 of the National Audubon Society, Edited by A. Sprunt., J.G. Ogden and S. Winkler. N.York: National Audubon Society Pp. 27- 34

Young , J . Z . (1981). *The Life of Vertebrates* (3rd Ed.) Clarendon Press, Oxford. U.K