OPEN ACCESS J. Zoo Biol. 04 (01) 2021. 21-27 DOI: 10.33687/zoobiol.004.01.3611

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Available Online at EScience Press

Journal of Zoo Biology

ISSN: 2706-9761 (Online), 2706-9753 (Print)

https://esciencepress.net/journals/JZB

# The Response of Captive Ostrich (*Struthio camelus*) to Visitor Group Size and Activity at the Accra Zoological Garden in Ghana

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**ARTICLE INFO**

**Article History**

Received: June 01, 2021

Revised: September 20, 2021

Accepted: October 24, 2021

**Keywords**

Behaviour

Enclosure usage

Visitor

Zoo animals

**ABSTRACT**

Zoo visitors interact with captive animals in diverse ways of which some may affect the behaviour of the animal positively or negatively. This study investigated the responses of captive ostriches to visitor group size and activity at the Accra Zoo. It also explored the enclosure usage of the birds. To test the hypothesis that visitor group size and activity have no effects on the behaviour of the ostriches, instantaneous scan sampling method was employed to study the birds' behaviour. A Generalized Linear Model indicated that visitor group size has no effect on the locomotory, inactivity and threat-induced behaviour. Visitor activity however influenced threat-induced behaviour. A Chi-square test showed a uniform usage of all parts of the enclosure in the presence visitors. The study shows that visitor group activity solicits aggressive behaviour from the birds. It is recommended that, zoo visitors visit the enclosure and observe the birds in silence, avoiding verbal and non-verbal communications to prevent the exhibition of aggressive behaviour that ultimately stresses the birds out.

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## INTRODUCTION

The zoo is an excellent place for humans to interact with captive animals. These interactions influence the behaviour of the animals positively or negatively (Hosey, 2000). Knowing the effects zoo visitors have on the behaviour of zoo animals is important for at least two reasons: animal welfare sustenance in captivity, and a positive zoo visitor experience (Sade, 2013). The presence of visitors around the enclosure of an animal can greatly affect the exhibition of natural behaviour (Hosey, 2005). Visitor group size for example affect the behaviour of certain species at the zoo (Stevens *et al.,* 2013). In primates, increasing visitor group sizes were found to increase aggressive behaviour (Hosey and Druck, 1987). Hill (1999) also observed captive chimpanzees to be aggressive towards noisy visitor groups resulting in fewer rest of the chimpanzees. In contrast, captive rheas behaviour is not affected by increasing visitor group sizes (Azevedo *et al.,* 2012). Aside visitor presence, size, and activity, visitors mimicking animals can also solicit certain behaviour from the animal. The Siamangs gibbons exhibits aggressive behaviour when visitors mimick them (Nimon and Dalziel, 2012).

Studies on captive animal behaviour and visitor interactions more often than not are focused on non-human primates (Gartner and Weiss, 2018; Ross and Leinwand, 2020; Vaglio *et al.,* 2021), while captive birds have received relatively little attention (Downes 2012; Azevedo *et al.,* 2012). Limited studies can be found on visitor influence of captive ostriches (Mutiga *et al.,* 2016; Sharma *et al.,* 2020). In Ghana, information on captive animal and visitor interactions are limited. The study therefore focused on the largest flightless bird, the ostrich

(*Struthio camelus*) which are housed in most zoos around the world (Mush *et al.,* 2008; Cooper *et al*., 2009; Hambali *et al.,* 2015), including the Accra Zoo. Reaching heights of about 2.7 m, it is part of the ratites group of birds and have two toes on each foot (Hambali *et al.,* 2015). They have a long neck and a pair of powerful long legs that compensate for their inability to fly making them the fastest birds on land, reaching speeds of about 70 km/h (Aravinth and Selvan, 2015; Adetunji and Ogunsola, 2018). Ostriches are seasonal breeders, breeding from July through to March with latitudinal and altitudinal variations (Leuthold, 1977; Jarvis *et al.,* 1985). The bird is native to Africa and mostly found in the open semi-arid savannahs, deserts and woodlands across the continent (Aravinth and Selvan, 2015). Their numbers have drastically reduced in the wild due to hunting for their meat, feathers and skin (Boum and Bonine, 2015; Magige and Røskaft, 2017). Generally, ostriches are shy of threats and would often flee when confronted by predators in the wild (Mutiga *et al.,* 2016). On the other hand, they have been observed to be aggressive towards human and non-human threats. Interactions between humans and ostriches have sometimes resulted in fatal injuries or death to either party (Mutiga *et al.,* 2016).

Understanding the influence zoo visitors have on the ostrich is important, especially if Ghanaian zoos are to concentrate on creating a positive zoo visitor experience while encouraging the expression of natural behaviour of the bird. The aim of the study was therefore to understand visitor effects on the behaviour of the ostriches at the Accra zoo. Specifically, the study: 1) determined the effect visitor group size and activity have on the behaviour of captive ostriches, and 2) investigated the effects of different audience conditions on the enclosure usage of the birds. It was hypothesized that visitor group size and activity have no effect on the bird's locomotory, threat-induced, and inactive behaviour. Moreover, all parts of the enclosure were expected to be uniformly used by the birds in the presence of different audience conditions.

## MATERIALS AND METHODS

### Study area

The study was conducted at the Accra Zoological Garden (Figure 1). The zoo is located in the Achimota Forest Reserve in Accra, the capital city of Ghana (5°37'31.5" N 0°12'09.5" W). The zoo houses several wild animals such as the warthog, hyena and ostriches. It has one mature male and female ostriches that have been at the zoo for approximately 10 years. The size of the ostrich enclosure is 25 m in length and 15.5 m in width, enclosed with lines of wire parallel to the ground and supported by concrete posts (Figure 2). The enclosure has a base substrate of sandy soil with vegetation distributed within and around it. The zoo has average temperatures ranging between 25°C and 37°C. Visiting hours for the public is between 9:00 am to 5:00 pm each day of the week.

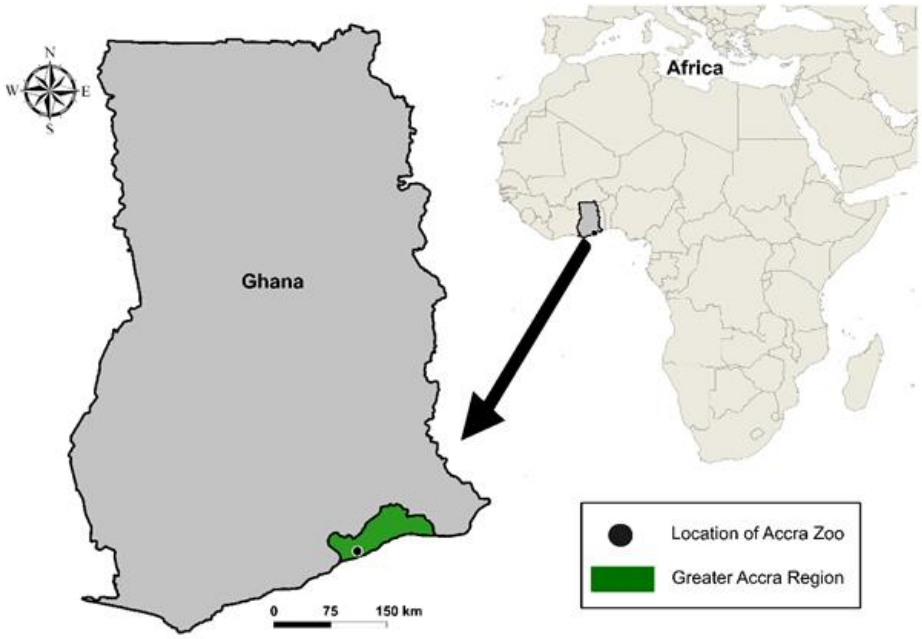


Figure 1. Map indicating the location of the Accra Zoological Garden in Ghana.

**Data collection**

The study was carried out from December 2016 to February 2017. From the one-week pilot study carried out, and interactions with the Zoo Manager, Wednesdays, Saturdays and Sundays were selected for the study as visiting peaked at these days. An ethogram for ostriches was constructed, which described the targeted behaviour of interest (Table 1). Instantaneous scan sampling method of data collection was used to record observations every three minutes. All data were collected between 1300 hours and 1600 hours daily. Data on the visitors were also simultaneously collected in the same period by a second observer. Inter-observer reliability of 95% agreement was confirmed during the pilot study using percentage agreement reliability test by diving the smaller of the two recorded activity by the larger and multiplying by 100 (Hartmann 1977). To minimize bias as much as possible, the visitors were not aware of the data collection process as not to cause changes in their original intended behaviour.


Figure 2. Enclosure of the ostrich at the Accra Zoological Garden. "A" depicts one of the bird in its enclosure. "B" shows the concrete post and the visitor viewing area. The viewing area is the area before the wooden barrier in "B".

Table 1. Ethogram of the ostrich (*Struthio camelus*) in the Accra Zoo.

| Behaviour Category | Behaviour | Description of Behaviour |
|---|---|---|
| Locomotory behaviour | Walking | Ostrich moves around the enclosure. |
| Locomotory behaviour | Running | Ostrich runs straight or zigzag within the enclosure. |
| Threat-induced behaviour | Vigilance | Ostrich keeps neck upright whilst staring |
| Threat-induced behaviour | Threatening | Ostrich presses its gular tissue upward and opens its mouth with its tongue slightly upward and stares. |
| Inactive | Standing | Ostrich is on two feet without changing its relative position. |
| Inactive | Sitting | Ostrich's legs are bent and its body is partially resting on the floor. |

Visitor group size was categorized into small (1 to 5 visitors) and large (≥ 6 visitors) groups. Visitor group activity was defined as any form of attempt (talking and mimicking) a visitor makes in seeking the birds' attention. Therefore, visitors who chose to watch quietly without any form of activity or obvious attempts to interact were all considered as passive audiences, whereas an active audience denoted a group where at least one person tried to actively interact with the animal. The above visitor variables (group size and group activity) were paired and categorized to form four visitor audience conditions: Small Active (SA), Small Passive (SP), Large Active (LA), Large Passive (LP). The No Audience condition (NA) represented cases where visitors were completely absent.

To measure the enclosure usage by the birds, the floor area was divided into two sectors A and B based on vegetation cover and nearness of the sector to the audience viewing area. Sector A comprised of the front part of the enclosure, closest to the audience viewing area whilst Sector B was the middle to the back of the enclosure away from the audience viewing area. The birds were mostly difficult to see when they were present at Sector B because of the vegetation cover in that part of the enclosure. During each observation, the positions of both ostriches in the enclosure were noted as the number of ostriches in either enclosure.

**Statistical analysis:**

To test the hypothesis that visitor group size and activity do not affect the behaviour of the ostriches, a General Linear Model (GLM) was fitted as Kolmogorov-Smirnov normality test indicated a non-normality ($P < 0.05$) of data. The predictor variables were group size and activity whilst the response variable was the frequency of exhibited behaviour. A Chi-square test was used to compare enclosure usage in the presence and absence of visitors. For this analysis, the audience conditions (SA, SP, LA and LP) which signify visitor group size and activity were compared with no audience condition (NA). All analyses were performed using IBM SPSS Statistics 20 and a p-value threshold of 0.05 was considered significant for all analysis.

**RESULTS**

A total of 2160 minutes were used to observe the birds. Altogether, 359 people visited the enclosure of the birds. The maximum number of people observing the ostriches were 26. Visitor group size had no significant effects on the locomotory behaviour of the birds (GLM: $F_{1,30} = 0.1$, $P > 0.05$) (Figure 3). Likewise, the effects of visitor group size on threat-induced behaviour were not significant (GLM: $F_{1,34} = 0.3$, $P > 0.05$) (Figure 3). In addition, there was no significant effects of visitor group size on inactivity (GLM: $F_{1,11} = 0.3$, $P > 0.05$) (Figure 3). In contrast, visitor group activity significantly increased threat-induced behaviour (GLM: $F_{1,48} = 5.3$, $P < 0.05$), whereas it did not significantly influence locomotory behaviour (GLM: $F_{1,11} = 0.1$, $P > 0.05$) and inactivity (GLM: $F_{1,5} = 0.9$, $P > 0.05$). Interaction effects for the predictor variables (group size + activity) for all analysis were not significant: locomotory behaviour ($P = 0.71$), threat-induced behaviour ($P = 0.53$), Inactivity ($P = 0.77$). The ostriches uniformly used both sectors of the enclosure when visitors were absent. Their usage of the enclosure under different audience conditions also did not change, and the Chi-square test did not reveal any significant differences (Table 2).

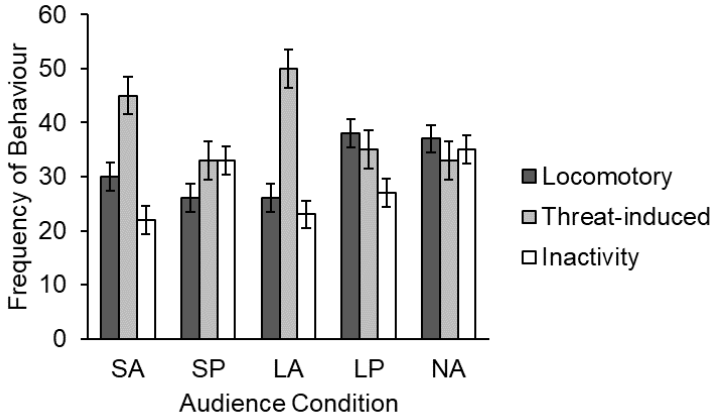


Figure 3. Frequency of exhibited behaviour under various audience conditions. Small Active (SA), Small Passive (SP), Large Active (LA), Large Passive (LP) and No Audience condition (NA).

**DISCUSSION**

The effect zoo visitors have on captive animal behaviour is important for zoo management (Hosey, 2000, 2005). The null hypothesis that visitor group size does not affect captive ostrich locomotory, threat-induced and inactive behaviour is accepted as there was no significant differences ($P > 0.05$). This suggests that visitor group size does not solicit these behaviour from the ostriches. Although studies on visitor group size is limited, visitor presence have been found to influence resting behaviour of

male ostriches, but not females (Sharma *et al.,* 2020). This effects in the males were attributed to the design of the enclosure which was different than the females (Sharma *et al.,* 2020). Where enclosures are designed to mimic the natural environment of the species as seen at the Accra Zoo (Figure 2), then visitor effects on the birds are likely to reduce. The vegetation and shades in the enclosure offers great hideouts that reduces stress on the bird (Mbaya *et al.,* 2015). Nevertheless, the result could also be due to visitor familiarity. Some zoo animals for example, primate species are agnostic to human presence at their enclosure (Chamove *et al.,* 1988). It is possible that the studied ostriches are more familiar with visitors considering they have been in the zoo for nearly a decade, therefore not intimidated by the mere presence of small or large visitor numbers at the Accra Zoo. This however contradicts findings in Central Zoo of Nepal where the mere presence of visitors were found to influence the locomotory behaviour of the ostriches (Sharma *et al.,* 2020).

Table 2. Enclosure usage by the ostriches under active and passive audience conditions compared to No Audience condition (NA).

| Audience condition | $\chi 2$ | *p value* |
|---|---|---|
| Small Active (SA) | 2.294 | 0.13 |
| Small Active (SP) | 2.124 | 0.15 |
| Large Active (LA) | 0.081 | 0.78 |
| Large Active (LP) | 0.001 | 0.98 |

Visitor group activity on the contrary was found to increase threat-induced behaviour ($P<0.05$). Disturbance from visitors generally affect zoo animals negatively (Stevens *et al.,* 2013). Disturbances like talking, camera flashes, mimicking of animals may affect the behaviour of zoo animals (Wells, 2005). This results from the Accra Zoo suggest a high relative susceptibility of the ostriches to disturbance, and that the ostriches may need a higher protection from boisterous visitors who visit their enclosures. One practical way to achieve this is through keeper talks and visitor education before visiting the birds' enclosure.

The null hypothesis that the birds use all parts of the enclosure uniformly in the presence of visitors is accepted. Enclosure complexity and floor substrate is known to influence the use of different parts of captive animals' enclosure (Morgan and Tromborg, 2007). Ostriches favour sandy floor substrate to others as it aids them to exhibit relaxed behaviour such as sand-bathing (Hambali *et al.,* 2015). This uniformity of sandy substrate distribution may have resulted in the uniform use of the enclosure as audience condition was not a relevant predictor for their usage.

## CONCLUSION

This study has shown that the captive ostriches at the Accra Zoological Garden responses to visitors vary. It was found that large visitor numbers and presence do not affect their locomotory, inactivity and threat-induced behaviour. In contrast, visitors who attempted to talk, mimic or attempted to gain the animals attention stimulated an aggressive behaviour in the birds. Moreover, the birds were found to use their enclosure uniformly irrespective of visitor size or activity. It is recommended that, the zoo educate the general public and visitors to avoid the birds exhibiting aggression when being observed.

## ACKNOWLEDGMENTS

We thank the management and staff of the Accra Zoo for their support during the data collection. We are especially grateful to Mr. Theodore Klevor, the Zookeeper, Mr. Humphrey Elorm (Student, KNUST) who assisted in data collection. No funds, grants, or other support was received from any organization to carry out this study.

## CONFLICT OF INTEREST

The authors have no conflicts of interest to declare that are relevant to the content of this article.

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