



## Leopards in Captivity: A Study of the Effects of the Zoo Environment on their Behaviour

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**ABSTRACT:** Captive environments in zoological parks often do not offer for natural behaviours due to spatial constraints and negative visitors response. However, captivity has been the only way to preserve the species. As the numbers of wild Leopards decline, captive conservation, research and breeding programs have become a major focus of the zoo community, which magnifies the importance of research on their husbandry. This study involved sampling of Leopards (*Panthera pardus* Linn.) housed in zoos and was carried out over a period of one year. The study subjects were observed only during their routine husbandry practices and visit hours and no experiments were conducted. To explore the personality profiles the investigation uses scan sampling and instantaneous recording to collect data on the behaviours of studied animals housed in different enclosures. The common methods used for observing behaviours include focal animal sampling and scan sampling, combined with immediate or continuous recording. The activities of one selected individual or a group were recorded continually with the help of small surveillance cameras and Bushnell 10X40 binoculars whenever necessary over 8 hours in this study. The data collected from the study were recorded season wise over the year. The study shows that stereotypic behaviour of Leopards varied significantly. The stereotypes in leopards decreased significantly with the presence of pool, den and high density of tree cover in the enclosure with natural substrates than those in artificial substrates. Thus, the results show the significance of greater enrichments simulating natural environments for leopards' psychological welfare over increasing the size of enclosures.

**KEYWORDS:** Leopard, captive, behaviours, space, stereotype, conservation, research, zoo

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### I. INTRODUCTION

Humans maintain wild animals in zoological parks. They are held captive for the purposes of conservation, education, research, and recreation [1], [2], [3], [4] and [5]. Due to spatial constraints and negative public reaction captive environments often do not provide natural behaviours for wild animals in zoological parks. Leopards present a difficult case; the wild and natural predatory hunting behaviours that are difficult to provide for in captivity. Leopards in wild show activity peaks during dawn and dusk time of the day. The leopards in zoos are housed in enclosures. All the enclosures are closed type. In closed types of enclosures, the tops and side are covered with chain link mesh. Being the most adaptable and versatile carnivores [6], they can manage in smaller areas with dense undergrowth in human landscapes [7]. Public exposure can be one of the determining factors in the expression of stereotypic pacing [8], [9], [10] and [11], the repetitive and apparently functionless locomotors behaviour displayed by captive animals [12]. Increased pacing rates have been associated with the occurrence of large crowds in the vicinity of the enclosures for Indian leopards, *Panthera pardus* [13] and [14]. This study presents an analysis of the effects of the captive environment on the behaviours of Leopards in Nandankanan zoological parks.

### II. MATERIAL AND METHODS

**Study site:** Behavioural observation was conducted in Nandankanan Zoological Park (85° 48' 53" – 85° 81' 47.03"E and 20° 24' 00" – 20.399965°N) lies in between Bhubaneswar and Cuttack, the former capital of Odisha. The park is at a distance of about 2 Kms from Baranga Railway Station. This park is 22 kms from the

airport at Bhubaneswar and 2 Kms from Baranga Railway Station. It is at a distance of about 11 kms from Bhubaneswar Bus Stand. The Zoological Park is located inside the lush green forests of Jujhagarh forest of Chandaka Forest Division, Odisha. It is the host zoo for white tigers also. Nandankanan is the First Zoo in the country to become a member of the World Association of Zoos and Aquarium (WAZA).

**Study species:** This study involved sampling of four Leopards (*Panthera pardus* Linn.) housed in zoo was carried out over a period of one year. The study subjects were observed only during their routine husbandry practices and visit hours and no experiments were conducted.

**Procedure methodology:** The present survey deals with the behavioural responses of leopards in relation to feeding, resting, sleeping and agonistic interaction. To explore the personality profiles the investigation uses scan sampling and instantaneous recording to collect data on the different behaviours of studied animals housed in different enclosures. The common methods used for observing different behaviours include focal animal sampling and scan sampling (sampling rules), combined with immediate or continuous recording (recording rules). One individual is selected for observation in focal animal sampling. Focal animal sampling often coupled with continuous recording and the study duration was recorded for a predetermined time period defined by the researcher [15]. The activities of one selected individual or a group were recorded continually with the help of small surveillance cameras and Bushnell 10X40 binoculars whenever necessary over 8 hours in this study.

### III. RESULTS

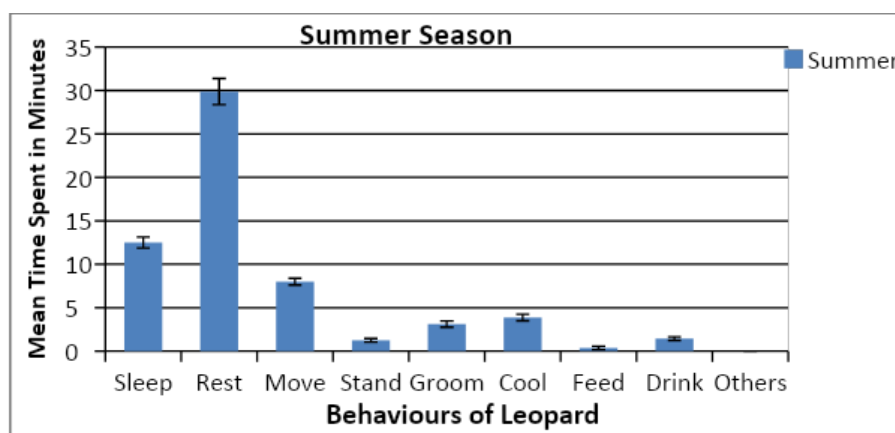
All the enclosures for leopards are closed type and covered with chain link mesh. In each enclosure there is a night shelter cum feeding chamber. This investigation presents an analysis of the effects of the captive environment on the behaviours of captive Leopards. Details of the Leopards investigated at Nandankanan Zoological Park are given in Table-1. All the behavioural responses of Leopard in relation to food and feeding; resting and sleeping; cooling; and agonistic interactions were recorded season wise over the year. A check sheet was prepared for data collection. The data collected from the study of time activity profile against behaviour are shown in the Table -2, Table -3 and Table -4 and graphs are plotted in Fig.-1, Fig-2 and Fig-3 respectively.

**Table-1:** Details of leopards studied at Nandankanan Zoo

	Name of the leopards	Sex
01	Barsha	Female
02	Suraj	Male
03	Manju	Female
04	Mangal	Male

**Table 2:** Mean Time Spent in minutes by Leopards on different activities on summer days at Nandankanan Zoo

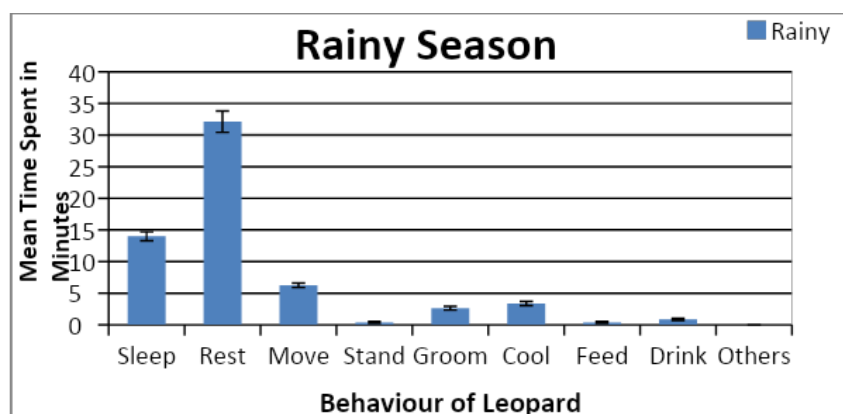
Time	Sleep	Rest	Move	Stand	Groom	Feed	Drink	Other activities	Total
08-09 AM	35	25	00	00	00	00	00	00	60
09-10 AM	10	40	5	00	4	00	00	1	60
10-11 AM	10	45	1	2	00	00	00	1	60
11-12 P.M	20	38	1	1	00	00	00	00	60
12-01 PM	25	32	00	00	00	00	1	2	60
02-03 PM	00	29	20	04	5	00	00	2	60
03-04 PM	00	7	28	2	6	16	00	1	60
04-05 PM	00	23	09	1	10	15	2	00	60
Mean $\pm$ S.D	12.50 $\pm$ 0.62	29.87 $\pm$ 1.51	8 $\pm$ 0.39	1.25 $\pm$ 0.21	3.12 $\pm$ 0.36	3.87 $\pm$ 0.38	0.37 $\pm$ 0.19	0.87 $\pm$ 0.21	00
%Time Spent	20.83	49.78	13.33	2.08	5.2	6.45	0.61	1.45	00



**Fig.1:** Mean Time spent in minutes by Leopards towards different behaviour during summer season.

**Table 3:** Mean Time Spent in minutes by Leopards on different activities on rainy days at Nandankanan Zoo

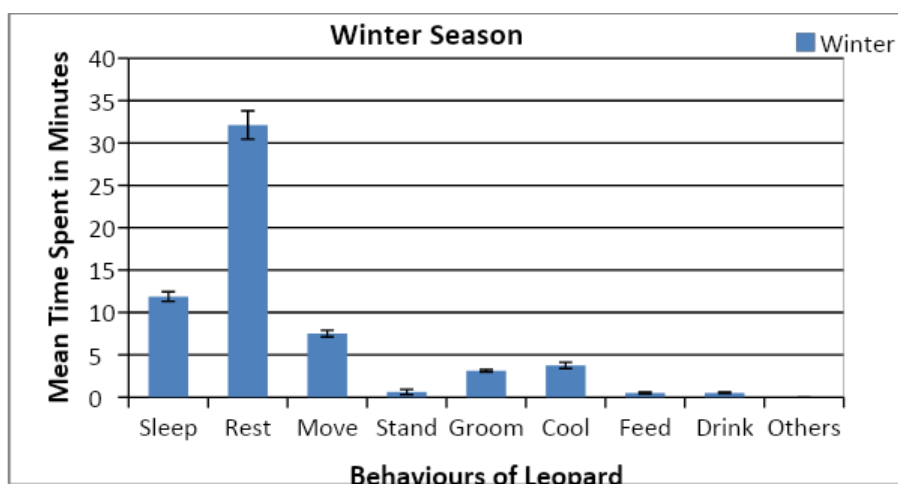
Time	Sleep	Rest	Move	Stand	Groom	Feed	Drink	Other activities	Total
08-09 AM	55	5	00	00	00	00	00	00	60
09-10 AM	20	35	2	1	2	00	00	00	60
10-11 AM	20	40	00	00	00	00	00	00	60
11-12 P.M	12	40	2	1	2	00	1	2	60
12-01 PM	00	56	1	00	1	00	00	2	60
02-03 PM	5	42	10	00	2	00	00	1	60
03-04 PM	00	10	30	1	3	15	00	1	60
04-05 PM	00	29	5	00	11	12	2	1	60
Mean	14	32.12	6.25	0.37	2.62	3.37	0.37	0.87	00
±S.D	±0.71	±1.68	±0.35	±0.15	±0.28	±0.34	±0.16	±0.17	00
%Time Spent	23.33	53.53	10.41	0.61	4.36	5.61	0.61	1.45	00



**Fig.2:** Time spent in minutes by Leopards on a daily basis towards different behaviour during Rainy season.

**Table 4:** Mean Time Spent in minutes by Leopards on different activities on winter days at Nandankanan Zoo

Time	Sleep	Rest	Move	Stand	Groom	Feed	Drink	Other activities	Total
08-09 AM	30	28	00	00	2	00	00	00	60
09-10 AM	10	44	4	00	00	00	1	1	60
10-11 AM	20	35	1	1	2	00	00	1	60
11-12 PM	18	40	2	00	00	00	00	00	60
12-01PM	17	35	2	1	3	00	1	1	60
02-03PM	00	36	18	2	4	00	00	00	60
03-04 PM	00	10	26	1	2	20	00	1	60
04-05 PM	00	29	7	00	12	10	2	00	60
Mean	11.87	32.12	7.50	0.62	3.12	3.75	0.5	0.5	00
±S.D	±0.57	±1.68	±0.38	±0.31	±0.14	±0.15	±0.09	±0.08	00
%Time Spent	19.78	53.53	12.5	1.03	5.2	6.25	0.83	0.83	00



**Fig.3:** Time spent in minutes by Leopards on a daily basis towards different behaviour during winter season.

The behaviours included in the study were resting, movement, sleeping, standing, grooming, feeding, drinking and other activities. Leopards were noticed to spend 20.83% in sleeping, 49.78% in resting, 13.33% in moving, 2.08% in standing, 5.2% in grooming, 6.45% in feeding, 0.61% in drinking, 1.45% in other activities in summer season while in Rainy the leopards spent 23.33% in sleeping, 53.53% in resting, 10.41% in moving, 0.61% in standing, 4.36% in grooming, 5.61% in feeding, 0.61% in drinking, 1.45% in other activities. But in winter the leopards spent 19.78% in sleeping, 53.53% in resting, 12.5% in moving, 1.03% in standing, 5.2% in grooming, and 6.25% in feeding, 0.83% in drinking, 0.83% in other activities. During feeding Leopard sat with two front legs together and kept the feed between two front paws. It pierced the flesh from the bone by the sharp canine teeth. After feeding nothing was left except bones. Leopards were found to be very calm during feeding. Leopards were not found to sleep in a particular posture for long. The leopard is lying flat on the ground or on the log or branches of the tree with its head down when sleeping. The eyes may or may not be closed and lie flat on one side with chest and abdomen upward, the hind leg raised and the foreleg of the same side resting on the chest. Leopards exhibited agonistic behaviour, against other leopards that were lower in the rank order or in size during feeding. They were found to be active during early morning. The resting period gradually increases from 8 A.M to 3 P.M. During pre-feeding and feeding time the resting period suddenly declines. After feeding again the leopard takes rest.

#### IV. DISCUSSION

Unlike wild Leopards, those housed in zoos are subjected to contact with unfamiliar humans. In the expression of stereotypic pacing, public exposure can be one of the determining factors [16] and [17], the repetitive and apparently functionless locomotor behaviour displayed by captive animals [12]. Captivity undoubtedly alters behaviour, which is undesirable from an aesthetic and scientific point of view. Animals will continually modify their behaviour to best fit their environment. A major problem with captivity is that all the essential requirements for survival are taken care of.

Leopards spent maximum time resting during the rainy and winter season in comparison to summer season. Usually, leopards were found resting under the shade of the trees or branches or in shady areas or inside the resting cell. In the winter the leopard takes rest in the sunny areas of the closed enclosure. Leopards were not found to sleep in a particular posture for a long time. The leopards were found to be disturbed during sleep by the roaring sound of lions in the nearby enclosures and noise created by the visitors.

Environmental variables such as enclosure size, enrichment factors, ambient temperature, visitor disturbance and keepers' attitude influence animal activity or behaviour in captivity. Leopards' stereotypic behaviour varied significantly. Factors like the presence of pool and den, tree cover are the characteristic features of leopards' natural habitat, with which the species in the wild often associate. For example, leopards use trees and rocky areas for resting and hide their hunted prey on tree branches to avoid disturbance from carrion feeders. The study also shows that stereotypes in leopards decreased significantly with the presence of pool, and den and high density of tree cover in the enclosure with natural substrates than those in artificial substrates. Thus, the results show the significance of greater enrichments simulating natural environments for leopards' psychological welfare over increasing the size of enclosures. The deprivation of the socialisation process especially in early life could reduce adaptability and promote stereotypes [18]. It is also suggested that enrichment would be highly positive for younger individuals [12].

The amount of time that all Leopards engaged in pacing increased significantly with the number of visitors. Increased pacing rates have been associated with the presence of large crowds in the vicinity of the enclosures for Indian leopards, *Panthera pardus* [13] and [14] and. This is in contrast; [19] found that Leopard increased pacing behaviour in response to low-level noise, but not to visitor numbers. Leopards under keepers with positive attitude show significantly lesser or absence of stereotype is a significant part of the environment in captivity than those under keepers with negative and neutral attitude. The overall study reveals that Leopards in captivity should be managed in enclosures enriched with tree covers, pool, stones, and in appropriate social conditions with adequate veterinary care to reduce stereotypes and stress levels.

#### V. CONCLUSIONS

Enclosures with abundant tree cover, presence of pool, stones, den, and positive keeper attitude are determining factors for leopards to best fit the captive environment. Since captivity has been the only way to preserve the species, the management practices of the Zoo therefore should be such that the captive environment allows an expression of the natural behaviour of the captive animal as far as possible.

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