

Research Article



Comparative behavioral changes in hand reared African lion (*Panthera leo*) cubs

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Abstract | African Lion (*Panthera leo*) is the most attractive exhibit of zoos and safaris. For the better management of this vulnerable species, particular attention should be given to breeding plans. It is common at captive sites that lioness completely neglects newborns; generally, at that stage hand rearing is preferred. However normal growth and better social behavior of hand reared cubs depend upon the quality and regularity of care given by professional staff. This study is valuable to highlight the behavioral changes in lion cubs adopted during hand rearing. A total of 5 cubs (3 males and 2 females) abandoned by lionesses in 2017-18 at Safari Zoo Lahore were successfully hand reared and shifted to 03 sub-adult lion's enclosure after keeping them at veterinary complex for initial four months' period in a temporary made card board enclosure. These cubs were adjusted to new environment very easily. The recorded behaviors for these cubs were hunting, aggression, playfulness, interaction with humans, territory marking, routine pacing, nursing of females and mating behavior of males. Five other lion cubs nursed naturally with their lionesses were also observed for comparative behavior study. All the hand reared animals were found significantly different in observed behaviors as compared to the naturally nursed animals by

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1. Introduction

Lions are the most sociable of all wild cats, and they typically live in prides ([Alden, 1995](#); [Black et al., 2000](#)). One of the most well-liked animal species housed

in zoos is the lion (*Panthera leo*) ([Bradshaw, 2016](#)). *Panthera leo* consists of cats that can be found throughout Asia, West, Central, and North Africa ([Dubach et al., 2005](#); [Kitchener et al., 2017](#)). Lions are classified as vulnerable in the wild,

where they have lost 92% of their historic habitat which has plummeted to 43% during the past two decades, leaving only an estimated 23,000–39,000 individuals which are still roaming free ([Bauer et al., 2015](#); [Bar-On et al., 2018](#)). African lions are threatened and today only exist in 67 populations throughout Africa ([Riggio et al., 2013](#)). The Asiatic lion (*Panthera leo persica*) is listed as Endangered species on the International Union for Conservation of Nature's (IUCN) Red List of Threatened Species ([Breitenmoser et al., 2008](#); [Schnitzler and Hermann, 2019](#)).

Human persecution, habitat loss and fragmentation have drastically reduced their numbers in the wild since early 20th century ([Nowak, 1999](#)). Out of all vertebrate animals, the lion's range has decreased the most since prehistoric times ([Yamaguchi et al., 2009](#)). Due to their top-of-the-food-chain positions, carnivores' distribution and behavioral reactions are influenced by the distribution of their prey in respect to important resources, which in turn is modified by the availability of structural and functional resources of the systems to which they belong ([Valeix et al., 2011](#)).

Due to their importance to the conservation effort, members of the *Felidae* family have long been kept in captivity in sites all around the World ([Brodie, 2009](#)). About 29 out of the 36 species of the *Felidae* family are classified by the International Union for the Conservation of Nature (IUCN) as having a declining population trend and the advantages of confinement can help to solve this issue ([Dickman et al., 2015](#)). Controlled breeding programmes that lessen the risk of extinction, safety from predators, and protection from competition are a few advantages of being in captivity ([Tidière et al., 2016](#)).

After an approximately 100–113-day gestation period, the pregnant lionesses

briefly separate from their prides to give birth in a secretive thicket or another suitable hiding place ([De Waal et al., 2004](#)). Numerous researchers have reported on lioness' estrus cycle, ovulation, conception rate, and gestation time ([Packer and Pusey, 1995](#); [Callealta et al., 2020](#); [Azam et al., 2023](#)). The reproduction of lions is restricted by food. Four cub litters fare best when there is an abundance of prey, and survival rates decline as prey levels fall. A generation lasts roughly seven years. Additionally, infanticide by male lions and times of a lack of prey are linked to 27% of offspring mortality. In captivity, lionesses can live up to seventeen years, but after three to four years, their mortality begins to fall and then quickly rise. The average male age is 12 years, with a maximum age of 16 years ([Green et al., 2020](#)).

At various zoological parks in Asia, approximately 153 Asiatic lions are said to exist ([Goswami et al., 2020](#)). Wild animals must be raised by hand, which can be extremely difficult yet is essential if in the absence of adequate maternal care. Hand-rearing has an extremely low success rate. The procedures for raising wild animals by hand vary depending on the species ([Goswami et al., 2023](#)).

2. Materials and Methods

2.1. Study area

Present study was conducted at Safari Zoo, Lahore. The selected site is situated at about 32 km from the main Lahore City on Raiwind Road and about 12 km from Thokar Niaz Baig Chowk (31° 22' 57" N, 74° 12' 47" E and elevation 208m) in District Lahore, Punjab, Pakistan. Safari zoo Lahore is constituted over an area of about 240 acres. It leads a 1.3 km road from Lahore Raiwind Road to the main Park entrance. Out of the total 240 acres, about 30 acres are occupied by the lion and tiger safaris. There is a 68450-square-foot open space and 653,400-square-foot

lion safari. The open space includes a sizable swimming pool, native trees, man-made dwellings, and vast grassland areas. The covered space has four rooms: two for sleeping on the back side and two for displaying animals on the front, each with protective grills ([Figure 1](#)).



Figure 1: Map of the Safari Zoo

A total of 10 lion cubs were included in following study, among which; five lion cubs (three males and two females) were hand reared which were abandoned by lionesses in 2017-18 at Safari Zoo Lahore. These five lion cubs were studied alongside 5 lion cubs that were nursed naturally with their lionesses for comparative behaviour study. Lion cubs born during 2017-18 at Safari Zoo Lahore were included in the study and their behavioural changes were recorded till their first breeding. Hand reared lion cubs were shifted to lion's enclosure in Veterinary Hospital after keeping them at veterinary complex for initial four months' period in a temporary made card board enclosure, while naturally nursed lion cubs were kept at 15 acres Lion Safari enclosure along with their ancestors.

2.2. Data Collection

Data was collected from Safari Zoo Lahore through frequent visits.

3. Results

3.1. Hand reared lion cubs

Hand reared five lion cubs were divided into two main categories based on gender

(male and female). The group cub 01, 02 and 03 included males and group cub 04 and 05 included females. The behaviour evaluation, time period and grading is presented in [Table 1](#). [Table 2](#) summarizes the behavioral changes observed in lion cubs such as hunting, aggression, playfulness, interaction with humans, territory making, routine pacing, nursing of females and mating of males.

In cub 01 (male), hunting, aggression, territory marking was observed less and the animal was less interested in mating. However, playfulness and interaction with humans was more prevalent. In cub 02 (male), hunting, aggression, territory marking, routine pacing was less present, and mating behavior was normal. Playfulness and interaction with human was more prevalent. In cub 03 (male), 04 (female), 05 (female), hunting, aggression, territory marking was less present while playfulness and interaction with human was more prevalent. Nursing behavior in cub 04 was normal and it did not exhibit any aggression however, in cub 05 nursing behavior was accompanied by aggression.

Statistically, all the hand reared animals were found significantly different ($p < 0.05$) in all observed behaviors as compared to the naturally nursed animals except for two hand reared animals ($p > 0.05$) i.e. one male and one female with respect to reproductive behavior by using Fischer Exact Test ([Table 2](#)).

3.2. Naturally nursed lion cubs

Naturally nursed five lion cubs were divided into two main gender-based categories of male and female. Lion cubs in group 01 and 02 were males while lion cubs in group 03, 04 and 05 were females. [Table 3](#) exhibits the observed behavior changes like hunting, aggression, playfulness, interaction with humans, territory making, routine pacing, nursing of females and mating of males with naturally nursed cubs.

Table 1: Behavior, evaluation time period and evaluating grades

Behavior	Behavior Evaluation time and period	Behavior Evaluating Grades		
Aggression	At time of feeding and interaction till 2021	Normal	Less	More
Playfulness	At time of interaction till 2021	Normal	Less	More
Interaction with humans	At time of feeding, cleaning of cage and visitors till 2021	Normal	Less	More
Territory marking	At time of urination in adult aged males	Normal	Less	Excessive
Routine pacing	Before feeding or in the evening or any free time of day in all ages	Normal	Less	Frequent
Nursing by females	After cubing of females	With aggression	No aggression	Not nursing
Mating in males	At adult age of males	Normal	Less interested	Not interested
Hunting	When any encountered with other animal/reptile/rodent from age of three months	Normal	Less	More

Table 2: Behaviors observed in hand reared lions

Behavior	Cub 01 (M)	Cub 02 (M)	Cub 03 (M)	Cub 04 (F)	Cub 05 (F)	p-value
Hunting	Less	Less	Less	Less	Less	0.008
Aggression	Less	Less	Less	Less	Less	0.008
Playfulness	More	More	More	More	More	0.008
Interaction with humans	More	More	More	More	More	0.008
Territory marking	Less	Less	Less	Less	Less	0.008
Routine pacing	Less	Less	Less	Less	Less	0.008
Nursing by females	-	-	-	No aggression	With aggression	0.4
Mating in males	Less interested	Normal	Less interested	-	-	0.4

Table 3: Behaviors observed in maternally nursed lions

Behavior	Cub 01 (M)	Cub 02 (M)	Cub 03 (F)	Cub 04 (F)	Cub 05 (F)
Hunting	Normal	Normal	Normal	Normal	Normal
Aggression	Normal	Normal	Normal	Normal	Normal
Playfulness	Normal	Normal	Normal	Normal	Normal
Interaction with humans	Normal	Normal	Normal	Normal	Normal
Territory marking	Normal	Normal	Normal	Normal	Normal
Routine pacing	Normal	Normal	Normal	Normal	Normal
Nursing by females	-	-	-	With aggression	With aggression
Mating in males	Normal	Normal	Normal	-	-

The comparative behavioral characteristics of hand reared and naturally nursed lions are illustrated in the [Figure 1](#).

4. Discussion

The survival of species having very small and highly threatened remnant populations in the wild such as the Asiatic lions, may ultimately depend on managed captive reserve populations such as those provided by Zoological gardens and Safaris. Lion cubs rely on maternal care for up to the ages of three to six months ([Hakala and Traylor-Holzer, 1994](#)). When the mother lioness is either incapable or is not

providing adequate care to the cubs, hand-rearing remains a last resort ([Hampson and Schwitzer, 2016](#)). Neonatal development is a sensitive process, since newborns are blind and have limited control over their motor, sensory, and excretory systems, their first few days are crucial. This highlights the need for hand-rearing newborns ([Gehlot et al., 2020](#)).

In present study, the age and gender-wise behaviours of both captive- and wild-born prides showed different patterns. However, no extraordinary difference in behaviours was observed. The hand reared cubs were less aggressive.

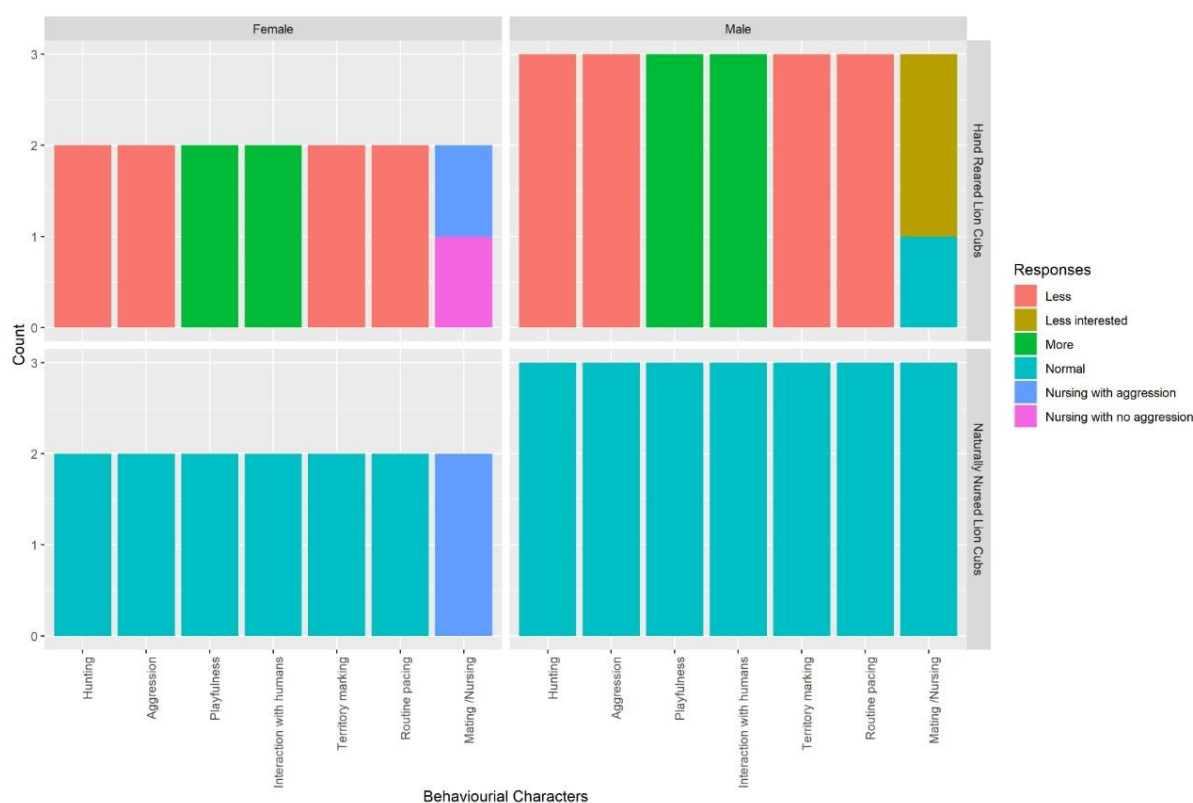


Figure 1: Comparative behavioural characteristics in hand reared and naturally nursed lions

Mild behaviours of hand reared or imprisoned animals in comparison with their wild counterparts can be described as artificial selection to adapt to their environment, which frequently favors animals that are more passive and less aggressive. However, normal aggression in naturally reared animals as natural selection leads to normal behavioural development (Dunston *et al.*, 2017).

Lions often spend a larger percentage of their time sleeping. This behaviour was observed in mother-reared cubs which were seen spending more time sleeping and little time moving around, which may be attributed to their confinement in cages (Ncube and Ndagurwa, 2010). Hand reared cubs in present study were observed as being playful and sociable around humans. In wild, female lions carefully tailor their behaviour in conflict situations in accordance with the number of individuals in opposing groups. This

suggests that making a wrong decision to approach a wild female or her cubs can be an expensive one (McComb *et al.*, 1994; Najera *et al.*, 2011). No such threats are presented to hand-reared lions, due to which territory marking behaviour was less pronounced in hand-reared lions in comparison with maternal reared cubs.

5. Conclusions

Hand-rearing can modify behaviors of cubs which are observed frequently in their wild counterparts, such as aggression, playfulness, interaction with humans, nursing and mating behaviors. However in the absence of adequate material care, hand-rearing is the last resort and becomes essential to ensure the survival of the abandoned cubs.

6. Acknowledgments

Authors acknowledge the management at Safari zoo Lahore.

7. Author's Contribution

All authors have contributed equally towards this publication.

8. Conflict of Interest

There is no conflict of interest.

9. Novelty Statement

Current study provides comparative information about the impact of hand-rearing practices on behavior of captive lions based on their age and gender. This study can become useful in the development of veterinary and hand-rearing protocols for healthy breeding and rearing of wild cats in captivity.

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