Behavioral Assessment and Activity Pattern of Two-toed Ostrich (*Struthio camelus*) in captive Environment

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Abstract

Captive conditions can result in deviation in behaviour and activities of the animals from the wild environment. It is necessary to regularly monitor the activities and behavioral pattern in captive animals to record any changes from normal for the well-being of the animals. Two-toed ostrich (*Struthio camelus*) is a large flightless bird endemic to the Ethiopian region. It is being farmed in many countries due to its low fat content and favorable fatty acid profile as compared to beef. The behaviour of ostrich is not well studied in wild or captivity so the current study was designed to observe and compare the behavioral trends in ostrich in three different captive environments i.e. Lahore Zoo (a highly urbanized locality), Captive Breeding and Research Center, UVAS (a semi-urban site), and Rachna Wildlife Park (a semi-captive environment). While there was no significant difference to be observed in activity pattern of ostrich in semi-urban environment and highly urbanized settings, time budget for various activities differed with the time of the day. Seasonal impact upon the general behaviour was also found to be pronounced.

Keywords: *Two-toed Ostrich, Captive environment, Activity of Ostrich, Behavioural assessment.*

Introduction

Two-toed Ostrich (*Struthio camelus*) is a large flightless, herbivore bird endemic to Africa and the only living member of the genus Struthio. Being a fast runner, the average running speed of ostrich is 70 km/h (Brown, Urban, & Newman, 1982). Ostrich live in groups called herds and lay the largest eggs. While the weight of an ostrich egg ranges from 1kg to 2 kg, ostrich eggs are the smallest of any bird relative to the size of the parent (Adams & Revell, 1998). These birds are very intelligent and with a keen hearing and vision, can recognize predators from a very long distance. Their body height may extend up to nine feet or more giving them an advantage over other species.

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Ostrich farming began in the mid-19th century in South Africa, and is now a widespread practice in many places worldwide. There are four ostrich sub-species in Africa *(S. camelus, S. molybdophanes, S. massaicus and S. australis*) which are being bred in farms (Bertram, 1992). Ostrich meat is popular due to its low cholesterol content and favorable fatty acid profile as compared to beef (Cooper, 2010) while there is an increasing demand for the feathers and leather as well (Brand and Malecki 2011). However, ostrich industry is still incompetent owing to reduced egg production, poor embryo survival, high chick mortality and substandard growth rates (Bonato, et al., 2015). This poor production is considered to be a result of inability of the birds to adapt to the captive environments in farms and the ineffective practices by the farmers which result in the high mortality rate (Bonato, et al., 2015). Apart from poor farming practices, diseases also play a detrimental role in deciding the fate to the farmed animals such as Newcastle disease which affect the nervous system of ostriches (Davies , 2003).

Low survival rate in ostrich chicks is experienced in the wild as well where predation is considered a major threat with only about 10-15% of hatchlings surviving up to the age of one year (Bertram 1992, Magige et al., 2009, Cooper et al., 2010). On the contrary, although the chick survival to 3 months of age is higher in farms, chicks in farms are more vulnerable to various infections and stress with up to 50% mortalities also reported (Verwoerd et al., 1999, Bunter 2002, Sebei & Bergaoui 2009).

A little is known about ostrich behavior in captivity or farmed environments and only a few studies were found in this regard including those by Deeming (1998), Ahmed (2012) and Hambali (2015). This scanty data regarding the behaviour and adaptability of ostrich in captive environments makes it necessary to understand the requirements of the species in confined environments for a better welfare and management plan for these majestic ratites. It may also help to identify the drawbacks in the current farming practices to ensure to better farming environment for these birds.

While ostrich is a non-native species in Pakistan, it is present in a few public and private zoos and its farming has also been recently started by the Punjab Government. In Punjab province, only Lahore zoo contains a pair of ostriches while three ostriches are present at University of Veterinary and Animal Sciences, Ravi campus-Pattoki. A few ostriches are also present at a private resort at Head Balloki (Kasur District) and Rachna Wildlife Park (Gujranwala District). The current study was conducted to observe and compare the factors influencing the general behaviour

of ostriches at three different locations to have a better understanding of the activities and time budget of these large ratites which may be helpful for ostrich keepers.

Study Sites

Three different sites were selected to study the behavioural patterns of captive ostriches. Site 1 was Ravi campus, UVAS (RC), site 2 was Lahore Zoo (LZ) and Site 3 was Rachna Wildlife Park (RWP).

Ravi campus, Pattoki is an extension of the main campus of University of Veterinary and Animal Sciences, Lahore located at a distance of 85 km from Lahore city. The Department of Wildlife and Ecology houses many animals in its Captive Breeding and Research Center for research purposes including Nilgae (*Boselaphus tragocamelus*), Chinkara (*Gazella bennetti*), Rhesus Monkey (*Macaca mulatta*), Indian Rock Python (*Python morulus*), Peafowls (*Pavo* spp.), Two Toed Ostrich (*Struthio camelus*) and few other avian species of Phasianidae family and Psittacidae family. The ostrich present at Ravi campus are three in number, all females and kept in an enclosure covering an area of 1858 m^2.

Lahore Zoo is one of the oldest zoos in South Asia covering a total area of 10 hectares (0.1 km^2) and houses 1381 animals of 136 species including 82 avian species, 8 species of reptiles and 336 mammals of 45 species (www.lahorezoo.com.pk). The zoo contains a number of exotic species including African Lion (*Panthera leo*), Hippopotamus (*Hippopotamus amphibius*), Rhinoceros (Rhinocerotidae family), Wallabies (*Macropus* spp.), Cassowary *(Casuarius casuarius)*, Llama (*Lama glama*), Ostrich (*Struthio camelus*), and Emu (*Dromaius novaehollandiae*) to name a few. The ostrich enclosure covers an area of 1515 m^2 and house a pair aged nearly twelve years.

Likewise Rachna Wildlife Park (RWP) houses a number of animals under captivity for research and recreational purpose. It covers an area of 1.9 acres (0.008 km^2) and holds a total of 20 species represented by 163 animals. The ostrich at RWP were kept in two adjacent enclosures; one containing three females and two males and the other housed a pair. The circular shaped ostrich enclosures had ground cover comprising of grasses and shade provided by a large hut.

Material and Methods

Study of behavior

A preliminary observation was carried out to observe major behavioral displays by the ostriches and an ethogram was constructed to document the major activities displayed by these birds.

Table 1: Ethogram to observe behavioral aspects of Ostrich

No.	Activities	Activities Defined
1	Feeding	Feeding defined the activities that included the supplement of materials that are necessary as nourishment. It comprised activities like eating, drinking and foraging.
2	Drinking	The activity in which an animal take a liquid in mouth and swallow is drinking
3	Excretion	Elimination of fecal material activity was declared as excretion and dropping.
4	Standing	The bird remain in rest position at one place is termed as standing
5	Walking	The activity state when the bird moves from one place to another.
6	Pecking	Pecking is defined the activity in which the bird strike or bite something with its beak.

Focal sampling method (Altmann, 1974) was employed for recording the behaviour of Ostrich. Observations were made in morning and evening at an interval of 05 minutes each. Seasonal impact was also studied with one set of observation made during the summer season (August, 2017) and the same methodology repeated during the winter season (January, 2018) at all selected sites. All data was recorded without disturbing the birds and observing them from outside of the enclosure from a distance. If the animal was disturbed by the visitors, recording of data was stopped for a while and then started again when they began to show their normal activities.

Statistical analysis

The recorded observations were subjected to statistical analysis using SPSS (v. 20.0) in order to determine any differences in behaviour during different timings of the day as well as in different seasons. Normality of the data was determined by running the Shapiro-Wilk test. Mann-Whitney U test was applied to determine any significance between the seasons and behaviour of the ostriches.Effect of difference in locations upon behaviour was also checked.

Results

Various activities of ostriches were observed during different times of the day at all sites. A distinct change in activity patterns was observed during the two seasons.

During the summer season, the ostriches spent more time in standing and walking around the enclosure with least time spent in excretion. In contrast, during the winter season, feeding took most time of the day while drinking was noted to be the least preformed activity.

On average, the activities during the summer season were performed in the following descending order with slight variations in ostriches of site 1 and 2 (Table 2 and 3):

Table 2: Activity budget of ostriches at Ravi campus, UVAS during summer and winter season (Os = Ostrich, RC = Ravi Campus, Morn = Morning, Eve = Evening)

Ravi campus UVAS	**Summer**						**Winter**					
	Os-A (RC)		Os-B (RC)		Os-C (RC)		Os-A (RC)		Os-B (RC)		Os-C (RC)	
%	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve
Walking	38.3	48.2	18.4	23.2	21.75	27.8	22.1	22.6	15.8	18.75	12.2	14.4
Standing	24	22.3	37.4	37.6	39.3	26.8	21.4	23.9	37.3	23.05	29.5	21.1
Running	5.3	11.8	2.1	0	0.2	1.4	0	0.2	0	0.2	0	0
Feeding	18	9.6	22.3	17.6	19.3	19.4	49	37.7	42.6	55	47.7	56.3
Drinking	1.5	0.6	1.5	2.9	1.9	10.3	0	0	0	0	0	0
Pecking	12.3	7.1	17.4	17.4	16.9	13.7	7.5	15.6	4.3	2.7	10.6	8.1
Excretion	0.6	0.8	0.9	1.1	0.65	0.6	0	0	0	0.3	0	0.1

Table 3: Activity budget of ostriches at Lahore Zoo (LZ) during summer and winter season (Os = Ostrich, Morn = Morning, Eve = Evening)

Lahore zoo	Summer				Winter			
	Os-A (LZ)		Os-B (LZ)		Os-A (LZ)		Os-B (LZ)	
%	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve
Walking	40	38	57.6	51	20	22	20	18
Standing	40.6	35	31.4	32.5	10	8	20	22
Running	0	0.5	0	0.8	0	0	0	0
Feeding	16.6	20	10.8	15.7	55	59	40	50
Drinking	0	0	0	0	0	0	0	0
Pecking	2.4	6	0	0	15	11	20	10
Excretion	0.4	0.5	0.2	0	0	0	0	0

Standing>Walking>Feeding>Pecking>Drinking>Running>Excretion

Likewise, the following order was observed during the winter season.

Feeding>Standing>Walking>Pecking>Excretion>Running>Drinking

At RWP, the activities were in a different order during the summer and winter season than the previous two sites (table 4). During the summer season, resting was more frequent activity as given below:

Resting>Walking>feeding>Pecking>Wingsflapping>Sandbathing>visitor interaction> Excretion >reproduction

The outcome was again different during the colder months:

Walking>Resting>Sandbathing>Wingsflapping>Feeding>Pecking>visitor interaction>aggression>excretion>reproduction

Statistical analysis indicated a significant association between the various activities and seasons at a significance level of 0.05. However pecking was not found to be associated with seasonal change ($p = 0.73$). Likewise, difference in surroundings was not observed to be a strong influencing factor upon activity budget of the ostriches. On the other hand, timing of the day was found to have a strong association with performance frequency of all observed activities.

Discussion

Two-Toed Ostrich (*Struthio camelus*) is an endemic species of Africa while it is present in some zoos in Pakistan. Other than these captive sites, it is being reared in more than 200 farms in Pakistan for its meat, skin, and feathers and is declared a

domestic bird by the provincial Government of Punjab (Abbas, et al., 2017). While it is considered a good addition in the poultry industry, farmers often face issues such as early age mortality in ostrich chicks (Cooper, et al., 2010). These birds can feed on a wide variety of diets including Lucerne fodder which is widely available in Pakistan (Abbas, et al., 2017). These ratites are known to feed on almost everything but there are very few studies on feeding and behavioral pattern of these birds which may help in assessment of its feeding or general behaviour in captivity or in farms (Bonato, et al., 2015).

In the current study three sites were selected to document the activities and time allocation of these activities by ostrich. Although the species exhibited no significant variation in behaviour at the selected sites, a distinct difference was noted during different times of the day. A study conducted by (Schaller, et al., 2011) observed no significant behavioral difference between captive and wild ostriches and noted that walking was the most performed activity while running was not a more frequent activity On the contrary, our results indicate that drinking was the least performed activity, being absent altogether during the colder months during observation hours. Similarly excretion was also noted to be performed very few times. It may be due to the short observation intervals that drinking and/or excretion was not noted to occur more often.

Among the locomotive activities (walking, standing and running), running was not observed more often as observed by (Hambali, Hambali, K., Zakaria, N., Fauzi , N., & Amir, A, 2015) also while the other two had high occurrence. According to (Mushi, et al., 2008), ostriches tend to spend more than 60% of their time in standing or walking. Pecking is behaviour peculiar to avian species. Pecking has been documented by some researchers to affect the growth of chicks in “mixed weight” groups as this pecking by adults prevented the younger chicks to feed more frequently (Lambert, M., Deeming , D., Sibly , R., & Ayres , L. 1995) and was termed as aggressive. Pecking was observed in our study but its frequency was less than feeding and most often it involved pecking the ground or other objects instead of other companions in the enclosures as reported by (Paxton , C., Bubier , N., & Deeming , D.1997) as well.

Gender also has been documented by some to result in different time budgets of various activities in captive ostriches (McKeegan & Deeming, 1997). In our study the ostriches were all females at RC so no effect of gender could be determined. However the pair at LZ also exhibited no significant behavioral variation which could

be related to gender differences. The observations made at RWP were also insignificant in this regard.

Surroundings can have a strong influence upon behaviour of the captive animals (Shannon, et al., 2015). While impact of noisy surroundings can vary from species to species based on its sensitivity, Shannon (2015) indicated noise to be a form of environmental disturbance leading to reduction in vigilance and fitness and changes in foraging behaviour. The study sites in our research were in three different types of settings. RC is located outside the Pattoki city in a semi-urbanized setting while LZ is located in the midst of the city with high traffic density all around. On the contrary, RWP is located in an urban setting but with low traffic density and comparatively peaceful residential area with little disturbance from ambient sources. It was hypothesized that a difference in surroundings could affect the behaviour of the species. However, our results found no significant effect of surroundings upon the activity pattern of the species thereby making indicating its suitability for farming in urban and noisy locations as well.

While the results of the current study explore the behavioural aspects of *Struthio camelus* in captivity, more studies need to be carried out in this regard. Detailed behavioural assessments are necessary for a better understanding of this species in captivity and the shortcomings which result in early age mortality of these ratites.

Table 4: Activity budget of female ostrich at Rachna Wildlife Park (RWP) Gujranwala during summer and winter season (Os=Ostrich , Morn =Morning ,Eve=Evening) OS-A=Female ,OS-B=Female ,OS-C=Male

Rachna wildlife Park GRW	Summer						Winter					
	Os-A (RWP)		Os-B (RWP)		Os-C (RWP)		Os-A (RWP)		Os-B (RWP)		Os-C (RWP)	
%	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve	Morn	Eve
Walking	34.1	42.2	18.4	20.5	20.45	25.8	19.5	23.4	17.4	20.3	10.0	15.4

Standing	26	21.	34.	39.	36.5	24.	19.	24.	37.	23.	29.	22.
Running	6.5	12.	3.5	2.4	2.2	1.6	1.2	1.2	2.2	0.2	1.1	1.8
Feeding	20	12.	24.	17.	18.4	19.	47	37.	41.	51	47.	53.
Visitor interaction	2.2	3.4	1.1	1.5	2.1	4.4	1.1	2	0.1	0	1.4	1.6
Sand bathing	3.2	3.4	2.5	2.2	1,5	1,9	0	1.1	0	0	1	1.1
Drinking	3.5	2.5	2.2	2.9	3.2	10.	0	0	0	0	0	0
Pecking	14.	9.3	16.	17.	16.9	17.	8.5	17,	5,3	3.7	13.	9.6
Excretion	1.2	1.1	0.9	1.1	0.65	0.6	0	1.1	0	0.3	0	0.1

References

Abbas , G., Mahmood , S., Sajid, M., & Ali , Y. (2017). Ostrich farming: A new turn in Poultry Industry of Pakistan. *Adv Zoo Bot, 5*(3), 33-38.

Adams, J., & Revell, B. J. (1998). *Ostrich Farming:- A Review and Feasibility Study of Opportunities in the EU.* Newport, Shropshire: Harper Adams University College.

Ahmed, F., Salih, M., & Mohamed , A. (2012). Some Behavioral Traits of Red Neck Ostrich under Captive Conditions. *World's Vet Journal, 2*(2), 23-26.

Altmann, J. (1974). Observational study of behavior: sampling methods. *Behaviour, 49*(3-4), 227-266.

Bertram, B. (1992). *The Ostrich Communal Nesting System.* Princeton, New Jersey : Princeton University Press.

Bonato , M., Cherry , M., & Cloete , S. (2015). Mate choice, maternal investment and implications for ostrich welfare in a farming environment. . *Appl Anim Behav Sci., 171,* 1–7.

Brown, L., Urban, E., & Newman, K. (1982). *The Birds of Africa.* London: Londom Academic Press.

Brand, Z., et al. (2011). "Influence of incubation management on pipping position, hatching ability and survival of ostrich chicks." **41**(3): 265-274.

Bunter , K. (2002). The Genetic Analysis of Reproduction and Production Traits Recorded for Farmed Ostriches (*Struthio camelus*). *Livestock Production Science, 91*(1), 9-22.

Cooper , R., Horbańczuk , J., Villegas-Vizcaíno, R., & Seb. (2010). Wild ostrich (*Struthio camelus*) ecology and physiology. . *Trop Animl Health Prod, 42*(3), 363-373.

Davies , S. (2003). "Birds I Tinamous and Ratites to Hoatzins". In M. Hutchins , *Grzimek's Animal Life Encyclopedia.* (2 ed., Vol. 8, pp. 99–101). Michigan: Farmington Hills, MI: Gale Group.

Deeming , D. (1998). A note on effects of gender and time of day on the winter time-activity budget of adult ostriches (*Struthio camelus*) in a farming environment. *Appl Anim Behav Sci, 59*(4), 363–371.

Hambali, K., Zakaria, N., Fauzi , N., & Amir, A. (2015). Behaviour of Captive Ostriches (*Struthio camelus*) at University Malaysia Kelantan, Bachok Campus, Kelantan, Malaysia. . *J Trop Resour Sustain Sci, 3*(1), 13-17.

Lambert, M., Deeming , D., Sibly , R., & Ayres , L. (1995). The relationship between pecking behaviour and growth rate of ostrich (*Struthio camelus*) chicks in captivity. *Appl Anim Behav Sci, 46*(2), 93-101.

Magige, F., Stokke , B., Sortland , R., & Røskaft , E. (2009). Breeding biology of ostriches (*Struthio camelus*) in the Serengeti ecosystem, Tanzania. *African Journal of Ecology, 47*(3), 400–408.

McKeegan, D., & Deeming, D. (1997). Effects of gender and group size on the time-activity budgets of adult breeding ostriches (*Struthio camelus*) in a farming environment. *Appl Anim Behav Sci, 51*(2), 159-177.

Mushi , E., Binta, M., & Lumba, N. (2008). Behaviour of Wild Ostrich (*Struthio camelus*) at Mokolodi Nature Reserve, Gaborone, Botswana. *Res J Poultry Sci, 2*(1), 1-4.

Paxton , C., Bubier , N., & Deeming , D. (1997). Feeding and pecking behaviour in ostrich (*Struthio camelus*) chicks in captivity. *Bri Poultry Sci, 38*(2), 151-155.

Schaller, N., D'Août, K., Villa , R., Herkner , B., & Aerts , P, Angeloni. (2011). Toe function and dynamic pressure distribution in ostrich locomotion. *J Exp Biol, 214*(7), 1123-1130.

Sebei , S., & Bergaoui , R. (2009). Ostriches reproduction behaviour and mastery of incubation under farming environment. . *Trop Anim Health Prod, 41*(2), 353–361.

Shannon , G., McKenna , M., Angeloni , L., Crooks , K., Fristrup, K., Brown, E., & McFarland, S. (2016). A synthesis of two decades of research documenting the effects of noise on wildlife. *Biol Reviews, 91*(4), 982-1005.

Verwoerd , D., Deeming , D., Angel, C., & Perelman , B. (1999). Rearing environments around the world. In C. D. Deeming, *The Ostrich: Biology, Health and Production.* (pp. 191–216). Cambridge: CAB International, University Press.