

A Study of Diurnal Activity Pattern and Time Budget Analysis of Captive Ostrich (*Struthio camelus*) in Monsoon, Winter and Summer Seasons at Alipore Zoological Garden, Kolkata, India

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ABSTRACT

Understanding the behaviors of a particular species in captivity is crucial to compare them with the ones in wild for the overall growth of animal population. Hence, a study on diurnal behavioral pattern and time budget analysis of a male ostrich (*Struthio camelus*) was conducted at Alipore Zoological Garden, Kolkata, India, from August 2023 to June 2024, in order to explore all the seasonal variations. Data was collected from 10:00 h to 17:00 h by using focal sampling method with total 23,520 minutes of observations. The current study revealed total 18 different behaviors such as standing outside shade, standing inside shade, running, walking, eating of leaves, grasses, eating of mud, stones, self-maintenance, dust bathing, investigatory picking, sitting with head high, sitting with head low, flapping, preening, sleeping during standing, sleeping during sitting, defecation,

keeper interaction and feeding of offered feed. The studied ostrich primarily displayed self-maintenance (16.10%) during monsoon, whereas, it was predominantly engaged in standing outside the shed (14.67%) and eating of leaves, grasses (13.86%) in winter and in summer also the standing outside the shed (13.86%). When the seasonal variation among activity budget data were considered, it was noted that, the ostrich primarily exhibited walking, eating of stones, mud, self-maintenance and investigatory picking during monsoon, compared to the other two seasons ($p < 0.05$, DMRT), whereas, activities such as sitting with head high and sleeping during sitting were prevalent during summer season. This study will serve as a guide for further investigations on behaviors of captive male ostriches to take conservation efforts for their welfare.

Keywords Alipore Zoological Garden, Conservation efforts, Diurnal behavioral pattern, *Struthio camelus*, Time budget analysis.

INTRODUCTION

Ostrich, the largest flightless (Brasso *et al.* 2020) as well as the heaviest living bird in the world, belongs to the family struthionidae under order Struthioniformes and is known for its biggest eggs among all birds worldwide. This omnivorous bird currently inhabits true desert or semidesert area of Southwest Africa (Mbaya *et al.* 2015). These long-necked birds have small head with short beak and big brown eyes with thick, black lashes providing them a good

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eyesight to help see from a long distance. An adult male ostrich has a black colored body, usually larger than females, with its wings and tail feathers white; whereas, female ones have greyish brown plumage with a smooth, soft texture. This flightless bird has powerful, strong legs with two claws in each toe to run very fast. Being a curious, yet gentle bird, they avoid human contact, thinking of them as predators and run away from human population in wild, but they can also be protective of their territory and offspring, and become aggressive. Ostriches are currently under 'least concern' category of IUCN, their population is in constant danger due to many possible threats like illegal hunting for their meat and eggs, ornamental feathers, loss of habitats and predation by spotted hyenas, leopard, lions. As a result of this population decline, many zoos, farms and national parks have taken initiatives to conserve this species through proper management to mitigate those problems. In captive condition, these birds are safe from any potential threats and hence their survival rate increases. So, for sufficient take care and complete protection of this species, conservation through captivity is of utmost importance, for which, studying of their behaviors are much needed.

Animal behavior refers to the organized response of an animal to any environmental stimuli and indicates the interaction between animals as well as the relationship between the animals and with their surroundings. Understanding animal behavior is necessary to know about their adaption in nature and also about their various stereotypic behaviors in captivity, by finding out the differences in activities and behaviors of wild and captive species, ultimately enable us to take conservation efforts which will ensure a sustainable and stable population of the studied animal. While in the wild, ostriches remain engaged in activities such as feeding, communication, grooming, pecking (Newberry *et al.* 2007), the captive ones develop abnormal behaviors like feather pecking, anorexia etc. possibly due to enclosure size and captive environment (Hambali *et al.* 2015). Thus, a thorough understanding of behavioral pattern of ostriches could act as a vital conservation tool and aid in their overall welfare.

Activity pattern depicts about the definite pattern

of the daily activities of a particular species, whereas, the different behaviors exhibited by the animals in a specific time period, noted as the mean activity percentage (Baskaran 2013), is known as activity budget. Besides providing important baseline data about captive animal, a detailed activity budget and its behavior pattern, and also a comparison of activity budget within species or between captive and its wild conspecific could be useful to state the effect of captivity and other factors on the species of interest as the success of conservation efforts of a wild animal in captivity relies on the documented observation-based data of its activity budget.

However, very few studies have been conducted to find out about the behavioral pattern of ostrich (Mbaya *et al.* 2015, Hambali *et al.* 2015, Fericean and Rada 2013) till date. Therefore, the current study was aimed to observe and determine the diurnal activity budget of captive male ostrich in Alipore Zoological Garden, Kolkata, India, to deal with the scarcity of information in the prior studies. The broad objective of this study was to assess the behavioral pattern of the ostrich and prepare a proper ethogram to gain insight on the seasonal variation of its behaviors.

MATERIALS AND METHODS

Study area

Alipore zoological garden, Kolkata, is one of the oldest zoological parks in India, coordinating 22.535913°N, 88.332053°E. It covers an area of approximately 18.811 hectares and houses a diverse range of fauna including mammals, reptiles, birds which attracts huge number of tourists every year, especially in winter. Moderate climate condition is observed throughout the year in this zoological garden. Summer starts from March and extends till May with an average temperature of 37°C which can reach as high as 42°C, whereas, the rainy season lasts from July to October with average rainfall of 1641.4 mm annually. During winter, from mid-November to end of the February, temperature in this area can vary from 13°C to 14°C with the minimum temperature of 10°C.

Studied animal and its enclosure

The behavioral study was conducted on a male ostrich

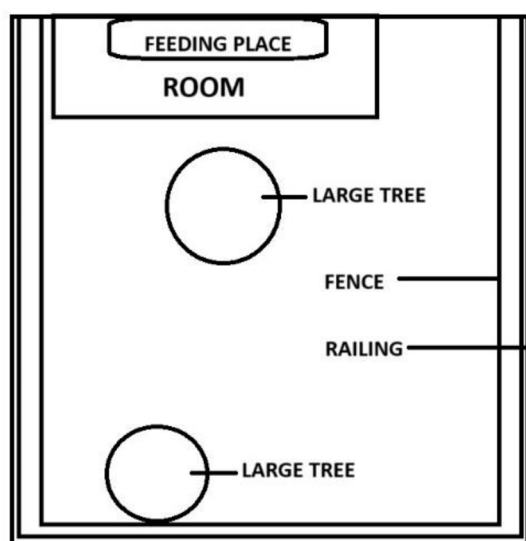


Fig. 1. Layout of ostrich enclosure at Alipore Zoological Garden (based on visual observations during present study).

which was kept in an open enclosure occupying a total area of nearly 392.35 m². The enclosure (Fig. 1) is surrounded by a netted fence and an iron railing from inside to outside. There are two large trees and a grassland area in the middle of the enclosure and a suitable room at one side of the area, where keepers provide food and water twice a day.

Data collection

The study on activity pattern of ostrich was carried out for eleven-months, two and half months of monsoon, four and half months from winter and four months from summer, in the Alipore Zoological Garden. Behavioral patterns of the studied bird were recorded and marked on a sheet from 10 am to 5 pm twice a week. All of the observations were recorded from a suitable view point with unaided eye using focal sampling method (Altmann 1974), without creating any disturbances to the animal. Total observation period was 23,520 minutes.

Ethogram

An ethogram is a detailed description of the behaviors exhibited by a particular species to have a proper understanding and analysis of its actions. Creating an ethogram involves a systematic observation,

Table 1. Ethogram used for collecting behavioral data of ostrich, in captivity at Alipore Zoological Garden, Kolkata (based on Mbaya *et al.* 2015, Hambali *et al.* 2015, Fericean and Rada 2013).

Behavior	Description
Standing outside shade	Standing one place with head raised outside shade
Standing inside shade	Standing one place with head raised inside shade
Running	Locomoting with both feet off from ground at a time
Walking	Moving on one place to other with the tip of its toes
Eating of leaves, grasses	Eating grasses, leaves of tall tree or shrubs
Eating mud, stones	Eating insects, pebbles, faecal matter
Self-maintenance	Rubbing its beak along the ground or railing of enclosure and cleaning beak after eating something
Dust bathing	Sitting on ground or sand and rubbing its neck and tail while flapping wing to coat its feathers with dust
Investigatory picking	Picking something while walking, not for eating
Sitting with head high	Sitting with raised head
Sitting with head low	Sitting with lowering its head and laying its neck on ground
Flapping	Moving its two wings up and down
Preening	Cleaning its body specially feathers to prevent foreign particles stuck on feathers or disease-causing agents
Sleeping during standing	Standing with closed eyes
Sleeping during sitting	Sitting with closed eyes
Defecation	Removing waste products from body by popping
Keeper interaction	Interacting with trainer or keeper when food is given.
Feeding of offered food	Eating food given from the zoo

recording, categorization of the observed behaviors, and justified nomenclature and description of each behavior. Based on previous behavioral studies and current preliminary observation on ostrich (Mbaya *et al.* 2015, Hambali *et al.* 2015, Fericean and Rada 2013) a proper ethogram (Table 1) was created. Total 18 different behaviors such as standing outside shade, standing inside shade, running, walking, eating of leaves, grasses, eating of mud, stone, self-maintenance, dust bathing, investigatory picking, sitting with head high, sitting with head low, flapping, preening, sleeping during standing, sleeping during sitting, defecation, keeper interaction and feeding of offered food were noted for the male ostrich. The

time budgeting of different activities displayed by the species of interest in a definite time span provided an opportunity for making evaluations between the behaviors expressed by wild and captive ostrich and pointing out the differences observed as well as the factors causing such alterations.

Data analysis

To determine the diurnal activity time budget, the initial step was to differentiate activities into various behavioral categories. Then duration for each activity was recorded. The collected data from simple observation on the studied ostrich were analyzed and then calculated as mean percentage of time, engaged in each activity (Crockett and Ha 2010). All the graphical representations necessary for the study were constructed using MS-Excel software. The observational data were presented as mean percentage \pm standard error (SE). For the comparison of different diurnal activity patterns among the three different seasons as well as within the observational hours, One-way analysis of variance (ANOVA), followed by Duncan's multiple range tests (DMRT) was performed for multiple comparisons at the significance level of 0.05.

RESULTS AND DISCUSSION

A total of 7,840 minutes of diurnal behavioral data of the studied male ostrich were collected for the present study from each of the three studied seasons. Analyzed data were presented as a percentage of time spent by the ostrich.

Diurnal activity budget of ostrich during monsoon, winter and summer season (Fig. 2)

Through-out the monsoon season the studied ostrich

was predominantly engaged in self-maintenance, accounting for 16.10% of its time, followed by standing outside the shed (15.28%), walking (13.09%), preening (9.33%), eating of stones, mud (9.09%), eating of leaves, grasses (8.52%), sitting with head high (6.52%), standing inside shed (4.67%), investigatory picking (4.48%), sleeping during sitting (4.10%), feeding (2.62%), keeper interaction (2.43%) and flapping (0.90%). Behaviors like dust-bathing, sitting with head low, sleeping during standing and defecation only constituted 0.67% of the observation period, while, running was noted for only 0.19% of its time.

During winter, the ostrich primarily exhibited standing outside shed (14.67%) activity, closely followed by eating of leaves, grasses (13.93%). This was followed by self-maintenance (10.21%), preening (8.83%), walking (7.90%), sleeping during sitting (7.67%), eating of stones, mud (7.33%), sitting with head high (7.15%), sleeping during standing (6.60%), standing inside shed (4.43%), investigatory picking (2.83%), feeding (2.74%), keeper interaction (2.55%), dust-bathing (1.64%), sitting with head low (0.83%) and defecation (0.69%).

During the summer season, the studied bird spent the majority of its time in behaviors like standing outside shed and eating of leaves, grasses both accounting for 13.86% of the total observation period, followed by sleeping during sitting (9.62%), self-maintenance (9.57%), preening (9.33%), walking (9%), sitting with head high (7.86%), sleeping during standing (6.43%), eating of stones, mud (6.05%), standing inside shed (3.90%), keeper interaction (2.81%), feeding (2.52%), investigatory picking (2.33%), dust-bathing (1.57%), defecation (0.72%) and sitting with head low (0.57%).

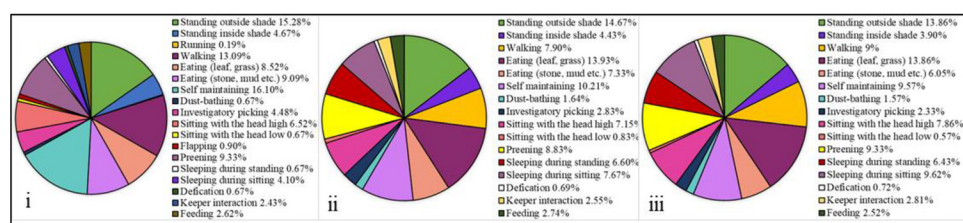


Fig. 2. Percentage of time spent in different behavioral categories by ostrich during monsoon (i), winter (ii) and summer (iii) season at Alipore Zoological Garden, Kolkata.

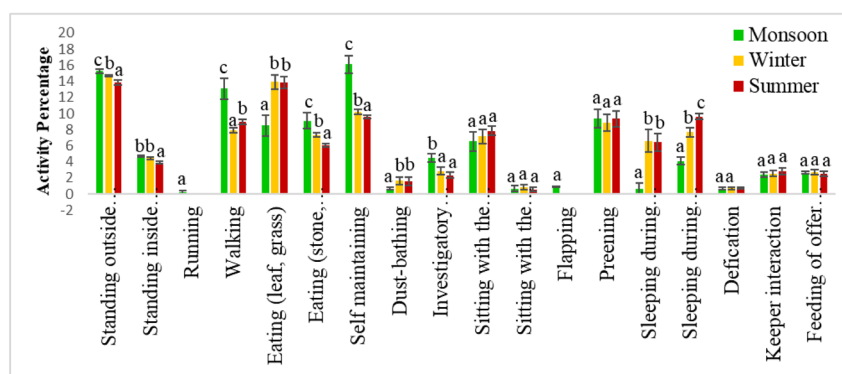


Fig. 3. Percentage of time spent in different activities displayed by the ostrich in three different seasons at Alipore Zoological Garden, Kolkata. Values are mean \pm SE. Bars with different letters are significantly different ($p < 0.05$) using DMRT after two way ANOVA.

Comparison of diurnal activity budget of the ostrich among three seasons (Fig. 3)

When comparing the activity budget data among the three studied seasons, it was revealed that, the ostrich primarily exhibited walking, eating of stones, mud, self-maintenance and investigatory picking during monsoon, compared to the other two seasons ($p < 0.05$, DMRT), whereas, activities such as sitting with head high and sleeping during sitting were prevalent during summer season. Running and flapping was only noted in monsoon, while, eating of leaves, grasses, dust-bathing and sleeping during standing was found to be significantly lower during that particular season ($p < 0.05$, DMRT). Behaviors like feeding of offered feed, keeper interaction, defecation, sitting with head low and standing inside and outside the shed did not vary significantly during the three seasons.

The findings of this study play a vital role in the welfare of the captive birds, especially the ostriches. Hambali *et al.* (2015) postulated that the ostriches at the farm in Germany were involved in walking mostly compared to running. Mushi *et al.* (2008) defended this statement and revealed 'being cautious for predators' as the cause of males spending more time in walking. Likewise, here in captivity too, walking was observed more frequently than running. The studied ostrich consumed a lot of stones or mud, mostly during monsoon (9.09%), possibly for the separation of nutrients from the feed to help with its digestion. This assumption supported a prior study by Csermely *et al.* (2007). Exploratory behaviors like

investigatory picking and eating leaves or grasses was constant in the captive ostrich through-out all the seasons, just like a previous report by Csermely *et al.* (2007) which stated that, wild ostriches remain engaged mostly in walking and foraging during the day, probably to meet the daily nutritional requirements. Flapping of wings was observed in the studied bird only in monsoon (0.90%), the reason behind which could be dissipation of body heat, previously explained by Mushi *et al.* (2008). The studied ostrich was predominantly engaged in self-maintenance during monsoon (16.10%) probably to get rid of dirt embedded in its feathers.

CONCLUSION

Though the studied ostrich was not as active as a wild one, it exhibited different types behavioral pattern among the three different seasons. Activities like walking was prevalent in monsoon, whereas, the resting behaviors dominated the summer season. The results of the present study would act as a guide in enriching the knowledge on the requirements of ostriches in captivity, leading to the ultimate welfare of those birds.

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