

Ecology And Influence Of Age And Habitats On The Diurnal Activity Patterns Of Cattle Egret (*Bubulcus Ibis*)

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Abstract: It was found that habitat types and age may influence diurnal activities of cattle egrets. In average, the grassland comprised 41.59% of all of diurnal activities, while forest and bushland comprised 21.54% and 35.79% of all of diurnal activities respectively ($P < 0.05$). Variation in the performance of diurnal activities overtimes of the day differed significantly ($P < 0.05$), similarly, the time spent by cattle egrets to perform diurnal activities was different ($P < 0.05$). Activity budget of cattle egrets differed significantly with age classes ($P > 0.05$). The adult cattle egrets spent much time feeding than sub-adults and juveniles. The feeding behaviour was the diurnal activity of cattle egrets performed most often in the morning hours. The diurnal activity patterns and time budgets of the cattle egrets may be due to their strategies to cope with environmental factors such temperatures, different habitats and food availability; and high foraging behaviour can be due to high energy demand.

Key words: Cattle egrets, Diurnal activity, Activity budget, Ecology, Conservation

1. Introduction

Cattle egrets are regarded as cosmopolitan bird species, and they commonly found in different habitats [1]. Due to their ability to adapt to different environments, they perform their diurnal activities in diverse habitats [2]. Diurnal activity patterns are the behaviour that animals do, and are structured with respect to the time of the day [3]. Activity patterns can be in the form of movement either of the whole or part of its body [1, 3]. The activity budget is the amount of time that is spent by an animal to perform their activities [1-3]. The cattle egrets are social birds that commonly seen in associations with other birds and livestock [4]. This is because the livestock's activities such as movement and grazing tend to flush out invertebrates, such as insect prey [4, 5]. Thus they capture any disturbed insect prey by grazing livestock in farmlands, pastures and grasslands [5]. The cattle egrets get their name from their adapted habit of hunting in pasturelands in close association with livestock [6]. Various studies have shown that the age of animals, sex, reproduction, environmental factors and habitats can influence diurnal activity patterns [5, 6]. However, in this piece of work I only considered the influence of age and habitats on the diurnal activity patterns and budget of the cattle egrets. The main objective of the study was to assess the influence of age and habitats on diurnal activity patterns of the cattle egrets. And the specific objectives were (i) to assess the diurnal activity patterns and budget of cattle egrets in different age classes (ii) to assess the activity patterns performed by cattle egret in different habitats (iii) to find out whether there is a variation in the performance of different activity of cattle egrets overtimes of the day and (iv) to compare the diurnal sustained and instantaneous activities of cattle egrets.

2. Materials and Methods

2.1 The description of the study area.

This study was carried out between April and May 2015 in Rungwe district, Mbeya regional. The area lies between 8°30' and 9°30'S and 33° and 34°E in south-west Tanzania [7]. The ecology of the Rungwe district support many animals including cattle egrets. The study site was selected in the Syukula village where is obvious to see many cattle egrets in close association with grazing animals such cows, sheep and goats near the Rungwe Mountain. The site was selected based on the availability of cattle egrets, suitability and accessibility of the study sites.

2.2. Research methodology

The activity patterns of the cattle egrets were studied by surveying the areas occupied by the cattle egrets. Three habitat types at the study site were identified; these were grassland, forest and bushland. A flock of cattle egrets in each habitat was studied till the whole flock disappears, there after other flocks were searched anywhere in the selected habitat and studied. This was done using scan sampling method while the diurnal activities were recoded using sustained and instantaneous rules.

2.2.1. Scan sampling method

Scan sampling was used to study diurnal activities patterns of cattle egrets in the field, the flock was observed and the behaviour performed was recorded. Each individual in the group was considered but only the activities of one individual were recorded at a particular time. The duration of the scan was 5 seconds and the interval between scanning was 3 minutes. The study was beginning from 6:30am to 7:00pm.

2.2.2. Recording rules: instantaneous and sustained methods

The diurnal activities were recorded using instantaneous and sustained methods. Instantaneous method is a recording rule in which observation sessions are divided into time interval. With this rule the individual's activity was recorded at instant time of contact. Then the individual was further observed and activity sustained for 5 seconds was recorded. This rule of recording activity done by animal sustained for certain time is

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known as sustained recording rule. Activities of cattle egrets recorded include foraging behaviour, perching, standing, walking, running, flying, drinking, grooming, preening, stretching body or feather shaking and scratching. The cattle egrets were observed with naked eye and through binoculars (Bushnell) whenever found necessary to record the data from quite a long distance without disturbing the birds. Other materials used were camera, GPS, and stopwatch.

2.3. Data analysis

The data obtained were subjected to statistical analyses by using a Microsoft Excel and STATISTICA software [8]. Data distribution was checked for normality using kolmogorov-smirnov while data transformations were performed using Box-Cox transformation. Non-parametric Kruskal Wallis was used to find the difference in the activity budget of cattle egrets in different age classes, the difference in the activity patterns performed by cattle egrets in different habitats, as well as the variation in the performance of different activity of cattle egrets the tested using. While the difference in the time spent in different activities performed by the cattle egrets was tested using Chi-square test. Moreover, to make data analysis easy all activity patterns were grouped into the following activity categories; resting (nestling, lying, shortening of the neck, perching and standing on one foot), feeding (all foraging behaviour such as searching and capturing or handling of prey using its beak, pecking, nibbling or chewing and swallowing of the food), locomotion (include activities like walking, jumping, running and flying). Drinking, fluttering, grooming, preening, stretching of the body or body shaking and scratching were grouped as comfort behaviour or maintenance. All activities performed by the cattle egrets not mentioned in the above behaviour categories (such as vigilance or gazing, making threatening calls or alerting, fighting, social behaviour such playing) were put together as other activities. Moreover, the

behaviour groups were categorised with respect to time into five phases, those from early morning (6:00 to 8:00 am), morning (9:00 to 11:00 am), noon (12:00 to 2:00pm), afternoon (3:00 to 5:00 pm), and evening (6:00 to 7:00 pm) hours. The cattle egrets were also grouped into three age classes; adults, sub-adults and juveniles.

3. Results

3.1. Diurnal activity patterns and budget of cattle egrets in different age classes

The cattle egrets were observed performing their activities in singles, pairs and flocks in grasslands, bushland and forest. Alongside the grazing livestock they were seen hunting, catching, and killing, tearing and swallowing preys. Food type observed eaten by cattle egrets include Invertebrate such as moths, spiders, butterfly, earthworms, grasshoppers, crickets, flies; and vertebrates included tadpoles, small lizards and flogs. There were an average of 7200 minutes (120 hours) of observations of activities of the cattle egrets in three habitats types (wooded grassland, forest and bushland) in which the average of time (hours) spent in feeding, locomotion, resting, comfort behaviour and other activities were 43.98 (36.65%), 37.18 (30.98%), 18.58 (15.48%), 11.34 (9.45%) and 6.58 (5.48%) respectively (Table 1). It was found that feeding behaviour was the dominant diurnal activity performed by the cattle egrets (Table 1). However, the feeding behaviour was observed more frequent in the adult cattle egrets than sub-adults and juvenile (Table 1); and activity budget of cattle egrets differed significantly with age classes ($H = 4.16$, $P > 0.05$). Moreover, the time spent by cattle egrets to perform diurnal activities differed significantly ($\chi^2 = 45.26$, $P < 0.05$) (Figure 1).

Table 1: Average of time (in hours) spent by the cattle egrets in each category of diurnal activities with respect to age classes

Age classes	Diurnal activities of cattle egrets				
	Feeding	Locomotion	Resting	Comfort behaviour	Other activities
Adult	22.30	17.45	8.67	5.08	3.20
Sub-adult	15.76	13.52	7.60	4.44	1.82
Juvenile	5.92	6.21	2.31	1.82	1.20
Total	43.98	37.18	18.58	11.34	6.22

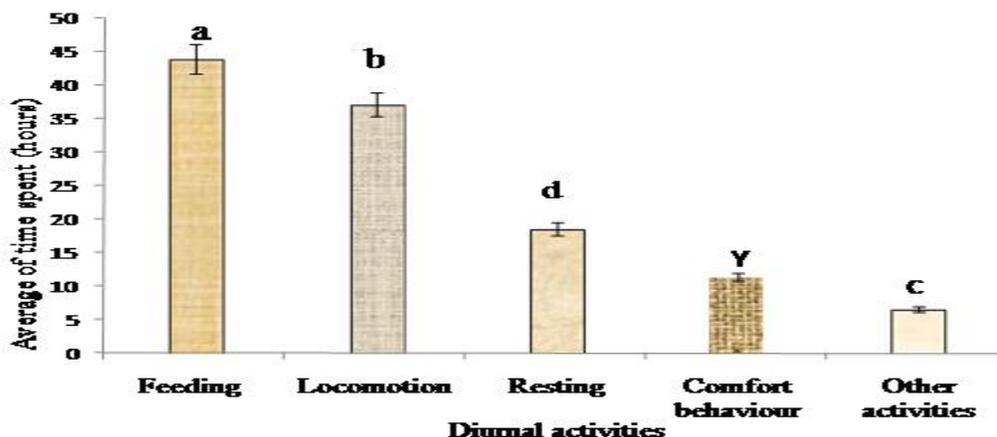


FIGURE 1: The time spent by cattle egrets in each category of diurnal activities. Different letters on the top of the bars indicate significant difference between diurnal activity categories at an alpha rejection level of 0.05 ($p < 0.05$).

3.2. Activity patterns performed by cattle egret in grassland, bushland and forest

It was observed that cattle egrets grassland than forest and bushland. The grassland comprised 41.59% of all of diurnal activities performed by the cattle egrets, while 21.54% and

35.79% of all activities were performed in the forest and bushland respectively (Table 2). Statistical test showed a significant difference in the activity patterns of cattle egrets in the three habitat types ($H = 1.625$, $P < 0.05$).

Table 2: Occurrence of diurnal activities of cattle egrets in three habitat types

Activities	Habitats		
	Grassland	Forest	Bushland
Feeding	916	221	891
Locomotion	612	482	612
Resting	396	314	261
Comfort behaviour	302	123	170
Other activities	111	59	149

3.3. Variation in the performance of different activity of cattle egrets overtimes of the day

The table 3 below shows amount of diurnal activities performed by the cattle egrets overtimes of the day. The feeding activity showed highest peak in the morning and then

decreased in the evening hours. Moreover, locomotion was also the highest activity performed by the cattle egrets. Thus, the variation in the performance of diurnal activities overtimes of the day by the cattle egrets differed significantly ($H = 6.543$, $P < 0.05$).

Table 3: Occurrence of diurnal activities of cattle egrets in different times of the day

Diurnal activities	Times of the day				
	Early morning	Late morning	Noon	Afternoon	Evening
Feeding	683	525	319	393	139
Locomotion	483	384	345	419	110
Resting	210	155	273	222	50
Comfort behaviour	95	103	146	128	59
Other activities	116	57	71	63	1

3.4. Sustained and instantaneous activities

Diurnal activities of cattle egrets recorded using sustained and instantaneous rules are called sustained and instantaneous activities respectively (Table 4). The difference between sustained and instantaneous activities was significant ($\chi^2 =$

22.084, $P < 0.05$). It was found that more instantaneous activities were observed than sustained activities. The total diurnal activities recorded by sustained and instantaneous rule in each activity category are presented in table 4.

Table 4: Occurrence of diurnal activities of cattle egrets recorded as sustained and instantaneous activities

Diurnal activities	Sustained activities	Instantaneous activities
Feeding	969	1059
Locomotion	802	904
Resting	404	567
Comfort behaviour	279	316
Other activities	178	141

4. Discussion

4.1. Diurnal activity patterns and budget of cattle egrets in different age classes

Cattle egrets were observed performing their diurnal activities sometimes in singles, pairs and flocks. Some of these activities took less or much time to be performed. In this study, among the four categories of diurnal activities (feeding, locomotion, resting, comfort behaviour and other activities),

feeding was the dominant diurnal activity performed by cattle egrets (Table 1). The egrets spent much time in feeding, because, like other animals especially birds have high metabolic rate and energy demand [9]. Therefore, they need food to survive and mostly important to compensate for the energy lost during searching or hunting of preys. The feeding activity being dominant is also explained in several researches on birds' behaviour which is attributed by high energy demand, hunger level and aggressiveness [3, 5, 6, 10]. Apart from

feeding activity, locomotion also took more time to be performed (Figure 1 and Table 1). This is because during searching or hunting of preys cattle egrets were observed changing their location or position or moving from place to place either by walking or flying. Movement of cattle egrets disturbs insect and make them to fly or jump away. This makes insects visible to cattle egrets and easy seized [11]. Due to the difficulty in searching for prey, egrets prefer to follow alongside grazing livestock to catch any disturbed preys [2, 6, 11]. Generally, the movement of cattle egrets themselves or by livestock increases feeding efficiency of cattle egrets. However, the later increases feeding efficiency even much more. This is true because the flocks of egrets which were feeding alongside the grazing cows were observed feeding continuously than egrets which were searching their preys alone. This is also shown by Thompson et al., [12], Scott [13] and Dinsmore [14] that cattle egrets foraging with cows capture more food items and takes fewer steps and less time to do so than those foraging alone. Furthermore, Grubb and Bulletin [15] explained that egrets are about 3.6 times as

4.2 Activity patterns performed by cattle egret in grassland, bushland and forest

Despite the fact that cattle egrets show no preference to any specific ecosystem in their diurnal activity, in this study cattle egrets were observed foraging more and occupying the grassland than forest and bushland. For instance, about 42% of all diurnal activities were performed in the grassland with short grasses, while 22% and 36% of all activities were performed in the forest and bushland respectively (Table 2). Similar observation was shown by Abigail et al [3] and Leslie et al., [16] that foraging success was significantly higher in the grassy habitats. Characteristically cattle egrets prefer grassland which provides them with movement or walking while searching or capturing the disturbed preys by the cattle or by the nearby conspecifics [17, 18]. Also it is in the grassland were many invertebrates such as arthropods which are main food item of the cattle egrets prefer to stay, hence once disturbed by the grazing cattle or themselves are easily to be seen and captured [12, 19]. This is efficient only in habitats with short grasses as in this study. Because in grassland with tall grasses, the foraging activity becomes difficulty as tall grasses reduce egrets' visibility and hence decrease foraging rate.

4.3. Variation in the performance of different activity of cattle egrets overtimes of the day

Observed diurnal activity patterns of cattle egrets showed different peaks in different times of the day. Total daily feeding activity generally was high in the early morning and late afternoon (figure 3). This is due to the fact that in the morning hours egrets are awake and active and therefore can hunt their prey actively. Likewise, in the morning and late afternoon the sun is less fierce and thus favoured the grazing cows to continue feeding while troubling insects; these insect are prey of cattle egrets and therefore lured the egrets to continue feeding as well alongside the grazing cows. Additionally, in the morning, the birds are active and tend to have high foraging rate in order to compensate for the energy used up during roosting. Similar observation was obtained by Leslie et al., [16] that cattle egrets forage mainly in the morning and afternoon nonetheless foraging success was largely higher in the morning. Furthermore, low peak of feeding activity in noon and

efficient when foraging with livestock as when foraging alone. The adult cattle egrets were observed feeding more often than sub adults and juveniles (Table 1). For instance, the adult egrets were observed attempting to capture more items, capturing more items, and had higher capture success rates than sub adults and juveniles. This may be due to the fact that adult egrets are more active and strong enough to walk, chase, capture and seize their preys compared to sub adults and juveniles. It was observed that adult cattle egrets consumed on average larger and many food items than did sub adults and juveniles. Furthermore, the activity budget of cattle egrets differed significantly with age. Mature egrets such as adults and sub adults spent much time in diurnal activities than less matured egrets such as juveniles (Table 1). This is because the matured egrets are strong enough to seize their prey and they do not get tired much quickly than sub adults and juveniles do. The more time spent on a particular activity shows how important this activity is, for instance, cattle egrets allocated more time budget in foraging or feeding than other diurnal activity categories (Figure 1).

evening hours were due to fierce temperature and dusk respectively. Cattle egrets avoided harsh temperatures during noon hours and therefore they went to rest on shadows of canopies. Since cattle egrets are not nocturnal [20] so during dusk were unable to see and capture their prey: Also the insects were least abundant in the evening. Thus they reduced or stopped foraging in those hours. Generally, in the evening hours many cattle egrets moved to their roosting places and diurnal activities stopped or decreased.

4.4. Sustained and instantaneous activities

Collected data by sustained and instantaneous rule were different. This difference may be caused by the amount of time used to record the activities using the two recording rules. For instance, sustained activities were recorded only if they were sustained within a given time, which was five seconds, while instantaneous activities were recorded at the beep when the bird is seen. Therefore, the activity recorded as instantaneous was not necessary to be recorded as sustained because the egrets changed their activity even within a second. This change in the performance of activities with time by the cattle egrets led a difference in the activities recorded by the two rules.

5. Conclusion and recommendation

The cattle egrets spent much time foraging than other diurnal activities; and prefer grassland habitat because it is easy to catch disturbed insect prey by cows. The grass habitat also provides them with movement while searching for preys. Variation in the diurnal activity patterns and time budgets of the cattle egrets may be due to their strategies to cope with environmental factors such temperatures and different habitat types. And the foraging success of cattle egrets may be due to factors such as prey obtainability, abundance, accessibility and hunger level. In this study, foraging success and efficiency of cattle egrets was higher in grassland habitat type and varied according to the time of day. Foraging was generally higher in the morning and lowest in the late evening. However, I recommend that more studies must be carried out to find more about diurnal activity of the cattle egrets. And these studies should not only focus on three habitats (grassland, forest, and bushland) but rather in many habitats types including wetlands

and dry land types. This may bring a very nice conclusion about the behaviour and diurnal activity patterns of the cattle egrets.

Conflict of Interests

The authors declare that there is no conflict of interests regarding the publication of this paper.

Acknowledgements

I would like to thank staffs in the department of science at Mbeya University of Science and Technology (MUST) for their support during preparation and completion of this work. I do also thank Mr Baraka Mbogora, Mr. Musa Mbotoni and Mr. Charles Chekecha for their sincere support during field work. I recognize my family and several colleagues for their financial help. Finally I thank all villagers in Rungwe district who helped during the study.

6. References

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