Pakistan J. Zool., vol. 46(3), pp. 601-607, 2014.

Comparative Behavioral Study of Male Nile Hippopotamus *(Hippopotamus amphibius)* after Pairing at Lahore Zoo

Sabiha Fazal,[1] Farkhanda Manzoor,[1] Bushra Nisar Khan,[2] Asifa Shehzadi[1] and Mahnoor Pervez[1]
[1]*Zoology Department, Lahore College for Women University, Lahore*
[2]*Centre for Undergraduate Study, University of the Punjab, Lahore*

Abstract. A comparative behavioral study was carried out on Nile hippopotamus *(Hippopotamus amphibius)* after pairing in Lahore zoo from March 2008 to July 2008. Previous study was conducted in 2003 when the male hippopotamus (named: Raja) was leading a solitary life in Zoo. During the study carried out before pairing, Raja was observed as an inactive animal and totally different from its wild conspecific. A female was introduced in 2007 after the suggestions given in the previous study. Results of recent study conducted after pairing were compared with results of the previous study with the help of histograms. Results showed a clear difference in the behavior of the male after pairing. Overall activity of the male increased after the introduction of female and the male became quite active. During the current study, behavior of male and female was also compared to explain the possible reasons of change in behavior of the male. Female was observed as an extremely inactive animal, activity however increasing towards the end of the study, perhaps due to change in environment as she was brought from a herd. Very little interaction between male and female was observed, that too in July only. The reason might be the age difference. For bringing a positive change in the behavior of captive animals some novel stimuli and environmental enrichment should be introduced by the zoo authorities.

Key words: *Hippopotamus amphibius,* Nile hippopotamus, Lahore Zoo.

INTRODUCTION

Animal behavior is the bridge between molecular and physiological aspects of biology and ecology. Research on animal behavior and behavior ecology has been burgeoning in recent years (Snowdon, 2007). The study of animal behavior can make a significant contribution to conservation. Animals have lived in captivity under human care since ages. Captivity is a generalized term to describe the keeping of domesticated or wild animals (Eaton, 1981). Zoo is the most popular place for the incarceration of wild animals. Many captive animals develop repetitive, purposeless motor behavior called as stereotypical behavior. These stereotypical behaviors are due to animals' abnormal environment and lack of opportunity to display full range of natural behavior patterns (Hancocks, 1980). However, despite all these facts, zoos claim other reasons for keeping animals under human care such as conservation, education and science (Eaton, 1981). In Pakistan zoos are the most entertaining places for the captivity of wild animals. Lahore Zoo is one of the oldest zoos in the subcontinent. Today Lahore Zoo has approximately 1127 animals of 128 species (Stock position records of Lahore Zoo, 2012). Various wild animals are attractive for zoo visitors. Among many other animals Nile hippopotamus (*Hippoptamus amphibius)* is a very valued animal. All around the world hippopotamus is a popular zoo animal. In their natural habitat hippos live in groups of 20-100 animals (Oliver and Laurie, 2008). Female hippos reach sexual maturity at 5-6 years of age while male hippos reach maturity at around 7.5 years. In the wild the hippopotamus eat soft grasses and other low lying plants, aquatic and reed leaves. While in zoos hippo are fed cultivated crops such as chopped sorghum, corn and sugar cane (Fradrich and Lang, 2000). The hippo is a big animal with a large mouth. The eyes, ear and nostrils of hippo are placed high on the roof of the skull as an adaptation to the aquatic mode of life. This allows them to submerge most of their body in the water. Their skin secretes a natural sunscreen substance which is red in color. This secretion is referred to as "blood sweat". This secretion was found to have antibacterial and sunscreen effects (Saikawa, 2004). Lahore Zoo had only the male hippopotamus (named Raja) for the

* Corresponding author: doc_farkhanda@yahoo.com
0030-9923/2014/0003-0601 $ 8.00/0

last two decades. It was brought in a pair but the female died soon after arrival due to unknown reasons. Since then male was leading a solitary life. A behavioral study conducted in 2003 showed that the hippo was an inactive animal showing absolutely different behavior from its wild conspecific (Ashraf, 2003). One of the recommendations given at the end of the study was to introduce a female hippo so that the animal could resort to its natural behavior and become active. After this suggestion, female hippo was introduced in Lahore zoo by the end of 2007. This study was carried out in 2008 to observe any behavioral change in male hippo after the arrival of female hippo for the first time at Lahore Zoo.

The main objective of the study was to observe the behavioral changes in male Hippopotamus (who spent a solitary life for more than two decades) after the introduction of female hippo and to study the effect of pairing after long stretch of spending a solitary life. The study also aimed at exploring the benefits of pairing.

MATERIALS AND METHODS

Subject and enclosure

The behavior of the pair of Nile hippopotamus was studied at Lahore Zoological Gardens for about five months from March 2008 to July 2008. At the time of study, male hippopotamus was 41 years old (Zoo name: Raja) and female hippopotamus was 8 years old (Zoo name: Rani).

The enclosure that houses the animals is divided in to the outdoor and indoor enclosures. Indoor enclosure for hippopotamus is small as compared to standards of AZA and BIAZA (2008); 90 m^2 as against 300 m^2 that would also include pond/pool of 70 m^2. It is made up of plastered brick wall with high and rounded roof to block the heat. Indoor enclosure has a small pond on one side (10 m^2) that is filled and emptied daily. The Zoo management has to empty the pond on daily basis because the hippo passes huge amount of stool which makes the pond very filthy and a foul odor comes out of it. The outdoor enclosure is approximately 180 m^2 including a pond of 58 m^2 with two partitions.

Feeding regimes of hippo

In zoo hippopotamus were given 120-160 kg fodder (Alfalfa (lucerne), Sorghum) and 20-30 kg (melon, watermelon, apple, carrot, onion and corn cob) once a day on the basis of seasonal availability.

Hippopotamus is a very large and quite lazy animal particularly during the day. It does not change its behavior quickly as compared to other animals. An instantaneous point-sampling technique (Altmann, 1974) was adopted for the study. Behavioural categories included resting, walking, standing, eating/drinking, eliminating, interaction with environment, with female/male and others. Behavior was recorded three days a week, two hours in the day with a time interval of 10 minutes from 10am to 11am and again from 4pm to 5pm.

A check sheet was used for recording behavior containing all defined categories along with time intervals, weather and temperature. Each check sheet represented two sessions of one hour each. Each hour was divided into six intervals of ten minutes each. Thus during the whole day a total of twelve readings were taken.

Data analysis

Behavioral categories were counted in check sheets. Percentages were calculated with respect to time of observations and histograms were made. Results of the previous study of the male hippo were compared with the results of the present study. Behavioral data of female were analyzed separately and then compared with behavior of the male.

RESULTS

Analysis of data showed different aspects of behavior of male hippopotamus during the study. Previous data collected from May to August 2003 were compared with the present data by months. Previous results showed that Raja was an inactive animal. About 85% resting was observed during the whole study period. Standing was about 8.1%, eating only 2.3% and negligible eliminating or territory marking behavior. Similarly, there was no interaction with the environment. Other categories of behavior constituted 4.6%.

Comparison of previous results with the present study

Table I shows the comparison of previous results with the present study. There was a marked difference in the behavior of the male hippo (Raja) after the female (Rani) was introduced in the enclosure.

Table I.- Behavioral comparison (%) of male Nile hippopotamus in previous (before pairing) and present study (after the introduction of female hippopotamus) and the behavior of the female hippopotamus.

Behavioral category	Previous study (%)	Present study (%)	
	Male	Male	Female
Resting	85	19.38	43.53
Walking	0	12.62	4.91
Standing	8.1	19.73	15.72
Eating	2.3	12.99	6.78
Eliminating	0	1.52	0

In March average temperature was 20°C and average relative humidity was about 16%. It was spring and weather was quite pleasant. Raja was active as it showed less resting behavior; only 6.74% compared to 85% in the previous study. Walking, standing and eating increased from no walking to 14 %, 8.1% to 23.48% and 2.3% to 25.27%, respectively. Eliminating or territory marking was 1.68% which was not observed in the previous study. Raja showed good interaction with its environment; 28.83% as compared to 0% in the previous study. But other activities like interaction with the keeper, response to crows sitting on the back and response to visitors were not observed in this month in the present study (Table II).

In April average temperature rose to 26°C and average relative humidity was 22%. Raja spent most of its time in the outdoor enclosure. It showed 9.23% resting behavior higher than the previous month. It showed 15.76% walking, 22.23% standing, and 1.97% eliminating slightly higher than previous month. Eating decreased in this month to 12.21% as compared to the month of March from 25.27% but still greater than 2.3% during the last study. 34.66% interaction with the environment like response to visitor's calls, interaction with wild pigeons and other birds sharing its food items, and response calls of peacock adjacent to its cage was observed, which was 0% in previous study. Other activity like interaction with keepers, response to crows sitting on the back and response to visitors' activities was 3.94%, more than previous results (Table II).

In May days were hot with 30.5°C average monthly temperature and 26% average relative humidity. Resting increased (12.87%) as compared to March and April but still it was less than 85% of previous results. In this month of study, Raja showed 11.66% walking, 23.45% standing, 1.15% eliminating behavior and 34.54% interaction with the environment. A slight increase in eating was noted from 12.21% in April to 14.09% in May. Other activities were only 2.23%; much less as compared to the results of the previous study (Table II).

June was the hottest month of the year with average temperature 33°C and 28% average relative humidity. Resting increased to 48.65% more than all the previous months of the study but still lower than the previous study (85%). Walking was 13.30% less than previous months but still more than previous study when walking was not observed. Standing was 8.84%, lowest of all the months of study. Observed eating was decreased to the minimum of the whole study duration *i.e.* 3.70% only. Eliminating behavior in June was raised from the last month *i.e.* 1.52%. Interaction with outer environment decreased to its lowest value in this study to 17.26% as compared with no interaction in the previous work. Other activities increased up to 6.73% (Table II).

Monsoon started in July. Average temperature decreased to some extent (31.5°C) and average relative humidity was 30%. Less resting was observed in comparison to hot month of June as 19.42%. Walking (8.36%), Standing (20.64%) and eliminating behavior (1.27%) were quite different from the previous study results. Raja showed less interest in eating (9.69%) but much higher as compared to previous month and the previous study (2.3%) before pairing. Interaction with environment was 24.52% as compared to no interaction in the previous study. Other activities were not observed. 16.10% interaction between male and female was

Table II.- Month-wise (percent) behavioural comparison of male Nile Hippopotamus recorded in 2003 with that recorded in 2008 (March to July) at Lahore Zoo.

Behavioral category	2003 study (overall) (%)	2008 Study (overall) (%)	2008				
			March	April	May	June	July
Resting	85.0	19.38	6.74	9.23	12.87	48.65	19.42
Walking	0.0	12.62	14.00	15.76	11.66	13.30	8.36
Standing	8.1	19.73	23.48	22.23	23.45	8.84	20.64
Eating	2.3	12.99	25.27	12.21	14.09	3.70	9.69
Eliminating	0.0	1.52	1.68	1.97	1.15	1.52	1.27
Interaction with environment	0.0	27.96	28.83	34.66	34.54	17.26	24.52
Others	4.6	2.58	0	3.94	2.23	6.73	0
Interaction of male & female	---	3.22	0	0	0	0	16.10

observed which was 0% throughout the previous months of study (Table II).

When the results of the previous study were compared with the overall results of the current study a clear variation was obvious in the behavior of male hippopotamus after and before pairing. Only 19.38% resting was observed during the whole study that was much lower than 85% before pairing. Raja showed 12.62% walking, 19.73% standing, and 1.52% eliminating behavior quite different from the previous results when it showed 8.1% standing, no walking and eliminating behavior. Eating increased to 12.99% from just 2.3% before pairing. Interaction with environment also occurred from nil to 27.96%. About 2.58% of other activities were observed as compared to 4.6% in the previous work. Interaction of male with female was observed 3.22% in the present study (Table I).

Comparison of male and female behavior

Table III shows the comparison of male and female behavior in each month. When behaviors of male and female were compared many differences were observed. In the first month of the study, the male showed only 6.74% resting while female showed 30.84% resting. Raja was observed to walk 14% of the time while Rani walked for 7.94% of the time. The male spent much of time in eating (about 25.27%) but the female spent only 6.12% of the time. Standing was observed 23.48% and 24.64% in male and female respectively. Eliminating behavior was 1.68% in male while no elimination in female. Both Male and female also showed interaction with environment like response to visitors' call, interaction with wild pigeons and other birds sharing its food items, and response calls of peacock located in the enclosures close by 28.83% and 30.46% respectively. Interaction between male and female was not observed. In April beginning of the hot days, marked difference was observed in the behavior of male and female. Raja showed 9.23% resting, 15.76% walking, 22.23% standing, 12.21% eating, 1.97% eliminating, 34.66% interaction with environment and 3.94% other activities. While Rani showed 55.28% resting, 8.70% walking, 10.56% standing, 1.24% eating, no eliminating, 24.22% interaction with environment and no other activities. During second month of study, no interaction was observed between the male and female.

During the third month of the study, female visited the outdoor enclosure many times. The male showed 12.87% resting, 11.66% walking, 23.45% standing, 14.09% eating, 1.15% eliminating, 34.54% interaction with environment and 2.23% other activities; while the female showed 37.45% resting, 2.72% walking, 18.34% standing, 12.9% eating, nil eliminating, 28.59% interaction with environment and no other activities and no interaction between Raja and Rani was observed (Table III).

In the month of June, summer season was at its peak. The male spent most of its time in the outdoor pond whereas the female remained almost all the time in indoor enclosure. The male showed 48.65% resting, 13.30% walking, 8.84% standing, 3.70% eating, 1.52% eliminating, 17.26% interaction with

Table III.- Showing month-wise % behavioral comparison of male hippopotamus with female hippopotamus.

Months	Behavioural categories															
	Resting %		Walking %		Standing %		Eating %		Elimination %		Interaction with environment %		Other activities %		Interaction 0f male & female (%)	
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F
March	6.74	30.84	14.0	7.94	23.48	24.64	25.27	6.12	1.68	0	28.83	30.46	0	0	0	0
April	9.23	55.28	15.76	8.70	22.23	10.56	12.21	1.24	1.97	0	34.66	24.22	3.94	0	0	0
May	12.87	37.45	11.66	2.72	23.45	18.34	14.09	12.9	1.15	0	34.54	28.59	2.23	0	0	0
June	48.65	65.69	13.30	0	8.84	4.86	3.70	4.69	1.52	0	17.26	24.76	6.73	0	0	0
July	19.42	28.38	8.36	5.19	20.64	20.18	9.69	8.97	1.27	0	24.52	18.64	0	0	16.10	18.64

environment and 6.73% other activities; while the female showed 65.69% resting, 0% walking, 4.86% standing, 4.69% eating, nil eliminating, 24.76% interaction with environment and no other activities. Even after four months of study no interaction was observed between the male and female hippos (Table III).

July, the last month of the study fell in the rainy season. It rained many times during the month and the weather remained quite pleasant. The female was also observed in the outdoor enclosure even in the pond with the male. The male showed 19.42% resting, 8.36% walking, 20.64% standing, 9.69% eating, 1.27% eliminating, 24.52% interaction with the environment; and male showed 16.10% interaction with the female of its total observed behaviour time in this month while the female showed 28.38% resting, 5.19% walking, 20.18% standing, 8.97% eating, no eliminating, 18.64% interaction with environment and no other activities. For the first time in the whole study period both Raja and Rani showed interaction with each other while eating and resting in the outdoor enclosure pond. Out of the total observed behaviour time of this month female showed 18.64% interaction with the male during the month of July only (Table III).

When results of the five months study were compared to find out the behavioral pattern of male and female hippopotamus a clear variation was noted. As the male showed 19.38% resting, 12.62% walking, 19.73% standing, 12.99% eating, 1.52% eliminating, 27.96% interaction with environment and 2.58% other activities and male female interaction 3.22% whereas the female showed 43.53% resting, 4.91% walking, 15.72% standing, 6.78% eating and 25.33% interaction with environment. Eliminating was not observed even for a single time in the female. Male and female were observed together showing some interaction only for 3.73% of the total time of female behaviors during July only (Table I).

DISCUSSION

The hippo female was introduced in the enclosure in 2007, where the male had already led a solitary life for 20 years. Several controversial

reports were made by the media when a female was introduced in the Zoo in 2007; the male at the time showed a very aggressive behavior and injured the female.

A clear difference was observed in the behavior of the male after the introduction of the female. Although male showed aggressive behavior towards female soon after its arrival, it soon calmed down. With the passage of time the male became more active as compared to the previous study. Raja spent most of its time resting before pairing but after pairing resting decreased and the percentage of other behavioral categories increased.

The female remained comparatively inactive as she rested 43.53% of her observed behavior time (Table I). The female inactivity could be due to several factors. The animals housed in zoological gardens are inevitably presented with the environments which are impoverished in comparison with the natural environment. Abnormal behavior is associated with the captive environment (Broom, 1983). In captivity animals become inactive because of decreased competition for the survival such as the necessity to hunt or looking for food, as the food for them is always available. When natural behaviors are disturbed, increase in the aggression to the cage-mates and sometimes boredom may result (Brambell, 1972). In natural environment hippopotamus live in groups of about 20-100. A single animal or a pair cannot exhibit the full range of natural behavior. Male appeared as an inactive animal in the previous study because it had spent a solitary life for more than two decades and there was no other hippo to disturb or interact with him so he had lost its natural behavior. There was no competition for food and space in the previous study so the male took the eating for granted. The male dominated while feeding. His walking behavior also increased. This may be to restrict entry of the female in his territory. The male disliked the introduction of female in the enclosure and attacked her inflicting serious wounds; allowed her to eat only after he had finished. Territory marking by spraying dung on the walls also appeared in the current study. These behavioral changes indicate that initially Raja did not accept Rani as a companion rather he took her as a competitor.

The male after the introduction of the female became active and increased the interest in feeding, walking and interacted with the environment. Interesting observations were made while studying the behavior of the male toward the newly introduced female. The male hippo showed an extremely aggressive behavior after the young female was introduced in the zoo. The male attacked and injured the female. The female was immediately separated from the male by zoo authorities. In January a partition was made to keep both the animals separate. They could see but could not reach each other. In February 2008, the partition was removed for 2 hours daily. In March 2008 the animals became familiar with each other and the partition was permanently removed. Even though the partition was fully removed, the interaction of the male with the female was not observed except in the last month of the study *i.e.*, in July 2008. Many factors may be involved in this unusual behavior. One reason may be the behavior of male who did not accept the female happily. Rather the male expressed the competitive behavior. When food was served male never allowed the female to join (Except in the last month of the study). The male started marking its territory and guarded it vigorously. This behavior was not shown by the male before the introduction of the female when he was leading a solitary life. The second reason may be the size and age difference of the animals. The age of the female was 8 years whereas the male was 41 years old at the time of the study. The female was at the start of its sexual maturity, while the male was at post- reproductive stage. Smuts and Whyte (1981) inferred that beyond the age of 30 the fertility of hippos decreased considerably. The female sometimes tried to get closer to the male but she was not encouraged. In the wild when female hippo is ready to breed, male hippos respond in a respectful manner (Physick, 1972; Garaham *et al.*, 2002). A change was observed at the end of the study that the male allowed the female to join when the food was served. The male did not show any aggression and even touched her face. The female which was brought to Lahore Zoo from Africa, was adapted to live with a group of hippos. On her arrival, she was treated aggressively by the male. The change of the climate, impoverished

environment and antagonistic behavior of the companion male had a negative impact on the behavior of the young female and as a result she acquired comparatively inactive mode of life. The female spent most of its time in the indoor pond. Only in the last month of the study *i.e.*, in July 2008, the female began to stay outdoor and the pair was observed together in the pond. This change may be due to change in the weather as the temperature decreased and rainy season started. The other reason for this positive behavioral change could be the fact that they had started to recognize or accept each other.

CONCLUSIONS

The male became more active after the introduction of the female. Overall activities of the male hippo increased perhaps due to competition with the female. He started moving around and making threatening sounds. Due to extreme age difference reproductive behavior was not observed, hence introduction of female was not proved fully fruitful. The female exhibited an abnormal behavior as initially she had not adjusted to the new environment. However, from overall study we can conclude that pairing positively affects the behavior of animals in captivity and we should try to provide the natural environments to captive animals.

REFERENCES

ASHRAF, S., 2003. *A Comparative behavioral study of African grazing mega fauna of Lahore Zoo with the wild conspecifics*. B.Sc. (Hons.) thesis, Lahore College for Women University, Lahore.

ALTMANN, J., 1974. Observational study of behavior: Sampling methods. *Behaviour*, **49**:227–265.

AZA (Association of Zoos and Aquariums), 2008. *AZA mission statement*.http://www.aza.org/AboutAZA/mission/index .html (On-line).

BIAZA (British and Irish Association of Zoos and Aquariums), 2008.http://www.biaza.org.uk/

BRAMBELL, M. R., 1972. The requirements of carnivores and ungulates in captivity. In UFAW Symposium. *The welfare and management of wild animals in captivity*. pp. 44-49.

BROOM, D. M., 1983. Stereotypies as animal welfare indicators. In: *Current topics in veterinary medicine and animal sciences.* 1st edition. Martinus Nijhoff, Netherlands, pp. 81-87.

EATON, R. L., 1981. An overview of zoo goals and exhibition principle. *Int. J. Stud. Anim. Probl.*, **2**: 295-299.

FRADRICH, H. AND LANG, E. M., 2000. Hippopotamuses, Grzimek's Animal life encyclopedia. *Mammal. Rev.*, **13:** 2-5.

GARAHAM, L.H. REID, K AND WEBSTER, T., 2002. Endocrine patterns associated with reproduction in the Nile hippopotamus (*Hippopotamus amphibius*) as assessed by fecal progestagen analysis. *Gen. Comp. Endocr*. **128**: 74-81.

HANCOCK, P. G., 1980. *Dynamics of over utilized areas in the Ndumu Game Reserve, Tonga land.* M.Sc. thesis, University of Natal.

KHAN, U., 1999. *A visit to Lahore zoo, teacher's resources.* Lahore Zoo.

MARTIN, P AND BATESON, P., 1993. Measuring behavior. In: *An introduction guide.* 1st edition. Cambridge University Press. Cambridge. UK, pp. 57-60.

OLIVER, R.C.D. AND LAURIE, W.A., 2008. Habitat utilization by hippopotamus in the Mara River. *East Afri. Wildl. J.*, **12**: 249-271.

PHYSICK, R., 1972. Hippopotamus behavior. *Lammergey*, **15**: 78-81.

SAIKAWA, Y., 2004. Pigment chemistry: The red sweat of the hippopotamus. *Nature*, **429** (6990): 363.

SMUTS, G.L. AND WHYTE, I.J., 1981. Relationship between reproduction and environment in the hippopotamus in Kruger National Park. *Koedoe.*, **24**: 169-185.

SNOWDON, C. T., 2000. Ethology. Comparative psychology and animal behavior. *Annu. Rev. Psychol*., **34**: 64-93.

(Received 4 October 2012, revised 4 April 2014)