# BEHAVIORAL ASSESSMENT OF SINDH IBEX (*CAPRA AEGAG*RUS *BLYTHI*) IN A MIXED GROUP: INSIGHTS INTO CAPTIVE MANAGEMENT AND WELFARE

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**ABSTRACT:** The Sindh Ibex (*Capra aegag*rus *blythi*) is a wild goat subspecies native to arid, rugged mountainous regions of Pakistan. This study investigates the differences in behavioral patterns of male, lactating and non-lactating females of Sindh Ibex in lactation period in a controlled captive environment. All of the observations were systematically recorded over a period of five days for different behavioral categories including feeding, grooming, climbing, social interaction, maternal care, nursing and territory. Using Mann-Whitney U test, the study revealed significant sex and status specific behavioral patterns. Lactating females exhibited significant higher frequencies of maternal care, lactation, and nursing behaviors while males exhibited greater alertness and territorial behavior. Grooming was also more observed in lactating females reflecting maternal investment and self-maintenance. Non lactating females, although behaviorally distinct, showed overlap with both groups in maintenance activities such as foraging and resting. The enclosure management with consistent food availability and spatial enrichment supported naturalistic behavior while mitigating stress. The findings emphasize the influence of reproductive status on behavioral priorities in captive ungulates. These results provide valuable insights for improving enclosure design, reproductive management and welfare monitoring protocols in zoological settings to house Sindh Ibex.

**Key words:** Sindh Ibex, *Capra aega*grus *blythi*, Ontogenetic influence, Lactation season, Intra-sexual behaviors, gender effect.

*(Received 18.03.2025 Accepted 16.06.2025)*

## INTRODUCTION

Wildlife play a significant role to enhance biodiversity,ecological balance, and provide necessary resources and services that support human life and the environment (Tanveer et al., 2022).The Sindh Ibex is a wild goat endemic subspecies to arid and rugged mountainous region of Pakistan particularly Baluchistan and some parts of Sindh (Al-Sheikly *et al*.,2020). Globally Capra aegagrus blythi has been listed by International Union for Conservation of Nature (IUCN) red list as Near threatened species (Weinberg and Ambarli 2020).

Most of these species were abundant at once, but now have been reduced due to habitat degradation, hunting and human encroachment in recent decades (Ghalib *et al*.,2018). Due to its conservation status, captive management of Sindh Ibex is an important step for Conservation and behavioral research, focusing mainly on closed observation of social dynamics and welfare indicators on a controlled environment (Mason *et al*.,2007; Kaczensky *et al*.,2011). Consequently, the distribution of Sindh Ibex species for Conservation in Pakistan has been restricted to Zoological parks, game reserves and wildlife sanctuaries (Yamad *et al*.,2004).

Within such captive management sites, understanding the influence of gender and life stages on social behavior, dominance hierarchies and space utilization among social ungulates is important for developing effective management practices (Krause & Ruxton 2002; Festa-Bianchet, 1991).

"Ungulates are those mammals having hooves, characterized by their unique foot structure". Among social ungulates adult males and females are sexually segregate from each other (Main *et al*.,1996). Males are larger and heavier than females (Bassan *et al*., 2003). Also, males have curved and larger horns that can grow up to a size of 1 meter in length, while females have much shorter and thinner horns (Rajpar, M.N., *et al*.,2024). In Spanish ibex, fights are typically observed

between males of similar age, with older individuals usually dominating encounters (Martinez *et al.,* 2014). Female mate choice also appears biased toward older males, who allocate more time and energy to mating related activities than younger cohorts (Martinez *et al.,* 2014).

During rutting season (when male Ibex are sexually active and shows aggressive behavior) to compete for female attention, for access to female (Willisch,C.S., & Neuhaus, P 2010). Different intraspecific behaviors are observed due to influence of gender and life stages among Sindh Ibex. In Siberian ibex, age based segregation within male groups further indicates that intrasexual interactions are structured not only by dominance but also by age similarity, reflecting both energetic and social compatibility (Zhao *et al.,* 2014). In captivity, these dynamics may be altered by space limitation, artificial grouping, and reduced predation risk, which can intensify aggression or disrupt natural segregation patterns (Mason *et al.,* 2007).

According to Sutherland; *Behaviors are internal coordinated responses (actions or reactions) of an animal or groups to internal or external stimulus* (Sutherland, W.J.1998).

Captive breeding programs have been initiated to safeguard this taxon and maintain viable populations for potential reintroduction, yet behavioral studies on captive Sindh ibex remain scarce (Sheikh & Molur, 2004). Captivity can profoundly influence animal behavior because restricted space, artificial grouping, and absence of predation pressure alter natural activity budgets, potentially increasing intraspecific aggression or disrupting natural social structures (Mason et al., 2007; Carlstead, 2009). Therefore, studying ontogenetic and intrasexual behavior in captive ibex is critical for both welfare and management purposes.

Ontogenetic behavior, defined as age-related changes in activity and social roles, plays a central role in structuring ungulate societies (Ruckstuhl & Neuhaus, 2002). For instance, in Siberian ibex (Capra sibirica), younger males between two and three years old often associate with female groups outside the rutting season, displaying tolerance that may function as pseudosexual play, while older males remain socially segregated, forming age-homogeneous groups (Zhao et al., 2014; Wang et al., 2018). This supports the social affinity hypothesis, which posits that individuals prefer to associate with age-matched peers, and the activity budget hypothesis, which emphasizes energetic compatibility within groups (Ruckstuhl & Neuhaus, 2002; Zhao et al., 2014).

In captivity, these behaviors may manifest differently. Restricted enclosures can intensify encounters between males, leading to higher frequencies of aggression and stress, while limited opportunities for sexual segregation may reduce the ability of individuals to express natural age-specific social preferences (Mason et al., 2007; Carlstead, 2009). Consequently, understanding the ontogenetic and intrasexual behavior of captive Sindh ibex is essential for designing enclosures, managing group composition, and maintaining welfare standards, while also informing conservation breeding programs aimed at sustaining viable populations for long-term survival (Sheikh & Molur, 2004).

The aim of the current study was to gain insights for understanding the influence of gender and various life stages among the intraspecific behaviors of *Capra aegagrus blythi.*

## MATERIALS AND METHODS

**Study site:** This study was conducted at Lahore Zoo Lahore that is situated on Shahrah-e-Quaid-e- Azam (The Mall Road) Lahore. The zoo spans 25 acres and is ex-situ conservation site for variety of animals including mammals, birds and reptiles.

**Study Animals and Captive Management:** The study was conducted on group of Sindh Ibex being captive at Lahore Zoo. The habitat of Sindh Ibex is surrounded by strong iron fence. The overall captive area was of 7875 square feet. The area is designed to mimic their natural habitat with stony or hilly surfaces and flora suitable for this species. Appropriate diet, feeding spots, water supply and proper veterinary care is managed for them.

**Description of Animals under observation:** There is total five number of individuals having different genders and age. Here is the view of life stages and age of all individuals of Sindh Ibex.

**Table 1.1: Life stages of captive Sindh Ibex with respect to age at Lahore Zoo.**

| Life stages | No. of individuals | Age |
|---|---|---|
| Adult stage | One male | 2.5 years |
| | Lactating female A | 3.5 years |
| | Lactating female B | 2 years |
| | Non lactating female 1 | 1.5 years |
| | Non lactating female 2 | 1.5 years |

**Behaviors under observation:**

- **Feeding:** It refers to the set of actions and physiological processes by which an organism selects, consumes, and digests food to meet its nutritional needs.
- **Resting:** It is the act of lying down, sitting, or remaining still, and may occur during both wakefulness and sleep.
- **Grooming:** One ibex licks or nibbles another to clean or maintain social bonds.

- **Nursing:** Mother allows young to suckle.
- **Exploratory:** Investigation in surroundings especially for food or shelter.
- **Territory:** A defined area that an animal or group defends against others.
- **Climbing**: Rests on elevated rock platforms to keep a lookout and avoid danger.
- **Foraging**: Act of gathering and searching food resources in surroundings.
- **Territory**: A specific area defended by an individual or groups.
- **Lactation**: A process of milk production to nourishing offspring or kids.
- **Social interaction**: Forming herds for protection and social bonding.
- **Maternal behavior**: Care given by mother to kids.
- **Ruminating**: Re chewing the food to break it into pieces.
- **Alertness**: State of vigilance to detect any harm or threat.

## METHODOLOGY

**Sampling method:** Focal sampling and scan sampling methods were used to observe their behaviors at regular intervals. This research was conducted in March. This was the lactation period of Sindh Ibex starting just after gestation period usually in spring season. The data was collected for five days. The readings were taken three times a day (Morning, Noon, Afternoon). The duration of each reading was of two hours. The temperature was moderate about 30 degrees Celsius.

**Statistical analysis:** As all individuals were kept at same site for observing the intraspecific behaviors among them so we applied Wilcoxon Signed Rank test to observe the effect of gender and life stages on behavioral frequencies of Sindh Ibex.

## RESULTS

**Behavioral differences between Male and lactating Females**: The behavioral comparison was conducted between a male and both lactating females in table 1.2. It shows that Foraging and Resting behaviors have a significance difference ($p<0.005$) while Territory, Nursing and Maternal behaviors are highly significant ($p<0.001$).

Whereas there is no significance difference between alertness, grooming, ruminating, feeding, climbing, social interaction and exploratory behaviors.

**Behavioral differences between Male and non-lactating Females:** In table 1.3, Ruminating, Territory, social interaction, Alertness and Feeding behaviors are highly significant ($p<0.001$) a, exploratory, climbing, foraging, resting and grooming behaviors are not significant at all.

**Behavioral differences between lactating and non-lactating Females:** In table 1.4, Nursing, grooming, lactation and maternal behaviors have high significant difference ($p<0.001$). While all other behaviors including Alertness, social interaction, foraging, exploratory, ruminating, feeding and climbing behaviors are not significant.

**Table 1.2: Behavioral differences between male and lactating females.**

| Behaviors | Females (N=2) Mean ± SD | Male (N=1) Mean ± SD | Significance level |
|---|---|---|---|
| Climbing | 4.60 ± 1.14 | 4.60 ± 2.07 | NS |
| Exploratory | 3.20 ± 0.84 | 4.00 ± 1.87 | NS |
| Feeding | 5.40 ± 2.07 | 5.20 ± 0.84 | NS |
| Ruminating | 3.00 ± 1.58 | 3.20 ± 0.84 | NS |
| Grooming | 4.00 ± 1.58 | 2.80 ± 0.84 | NS |
| Foraging | 6.00 ± 1.00 | 4.40 ± 0.55 | * |
| Maternal | 4.40 ± 1.14 | 0.00 ± 0.00 | ** |
| Resting | 5.40 ± 1.14 | 2.80 ± 0.84 | * |
| Nursing | 4.40 ± 1.14 | 0.00 ± 0.00 | ** |
| Alertness | 3.40 ± 1.34 | 3.80 ± 0.84 | NS |
| Territory | 0.00 ± 0.00 | 5.00 ± 0.71 | ** |
| Social interaction | 3.00 ± 1.58 | 3.20 ± 1.79 | NS |

SD= Standard Deviation
NS= Not significant (P>0.05)
*= Significant
**= Highly Significant

**Table 1.3: Behavioral differences between male and non-lactating females**

| Behaviors | Females (N=2) Mean ± SD | Male (N=1) Mean ± SD | Significance level |
|---|---|---|---|
| Climbing | 5.2 ± 1.30 | 5.4 ± 0.89 | NS |
| Exploratory | 5.0 ± 0.71 | 6.4 ± 1.14 | NS |
| Resting | 5.4 ± 1.34 | 5.2 ± 1.30 | NS |
| Foraging | 4.0 ± 1.22 | 4.8 ± 1.48 | NS |
| Social Interaction | 4.4 ± 1.14 | 2.2 ± 0.84 | ** |
| Alertness | 6.4 ± 0.89 | 1.2 ± 0.45 | ** |
| Feeding | 6.2 ± 0.84 | 7.4 ± 0.55 | ** |
| Grooming | 2.2 ± 0.84 | 2.2 ± 0.45 | NS |
| Territory | 6.6 ± 1.14 | 0.0 ± 0.00 | ** |
| Ruminating | 3.8 ± 0.84 | 5.2 ± 0.45 | ** |

**Table 1.4: Behavioral differences between lactating and non-lactating females**

| Behavior Pattern | Lactating Females (N = 2) Mean ± SD | Non-Lactating Female (N = 2) Mean ± SD | Significance |
|---|---|---|---|
| Climbing | 4.20 ± 0.84 | 4.80 ± 0.84 | NS |
| Feeding | 6.20 ± 1.30 | 6.80 ± 0.84 | NS |
| Ruminating | 4.60 ± 0.89 | 5.00 ± 1.00 | NS |
| Grooming | 5.20 ± 1.30 | 2.20 ± 0.45 | ** |
| Exploratory | 4.40 ± 1.14 | 5.20 ± 0.84 | NS |
| Foraging | 3.60 ± 1.14 | 4.80 ± 0.84 | NS |
| Maternal | 5.00 ± 0.71 | 0.00 ± 0.00 | ** |
| Lactation | 5.20 ± 0.84 | 0.00 ± 0.00 | ** |
| Nursing | 4.40 ± 1.14 | 0.00 ± 0.00 | ** |
| Alertness | 3.80 ± 0.84 | 3.00 ± 1.00 | NS |
| Social Interaction | 4.40 ± 1.52 | 2.60 ± 1.14 | NS |

## DISCUSSION

This study provides us critical insights about differences in behaviors of whole group including Lactating females, male and non-lactating females of Sindh Ibex due to impact of gender and life stages. These observations clearly claim and support the previous research studies that sexual dimorphism and maternal care have a major role in shaping behaviors in captivity (Clutton- Brock, 1991; Ralls, 1997). From this study it clearly indicates that lactating females have higher frequencies of behaviors including maternal, nursing, lactation and grooming. Also, due to these costly activities of lactating females the higher frequencies of exploratory and resting behaviors are highly observed. The same patterns like maternal investment and nursing are correlated or synchronized with mountainous ungulates where these behavioral patterns decrease the vigilance and locomotion of them (Smith *et al*., 2016; Khan *et al*., 2019). It means in lactation season mother-kids bond is very strongly created where mother feed is a significant factor, it increases maternal nursing and grooming behavioral frequencies among mother and kid, as the kid grows older the suckling behavior reduces with passage of time (Du and Sheng, 1996) many other interactive bond occur among lactating females, newborns, other females and peer groups (Meng *et al*., 2003). In comparison the territory and alertness behaviors are highly dominating behaviors among males. Territoriality and scent markings are well developed behaviors in wild *Caprinae* species and are thought to mediate social hierarchy and mate competition (Johnson & Munshi-South, 2017).

Ruminating and resting behaviors are most frequently occurring behaviors in non lactating females than other females and males. The reason of such behavioral differences is due to their reduced energy as they don't spend much of their energy in lactation, nursing or grooming the newborns. They spend a little energy on food digestion or behavioral maintenance. This is also proved from previous researches that reproductive load, especially lactation can suppress feeding in favor of offspring care (Ruckstuhl & Neuhaus, 2002).

Exploratory and climbing behaviors are those behaviors which did not change significantly across most groups, that predicts that general activities remain stable regardless the reproductive role in captivity. The separation of maternal, lactation and nursing behaviors of lactating females validate their role as bio indicators in reproduction in captivity. The complete absence of such behaviors in non lactating females and males further support their role in behavioral diagnostics.

Behavioral patterns not just affected by the gender and life stages but also the enclosures with specific natural habitats shape the normal and significant behaviors of Sindh Ibex. This captive area was properly managed having two feeding points, a specific place for drinking water and bath, also enrichment is provided that can be a good impact on Ibex. The strong iron fencing provides a large protective area and avoids them from any external threat or stimuli. Male also plays the role of territorial dominance and leads the whole group and also can use scent markings in wild area to defend its area from other males of same or another group.

Declining in their population and behavioral disturbance is also due to environmental factor. Recent studies shows that Ibex species or populations are declining due to habitat destruction, overgrazing and poaching (Tichon *et al*., 2023). The negative impacts of habitat loss and human interference on Ibex populations in Thar Desert was also reported by Geholt and Jakher (2011).

To protect Ibex populations from further damage, steps to conserve the species like ex-situ conservation and habitat restoration should be taken.

The results of the study highlight the importance of considering both gender and physiological role when assessing welfare and designing captive environments. Enclosure structure, enrichment and group composition should accommodate sex specific and age specific behavioral needs to promote naturalistic expression and psychological well-being in captive Sindh ibex populations.

**Conclusions:** This study demonstrates that both ontogenetic and sexual status significantly influence the intra-sexual behaviors of Sindh Ibex. Males exhibited greater territoriality and alertness, while lactating females exhibited high maternal care, nursing and grooming behaviors and non-lactating females showed intermediate behavioral patterns. These differences highlight the

importance of sex and stage specific management strategies in captive environment.

**Recommendations:** It is recommended that enclosure design should accommodate the specific needs such as separate or partitioned zones for lactating females. Male should provide spatial enrichment like scent marking zones to support their need for dominance display and environmental scanning. Additional longitudinal studies should be encouraged to monitor how behaviors change with age, season, offspring number and environmental enrichment.

**Authors' Contributions:** MA, KS, MMK and MRK helped in designing study plan, provided resources for its execution. AS, JM, FH, GA and AS recorded and compiled data set along with write up of manuscript while SSIB and RA provided support in data analysis proof reading.

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