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ETHOLOGICAL ASSESSMENT OF A SELECTED SPECIES (*AXIS PRONICUS*) UNDER CAPTIVE CONDITIONS FROM VEHARI PUNJAB PAKISTAN

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ABSTRACT

Management practices/strategies to re-modulate the wild behaviour of animal species could increase their number in natural areas. The behavioral adaptations of selected specie of Axis Pronicus were studied in zoo in Vehari, Punjab Pakistan using different strategies from January to March at different temperatures (morning to evening) and time intervals to understand the captive behavioural changes due to environmental pressure or stress. And to find out the reasons, Why this animal going towards extinction? And make different recommendations, plains and strategies to protect animal from being extinct. Hog deer belong to the family Cervidae (spotted deer). Male has branched antlers while female do not have antlers. Male antlers shaded annually and new developed. Female give birth to young one after 8 months. Breeding season of hog deer is March, April, and October. Adults 4 males, 9 females and 5 fawns were chosen for research purpose. Different behavior were studied such as feeding, grooming, resting, foraging, territorial, walking, running and mating behaviors. The mean values of selected specie of Axis pronicus (male) for these behaviours (feeding, grooming, moving, resting and mating) were 2.666, 0.333, 2.666, 1.333 and 0.333 respectively. The confidence level of these behaviours changes (feeding , grooming , moving , resting and mating) was 3.794, 1.434, 5.736, 5.736 and 1.434 respectively. The mean values of selected specie of Axis pronicus (female) for these behaviours (feeding, grooming, moving, resting and mating) were 10, 0.333, 10.666, 4.333 and 0.333 respectively. The confidence level of these behaviours changes (feeding, grooming, moving, resting and mating) was 15.513, 1.434, 12.74, 12.747 and 1.434 respectively. By using different tools and method we noticed these behaviors (like producing sounds by different means such as whistle and providing different kind of feed and cues). Mostly the adults were active during day time in morning and show resting behaviour in the afternoon. Fawns were less active as compare to adults. Males show less parental care as comparison to female. By studying wild behaviour of animal we protect animal from extinction. We try to provide natural environment to notice the actual behavior of the animal in captive conditions. There is need to examine that how limited space and altered activity patterns affect breeding behaviors, fertility rates, and cub survival rates in zoo populations.

1. INTRODUCTION

Biodiversity of the world declining day by day due to unsustainable activities of humans in natural environment and transformation of animals habitats for other purposes (IPBES, 2019; Diaz *et al.,* 2019).The CBD (Convention on Biological Diversity) define biodiversity as "biodiversity not refers to the species diversity but it have a great concern with the diversity among species and ecosystem diversity". The biodiversity concept's popularity based on the fact that it has three-term definition (diversity among species, within species and ecosystems diversity) provides a 'large platform' that encompasses a number of interests within the modern conservation movement (Thekaekara *et al*., 2020). Biodiversity of plants and animals mainly depend on the topogeographical regions and environmental conditions. Indus Plains, foothills and

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mountain ranges are three ecological zones in Pakistan. Mangroves, sandy areas, lagoons, large coastal belt, valleys and glaciers are various types of habitats found in Pakistan (Aslam *et al.,* 2022). Pakistan wildlife includes 700 bird species, 198 mammal species, 198 fresh water fishes, 177 reptile species, 22 amphibians, and 5,000 invertebrates' species (Pakistan's Sixth National Report, 2019).

Previously Hog deer (*Axis Pronicus)*found in Northern India, Pakistan spreading towards Nepal and Bhutan to Thailand, Cambodia, Lao PDR, Myanmar and Viet Nam (Timmins *et al.,*2015), and scattered in China, Yunnan . The *A.pronicus* is declared as Important Protected Wild Animal Species as a National Category I in China and on China's Red List Biodiversity declared as critically endangered due to its small population and restricted range on the IUCN Red List (Timmins *et al.,* 2015). 9% decrease in *Axis Pronicus* population in South-East Asia between 1991 and 2012, and declared as extinct in Thailand, the Lao People's Democratic Republic, and Viet Nam, but this specie again introduced in Pakistan and Thailand (Timmins *et al.*, 2015). The hog deer was previously identified in China's Gengma and Cangyuan Countries, which are located in the watershed of the Nanting River in border Myanmar and Southwest Yunnan (Yang and Ma; Wang *et al.,* 1998). The first *A.pronicus* sightings in China were in Sifangjing village, Gengma County, in (Yang and Ma *et al.,* 1965). How many people were living in Cangyuan Country at the time was not known. The Hog deer has not been seen since, scientist give different assumption that Hog deer disappeared (Smith and Xie *et al.,* 2009), despite the fact that field surveys and interviews suggested otherwise

Throughout the middle and latter decades of the twentieth century, the Hog deer (*Axis Porcinus*) had a dramatic decline (Brook *et al.,* 2016).It used to be common, but its population has been rapidly declining all over its range. According to reports, this species' global extinction rate is quite high, having increased by over 50% over the past 20 years and by 90% inside of its Southeast Asian range. In 2008 (Sinha *et al.*, 2019). The IUCN declared *Axis Porcinus* as an endangered species. Hog deer was listed as being protected in Indian Wildlife Protection Act of 1972 under schedule 1. Due to habitat loss and increased hunting pressure the population of Hog deer declining day by day in Pakistan. Despite being a threatened species, *A. Porcinus* is in one of the ignored and least researched mammalian species.

One of Pakistan's least studied animal species is hog deer (*Axis Porcinus*). It have belonging with the **Cervidae** family and order **Artiodactyla**. It is a short deer with a massive heavy body and shorts much sensitive legs and has dark olive brown color of body. Because of their meat, antlers, and skin, Hog Deer (*A. Porcinus*) has commercial important for which they are killed and farmed. Deer skin is used to make boots, gloves, and shoes. Antlers are used to make knife handles and buttons (Kanungo *et al.,* 2010). *Axis pronicus* byproducts such as antlers and velvet can be employed in oriental medicine. Cervids are very popular exhibits and may be seen in Zoos all over the world (Fowler, 1986).

Due to hunting pressure, hog deer (*A. Porcinus*) become more nocturnal (rest during night) and solitary (live individually not in the form of groups). IUCN declared that specie exist in the endangered species in red list. (IUCN, 1993). Hog Deer (*A. Porcinus*) habitat consists of damp grasslands near rivers (Biswas and Mathur, 2000). It has been found in the largest densities in flood plain grasslands (Odden *et al.,* 2005). It has a maximum predicted life span of 20 years in locations with no anthropogenic pressure and undisturbed ecosystems. Young fawns have a lighter sandy-yellow coloration. Hog Deer (*A. Porcinus*) are solitary creatures that do not live in vast herds.

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Whistling phonation and warning calls are given by hog deer when there is alarming situation (Rao and Acharjyo, 1984).

The Hog Deer is a grassland species that is largely endangered by habitat loss or degradation and illegal hunting (Dhungel and O'Gara 1991; Odden *et al.* 2005). *A.pronicus* serve as essential ecological function since, carnivores feed on it, it serve as food for them (Stoen and Wegge 1996; Lovari *et al.,* 2015). India is one of the *A. Porcinus* populations' strongholds in southern Asia, despite historically receiving little attention and the majority of information being anecdotal (Biswas *et al*., 2004).A place called a habitat is crucial for an organism's survival, reproduction, and population growth. The organism's range, quality, number, and rate of survival can all be directly impacted by the habitat (Zhang *et al.,* 2019). The primary factor imperiling creatures' ability to survive is habitat loss or habitat degradation (Brooks *et al.,* 2002; Haddad *et al.,* 2015). By changing species' natural habitats and distributions, climate change is predicted to result in a loss of biodiversity. The *Axis Porcinus* (Hog Deer) was a 'native' species, geographically confined to specific area Southeast and South Asia. The *A.pronicus* is among the least researched animal species in Pakistan. It belongs to the *Cervida*e family and Order **Artiodactyla.** In 2008, the IUCN designated the *Axis Porcinus* as a threatened species. The purpose of the current study was to examine how different environmental exposure, gender differences, and seasonal variations affected caged (*A. Porcinus)* in different areas like Lahore Zoo, Safari Zoo, and Jallo Park in Lahore, Pakistan.

The level of stress in hog deer was tracked using non-invasive methods. Four discrete months from each of the two seasons—winter and summer—were used to gather the samples. The hog deer is a small species of deer that has a big body, a dark brown colouring, and short, thin legs (Biosci et *al.,* 2022). The *Axis pronicus* hind legs are longer than its fore legs. The *Axis pronicus* face has a tiny, wedge-shaped shape (Robert *et al.,* 2022).

Geographically restricted to South and Southeast Asia, the hog deer (*Axis Porcinus*) is an endemic species (Sinha *et al.,* 2019). Hog deer can be found in Pakistan in areas with lush grass, such as meadows, forests near waterways, and woodlands (Arshad *et al.,* 2012). The meat, skin, and tusks of hog deer (*A. porcinus),* which are sought after and raised for, are valuable commercially (Kanungo *et al*., 2012).

The Hog Deer *(Axis porcinus*) saw a sharp fall in population in the middle and end of the 20th century (Brook *et al.,* 2016). It was originally ubiquitous, but the population has rapidly decreased. According to (Dhungel and Ogara 1991), hog deer typically ruminate on young shrubs shoots and leaves and graze on young grasses, herbs, flowers, and fruits. They are especially fond of *Imperata cylindrica* and *Saccharum spp*. In the region of Sambar (Rusa unicolor), it is regarded to be more of a grazer than a browser. On the other hand, introduced hog deer species in Sri Lanka are primarily found in scrub and cinnamon gardens, where they seriously harm local crops (McCarthy and Dissanayake, 1992). In *Axis pronicus* species polygynous mating system were present in which a male can mate with several females. But some have monogamous mating system in which male only mate with on female. Female give birth to single fully developed fawn after 8 months of gestation period from May-July.

Zoo is set up for the maintaince of a huge collection of wild animals, typically in a park or gardens, for study conservation, biodiversity, and display to public. Our area of study is the Vehari zoo of Vehari established in 1988 on an area of 16 acres at cost of 3million rupee by government of punjab.210 different types of animals are present over there and 20 number of different species.

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Objectives of study

The main objective of this research project to study the behaviour of selected specie of caged animal (*Axis pronicus)* to understand its wild behaviour by the help of this we can recommend possible changes or strategies to protect this specie from extinctions. This behavioural changes study also makes contribution in the well-being of this specie. And also have objective to find out the reasons why this animal going towards extinction. Visitors are basic factor of stress for zoo animals. Visitors have to respect their home of animals as if you were visiting a friend's home. There are definitely a lot of things to consider while seeing wildlife in captivity; study is essential, and being observant and considerate while you're there are a must. Different training and enrichments are used to train organism like puzzle feeders that enable animal to feed for food, hanging structures also made that strengthen specie abilities and training sessions in which animals have great interactions with zoo keeper.

2. METHODOLOGY

2.1. STUDY AREA

The research was carried at the Zoo Vehari (30.037376°N, 72.350351ºE) in Vehari district in Punjab province of Pakistan. The cage of the selected specie of *Axis pronicus* has a wall or boundary of 13 ½ and length 2870 sft. Zoo of Vehari construct in 1985-1987. This area contains several animals such as lion, bear, rabbit, monkey, blue bull, chinkara and hog deer etc. Among the caged animals the hog deer was selected for research purpose. From the family **Cervidae** and order **Artiodactyla** *Axis pronicus* mainly belongs. The area is offering potential habitats to host the population of hog deer. The details like how many species were present, about the gender of sampled organism, and age of Hog Deer are provided by some boards over there. The climate of this area is distinguished by hot and cold season yearly spread of rainfall less than 125/mm.

For the research purpose we moved from zoological lab of University of Education Lahore (Vehari campus to Vehari zoo) from February to April. Qualitative and quantitative statistical analysis was used to describe the behavioural changes of selected specie of ***Axis Pronicus***.

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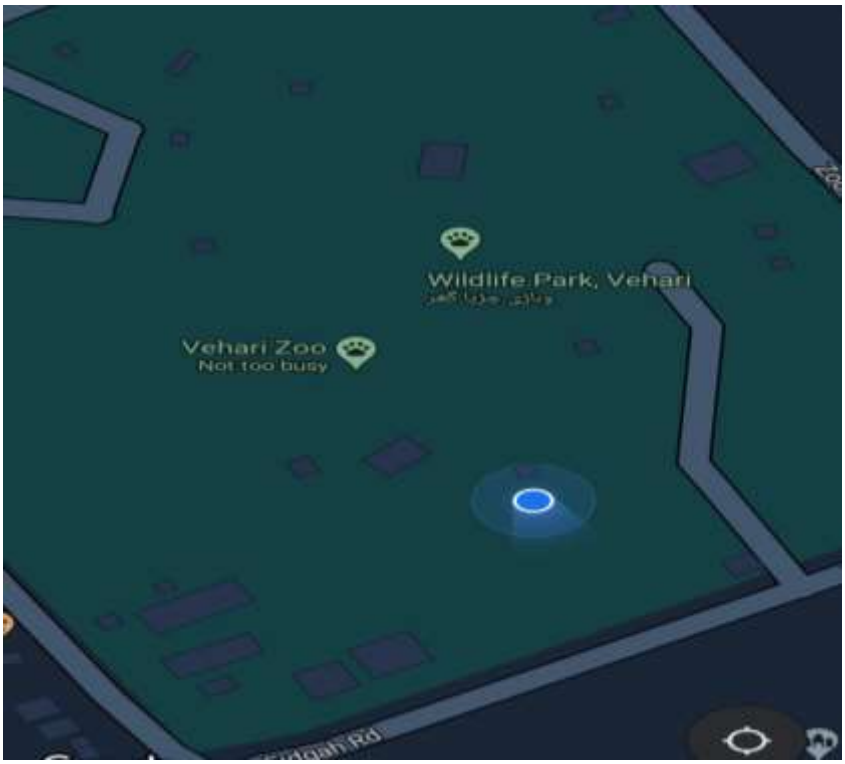

Figure 2.1: Hog deer cage pin location

2.2. DATA COLLECTION

The animal chosen for research purpose (*Axis Pronicus*) were 19 in numbers including 4 males (*Axis pronicus*), 5 fawns and 10 females. Different behaviours (sleeping, resting, running, feeding, mating behaviours) were noted on different dates on different time intervals (morning, evening and afternoon). Some information also collected by the Zoo officer such as feed given in morning at 10/is (160/ kg) to whole group of species and in the evening boiled chickpea 6/kg to this animal *(axis pronicus)*.

Basic difference seen in the males and females is males usually carry antlers on head while female don't have antlers. Male antlers shade annually and new antlers grow out.20 minutes observation where conducted on the each individual of hog deer .Five observation were performed on animals with different methods (such as giving feed, disturbing them with stick and producing some annoying sounds with whistle) on each day with different temperature ranging from 22°c to 32°C temperature in morning, evening and afternoon.

Observations were made between January to March. The morning observation usually taken from 8am to 10am, while the afternoon observation from 2 to 4pm and evening from 4 to 6pm on daily basis. These information were collected in early summer weather with maximum daily air temperature is 30°C and minimum air temperature is 24°C in the average humidity 55% in air in the Vehari zoo.

First of all different observations methods were made to observe the feeding, running, walking , aggression, shyness, foraging, behaviours and what kind of behaviour shown by the animals in the case of presence of any visitor and predators. Experimental methods were used to study and examine how the changes in their feed affect the animal's behaviour. Stastical analysis of research project was conducted using tool anova.

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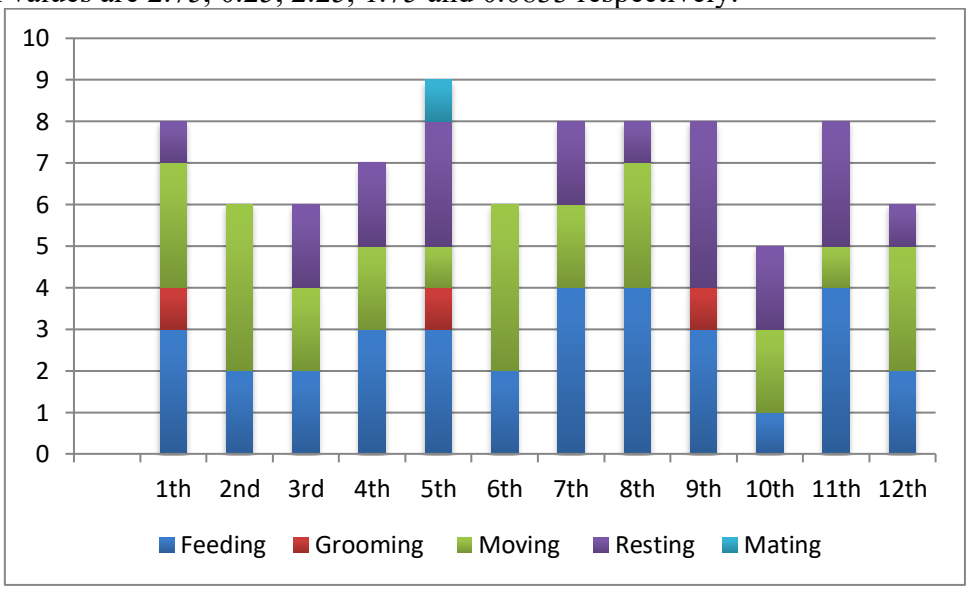
3. RESULTS

Table 3.1 :weekly behavioural changes in male hog deer (Axis pronicus)

Weeks	Feeding (no of specie)	Grooming	Moving	Resting	Mating
1th	3	1	3	1	0
2nd	2	0	4	0	0
3rd	2	0	2	2	0
4th	3	0	2	2	0
5th	3	1	1	3	1
6th	2	0	4	0	0
7th	4	0	2	2	0
8th	4	0	3	1	0
9th	3	1	0	4	0
10th	1	0	2	2	0
11th	4	0	1	3	0
12th	2	0	3	1	0

In this study the behaviour changes was observed in 12 weeks (table 3.1). In these weeks studied behaviours are Feeding, Grooming, Moving, Resting and Mating and the mean values are 2.75, 0.25, 2.25, 1.75 and 0.0833 respectively.



Graph 3.1: Weekly Behavioural Changes in Male Hog Deer (Axis Pronicus)

Table 3.2: Stastical Analysis Of Different Behaviours Of Male (*Axis Pronicus*) In 12th Weeks

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Behaviours	Mean	S.E	Median	Mode	S.D.	Range	Min	Max.	CL (95%)
Feeding	2.75	0.278	3	3	0.965	1-4	1	4	0.613
Grooming	0.25	0.130	0	0	0.452	0-1	0	1	0.287
Resting	2.25	0.350	2	2	1.215	0-4	0	4	0.772
Moving	1.75	0.350	2	2	1.215	0-4	0	4	0.772
Mating	0.083	0.083	0	0	0.288	0-1	0	1	0.183

**S.E= Standard Error; S.D. = standard deviation; CL= confidence level; Min= minimum; Max. = maximum

Stastical analysis of behaviour changes in male (*axis pronicus)* was also made (table 3.2). The confidence level of these behaviours changes (feeding, grooming, moving, resting and mating) was 0.613, 0.287, 0.772, 0.772 and 0.183 respectively. Ranges for these behaviour changes are 3, 1, 4, 4 and 1 respectively.

Table 3.3: Weekly behavioural frequency on Female hog deer(*Axis Pronicus*)**:**

Weeks	Feeding (No Of Species)	Grooming	Resting	Moving	Mating
1th	9	0	5	10	0
2nd	5	1	12	3	0
3rd	15	4	6	9	0

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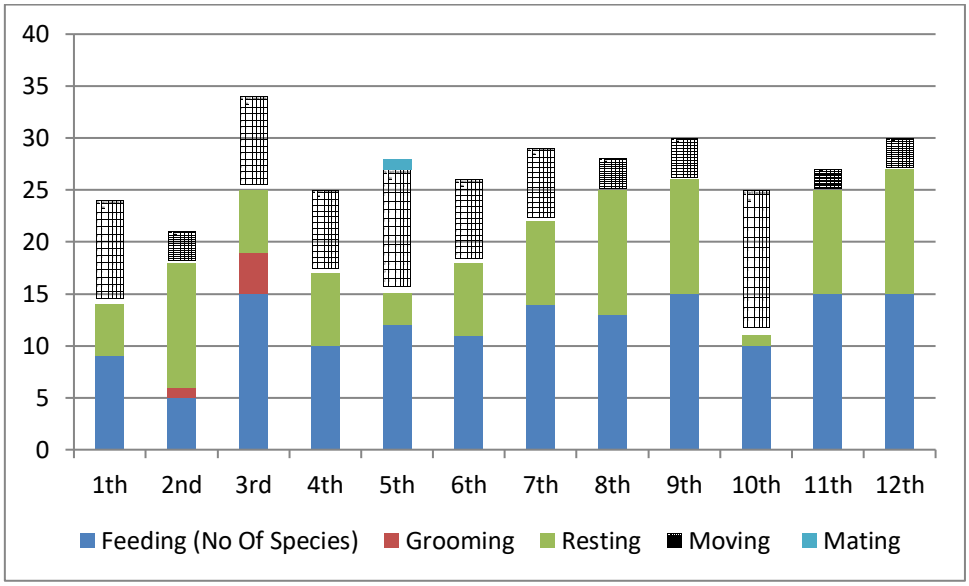
4th	10	0	7	8	0
5th	12	0	3	12	1
6th	11	0	7	8	0
7th	14	0	8	7	0
8th	13	0	12	3	0
9th	15	0	11	4	0
10th	10	0	1	14	0
11th	15	0	10	2	0
12th	15	0	12	3	0

In this study the behaviour changes was observed in 12 weeks in female (*Axis Pronicus*) (TABLE 3.3). In these weeks studied behaviours are Feeding, Grooming, Resting, moving and mating and the mean values are 12, 0.416, 7.833, 6.916 and 0.0833 respectively.



Graph 3.2: Weekly Behavioural Frequency On Female Hog Deer(*Axis Pronicus)*

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Table 3.4: Stastical Analysis Of Different Behaviours In Female (*Axis Pronicus*) During

Behaviou	Mean	S.E	Median	Mode	SD	Range	Min.	Max.	CL (95%)
Feeding	12	0.904	12.5	15	3.133	5-15	5	15	1.990
Groomin	0.416	0.336	0	0	1.164	0-4	0	4	0.739
Moving	7.833	1.064	7.5	12	3.688	1-12	1	12	2.343
Resting	6.916	1.137	7.5	3	3.941	2-14	2	14	2.504
Mating	0.083	0.833	0	0	0.288	0-1	0	1	0.183

**S.E= Standard Error; SD= standard deviation; CL= confidence level ; Min.= minimum ; Max.= maximum

Stastical analysis of behaviour changes in female (*axis pronicus)* was also made (table 3.4). The confidence level of these behaviours changes (feeding, grooming, moving, resting and mating) was 1.990, 0.739, 2.343, 2.504 and 0.183 respectively. Ranges for these behaviour changes are 10, 4, 11, 12 and 1 respectively.

Table 3.5: Five Categories Of Behaviour Of Selected Specie of *Axis Pronicus* (Male) Based On Morning To Evening

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TIME	FEEDING	GROOMING	RESTING	MOVING	MATING
Morning	3	1	0	4	0
Afternoon	1	0	4	0	1
Evening	4	0	4	0	0

Different behaviours (feeding, grooming, moving, resting and mating) of male (*Axis pronicus)* were noted at different time intervals in the morning, afternoon and in the evening (table 3.5). Usually they feed in day time in the evening food is not given to the animal. The mean values for these behaviours (feeding, grooming, moving, resting and mating) were 2.666, 0.333, 2.666, 1.333 and 0.333 respectively.

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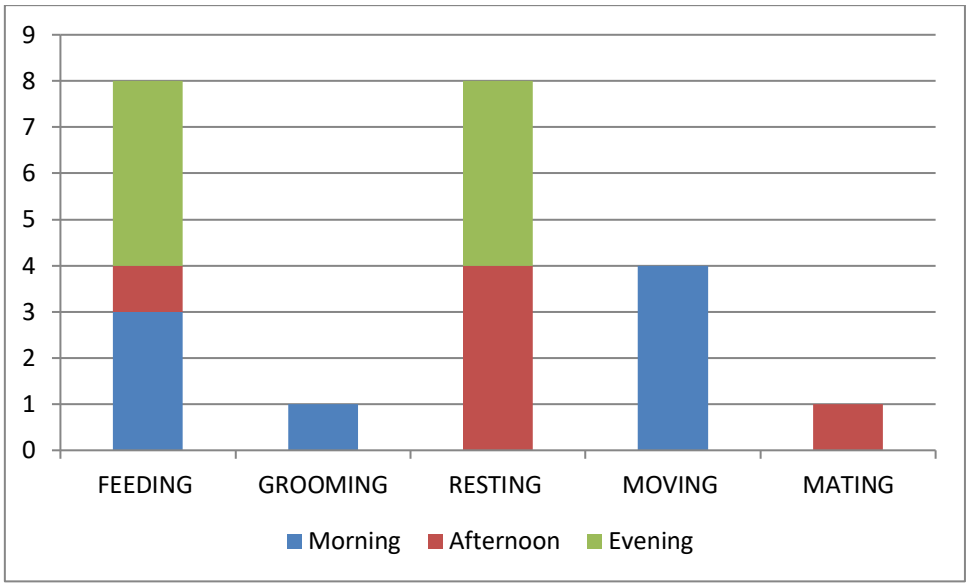

Graph 3.3: Five Categories of Behaviour Of selected specie of *Axis Pronicus* (Male) Based on Morning to Evening

Table 3.6: Stastical Analysis Of Male (*Axis Pronicus*) Five Categories Behaviour From Morning To Evening

Behaviours	Mean	SE	Median	Mode	SD	Range	Min.	Max.	CL (95%)
Feeding	2.666	0.881	3	3	1.527	1-4	1	4	3.794
Grooming	0.333	0.333	0	0	0.577	0-1	0	1	1.434
Moving	2.666	1.333	4	4	2.309	0-4	0	4	5.736
Resting	1.333	1.333	0	0	2.309	0-4	0	4	5.736

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Mating	0.333	0.333	0	0	0.577	0-1	0	1	1.434

**S.E= Standard Error; S.D. = standard deviation; CL= confidence level; Min. = minimum; Max. = maximum

Stastical analysis of behaviour changes in male (*axis pronicus)* from morning to evening was also made (table 3.6). The confidence level of these behaviours changes (feeding, grooming, moving, resting and mating) was 3.794, 1.434, 5.736, 5.736 and 1.434 respectively. Ranges for these behaviour changes are 3,1,4,4 and 1 respectively.

Table 3.7: Five Categories Of Behaviour Of Selected specie of *Axis Pronicus* (Female) Based On Temperature From Morning To Evening

TIME	FEEDING	GROOMING	RESTING	MOVING	MATING
Morning	12	1	5	10	0
Afternoon	15	0	12	3	1
Evening	3	0	15	0	0

Different behaviours (feeding, grooming, moving, resting and mating) of female (*Axis pronicus)* were noted at different time intervals in the morning, afternoon and in the evening (table 3.7). Usually they feed in day time in the evening food is not given to the animal. The mean values for these behaviours (feeding, grooming, moving, resting and mating) were 10, 0.333, 10.666, 4.333 and 0.333 respectively.

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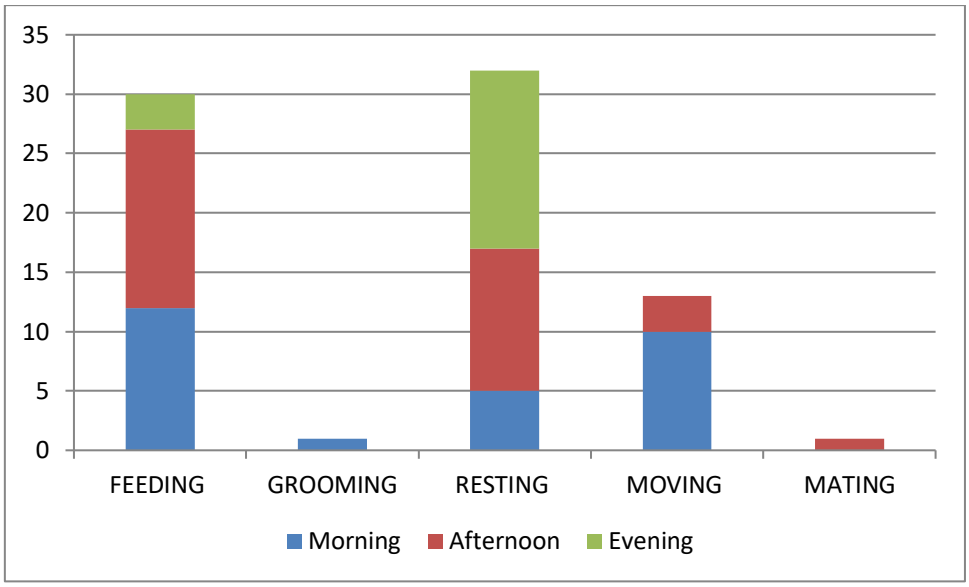

***Graph 3.4*:** Five Categories of Behaviour of Selected Specie of Axis *Pronicus* (Female) Based On Temperature from Morning to Evening

Table 3.8: Stastical Analysis Of Female (*Axis Pronicus*) Five Categories Behaviours From Morning To Evening

Behaviours	Mean	S.E	Median	Mode	S.D.	Range	Min.	Max.	CL (95%)
Feeding	10	3.605	12	12	6.244	3-15	3	15	15.513
Grooming	0.333	0.333	0	0	0.577	0-1	0	1	1.434
Moving	10.666	2.962	12	12	5.131	5-15	5	15	12.747
Resting	4.333	2.962	3	3	5.131	0-10	0	10	12.747

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Mating	0.333	0.333	0	0	0.577	0-1	0	1	1.434

**S.E= Standard Error; S.D. = standard deviation; CL= confidence level; Min. = minimum; Max. = maximum

Stastical analysis of behaviour changes in female (*axis pronicus)* from morning to evening was also made (table 3.8). The confidence level of these behaviours changes (feeding, grooming, moving, resting and mating) was 15.513, 1.434, 12.74, 12.747 and 1.434 respectively. Ranges for these behaviour changes are 12, 1, 10, 10 and 1 respectively.

Table 3.9: Different Behaviours Of *Axis Pronicus* With Description

Behaviour	**Figure no**	**Description**
Male (special character)	Figure 3.3	Male is differ from female because male contain antlers on head region
Female (special character)	Figure 3.4	Female don't have antlers
Sensitization behavior	Figure 3.6	Raising ears showing sensation
Feeding behaviour (solitary)	Figure 3.7	Usually feed in solitary
Feeding behaviour (groups)	Figure 3.8	When there is plenty of food then hog deer prefer to feed in groups
Inactive behaviors		
Resting behaviour(solitary)	Figur 3.9	Lying on ground its body is in resting position but raise the head
Resting behaviour (groups)	Figure 3.10	They show there resting behaviours in the rows in sitting positions with raising heads
Active behaviors		
Runing behaviour	Figure 3.11	Moving back and forth with herd
Responding to sounds	Figure 3.12	Hog deer responding to a sounds by raising their ears
Responding behaviour (CUE)	Figure 3.13	Hog deer responding to a cue(pencil) by sniffing
Staring behaviour	Figure 3.14	Hog deer showing aggression first time seeing any unknown visitors
Searching behaviour	Figure 3.15	Hog deer sniffing onto ground for feed
Mating behavoiur	Figure 3.16	Hog deer male sniffing the female legs for mating purpose
Parental care	Figure 3.17	Female (axis pronicus) interacting with fawn showing parental care
Communicating behaviour	Figur 3.18	Several animals (axis pronicus) interacting with one and other
Feeding behaviour	Figure 3.19	Basically herbivous but eating anything provided in the cage

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Walking behaviour	Figure 3.20	Moving forward showing walking behaviour
Hog deer cage	Figure 3.2	The hog deer cage shown in figure

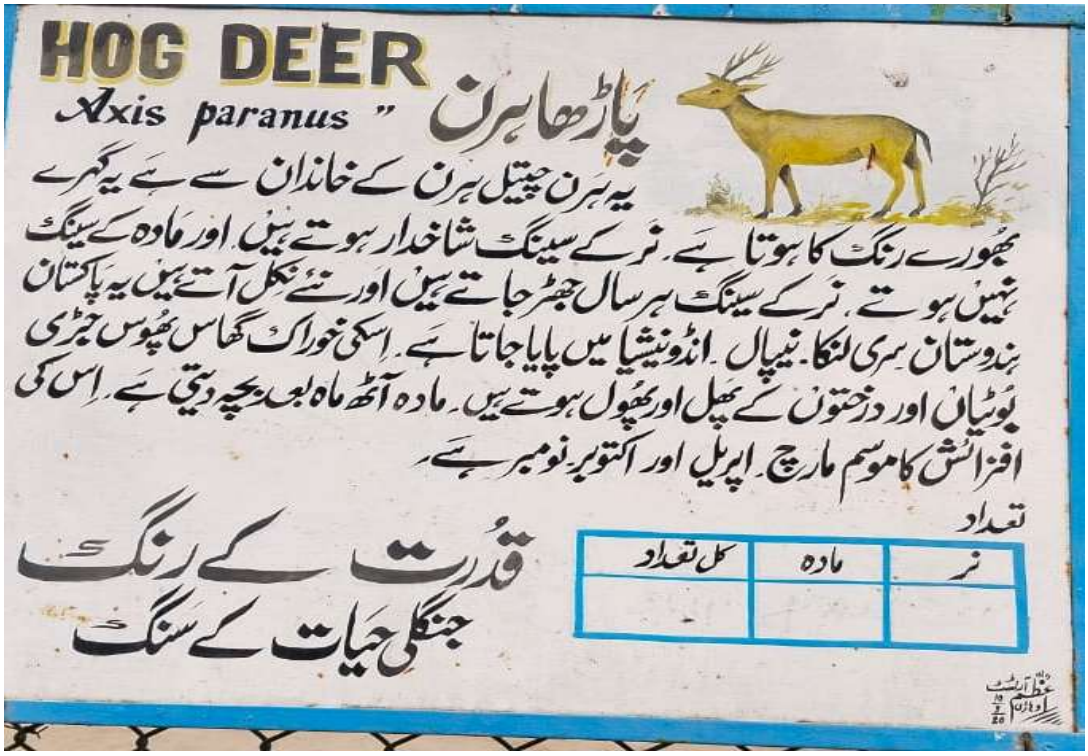

Figure 3.1: Some information about hog deer provided in zoo

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Figure 3.2:The cage of hog deer (*Axis Pronicus*)

Figure 3.3: Male (*Axis pronicus)* with antlers

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Figure 3.4:Female *Axis pronicus* without antlers

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Figure 3.6: Sensitization behaviour og Hog deer *(Axis pronicus*)

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Figure 3.7: Feeding behaviour of *Axis pronicus* in solitary

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4. DISCUSSION

Confined or semi-confined conditions forced the members of specie to live under some advantages and also under some disadvantages. Advantages like availability water, shelter, food and protection from predators; but also confined specie activities due to human impact and available spaces. The changes made in the habitat of specie forcing the specie to change their behaviour to survive under confined conditions (Baboo *et al.,* 2022). The modifications in behaviours are except to have same as of its wild behaviours slight changes can occur according to my study due to environmental changes. By the study of captive behaviour of animals also help in understanding the wild behaviour of animals and possible changes it can undergo during stress or captive conditions (Younas *et al.,* 2022). Some little changes from wild behaviour due to captive stress shown in captive groups of hog deer with no modification in wild behaviour patterns except captive stress (Farooq *et al.,* 2021) and in my study Hog deer (***Axis Pronicus***) also show change in behaviour such as Hog deer is solitary animal but in captive condition this animal live in grouping (due to small space). It is a little deer with short delicate legs and a massive heavy body having dark olive brown coloration (Kanungo *et al.,* 2010). In my studies hog deer is also a small animal with heavy body but colors faded due to some environmental stress and captivity pressure.

During the hottest part of the day, all subjects spent most of their time in sitting and relaxing. While, few hours of night in napping, resting and pondering. Fawn spent more time in sitting, resting, and concealing than adults (Khan *et al.,* 2021) and in my study in the morning Hog deer was so active but in afternoon when temperature is too high Hog deer show resting behaviour and spent few hours in sleeping in evening. Due to small body size Fawn (***Axis Pronicus***) show inactive behaviour mainly sleeping and resting.

In enclosure Hog deer were mainly dusky in feeding with irregular short intakes, and grazing on grasses. (Yonus *et al.,* 2021) these are contrary to my study because in my study Hog deer feed on anything provided in the captivity mainly grasses and also on chicken pee but actually Hog deer is herbivore in nature.

The Hog Deer is a grassland dependent (Dhungel and O'Gara 1991; Odden *et al.,* 2005) but in my study Hog deer was kept on barren land in captivity due to which their body color and behaviour changes (mainly environmental change).

Changes introduced by humans in environment caused an overall decrease in the number of this species (Shah *et al.,* 2022). However; a good environment is provided by zoo which helps in wildlife activities around the world. In the presence of visitors the wild animal feels a high level of annoyance (Rafi *et al.,* 2022) in my study animal show aggression in behaviour visitor also affect animal behaviour. The main aim of this study is to understand the wild behaviour of specie to protect them from extinction under captive conditions. Environment and human interference affects the specie behaviour badly. The main aim of this study is to find some better ways to protect the animal from extinction, to understand the behaviour carefully and in future suggest new ways to protect this animal, this animal are more safe in captivity because in wild environment people hunting this animal. Also prohibit the hunting of hog deer establish

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different laws and rules. Also provide the natural environment in captivity like moisture grasslands, food, space and several other factors that help them to survivor easily.

In this research project different behaviours were studies like Feeding, grooming, resting, sleeping, walking and mating etc. and possible changes were noticed that had happened to animal behaviours due to environment stress and captivity pressure. Mainly Hog deer (*Axis pronicus*) is herbivore but due to captivity this behaviour change it eats anything provided in the cage because sufficient food was not provided in the cage. We have to provide sufficient food to observe the actual behaviour of the specie in captivity. In our study we also observe change in color this is environmental change Hog deer is also grassland obligate but in cage grassland environment not provided but we have to try to provide grassland type environment to protect the color of specie. We try to provide natural environment to notice the actual behaviour of the animal in captive conditions

4.1. CONCLUSION

According to the finding of present study we can study different behaviour and changes in behaviour due to environmental stress. We can find some better ways to protect this species from extinction. And it also helps in better understanding of captive behaviour of (*Axis pronicus).*

FUTURE RECOMMENDATION

- Such kind of studies should be conducted for long-term monitoring of selected specie *Axis pronicus* behaviour to observe any changes or adaptations over time. This could involve tracking behavioural patterns, activity levels, and social interactions of lions under different degrees of behavioural restriction
- The comparison was made between behavioural effects of captive and wild environment. This could involve studying the differences in activity levels, feeding behaviours, social interactions, and overall well-being of *Axis Pronicus*.
- Investigate and develop new enrichment strategies that can mitigate the negative effects of behavioural restriction.
- Such studies will explore the impact of behavioural restriction on the social dynamics of *Axis pronicus* selected specie.
- Different investigation has done to know the effects of behavioural restriction on reproductive behaviours and success in *Axis pronicus.*
- There is need to examine that how limited space and altered activity patterns affect breeding behaviors, fertility rates, and cub survival rates in zoo populations
- Such studies will investigate that how human visitors and external stimuli influence activity levels, stress levels, and social interactions of selected specie of *Axis pronicus.*

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