International Journal of Science and Research Archive

eISSN: 2582-8185

Cross Ref DOI: 10.30574/ijsra

Journal homepage: https://ijsra.net/

(RESEARCH ARTICLE)

Check for updates

Breeding behavior of captive ungulates of Central India: A case study of Kanan Pendari Zoo, Chhattisgarh

Sandhya Kaushik * and Manoj Singh

Department of Zoology, Kalinga University, Naya Raipur, Chhattisgarh-492101.

International Journal of Science and Research Archive, 2025, 15(01), 1874-1879

Publication history: Received on 2 March 2025; revised on 5 April 2025; accepted on 10 April 2025

Article DOI: https://doi.org/10.30574/ijsra.2025.15.1.1062

Abstract

Kanan Pendari Zoo is situated in Bilaspur of Chhattisgarh. This Zoological Garden is extended over 114 hectares of land. The garden is covered with dry and deciduous flora. The garden was established to conserve the wildlife species which were put under different schedules of Wildlife Protection Act-1972. The garden harbors distinct varieties of flora and fauna. The zoo was established in 2004-2005.The zoo belongs more than 50 species of animals. The present study was undertaken to examine the breeding behavior of some captive ungulates in Kanan Pendari Zoo of Bilaspur Chhattisgarh. The results on breeding behavior of *Axis axis, Cervus unicolor*, and *Antilope cervicapra* was determined and it was found that the major breeding behavior like smelling, flehmen, scratching, rutting, conflict, mounting, chasing, and courtship were reported. Several earlier studies carried out in India on wild ungulates are descriptive and have not been able to justify quantitative behavioral responses. The general and breeding behavioral responses were analyzed for a prolonged time period of a day, continuously during different seasons for two years enabling to understand the whole story of origin of stress, production of stress induced behavioral response and consequences of these immediate changes over a period of time noted as alterations of general and breeding biology associated behavioral characteristic. Quantitative categorization in terms of time activity budgeting critically compared the activities of animals during day and night through different seasons. In India, the ungulates in captivity have been studied very less for comprehensive behavioral character analysis during different seasons. Earlier studies were carried out at least two decades before when in most of the Indian zoos, the animal population size was comparatively low, the cages were small and simple and the role of behavioral science in captive conservation and management was not much understood. Although, these studies also aimed at focusing the management necessities, somehow it was not achieved in the context of its length and breadth of applicability.

Keywords: Captive Animals; Zoos; Kanan Pendari; Breeding Behaviour

1. Introduction

Ungulates have been classified into two orders viz; the even-toed (order Artiodactyla) and uneven-toed (order Perissodactyla), collectively constitute about 257 species of ungulates (Jennings and Gammell, 2013). They inhabit all continental regions of world, with the exception of the Antarctic, and make up the bulk of big herbivores. From monogamous couple bonds to a variety of big group polygamous breeding systems, these orders diversified membership and extensive geographic spread are represented in a complex spectrum of social systems. Competition to get or maintain access to resources is a common trait in ungulate communities, despite their diversity and complexity. The general behavior of ungulates differs from species to species, even the overall behavior of same species varies from one locality to another (Lewis, et.al., 2022). Across different behavioral aspects of ungulates, the breeding behavior is considered to be the critical, as the breeding behavior determine the future structure of the ungulate community (Widen, 2023). The breeding behavior of ungulates has been well studied from the past few years, but as earlier stated that this behavior changes from one habitat to another.

* Corresponding author: Sandhya Kaushik

The breeding behavior of ungulates in their natural habitat varies from the captive environment (Ehlers, 2022). From past few decades the population of ungulates is facing serious threat from both natural and anthropogenic causes (Shi, et.al., 2023). Many species of ungulates are becoming vulnerable and endangered. One of the major causes the species of ungulates are becoming endangered by the natural and anthropogenic factors was the alteration in their social and breeding behavior (Yang, et.al., 2024; Champagnon, et.al., 2023;). This has restricted their population sprawl. Keeping in view this aspect of ungulates the conservation biologists have stressed on the ex-situ conservation of these species (Tang, et.al., 2020). One of the major reasons of the ex-situ conservation of any species is to enhance their breeding (Dolman, et.al., 2015). Across the globe different man-made habitat (Captive Habitat) has been developed to conserve different endangered species (Sutherland, 1998). The animals in captivity are not exposed to natural threats, community interactions or risk of reproductive failure (Lindburg and Fitch, 1994). However, the influencing factors may be different and may be integrated differently with other such factors leading to much variable set of conditions. Thus, these varying factors also influence the breeding behavior of the captive animals. The appropriate evaluation of behavior displays can indicate/advise/guide the personnel about the changing conditions and requirements of ungulates (Hutchins and Geist, 1987).

India is blessed by diverse geo-climatic conditions. These geo-climatic conditions gave rise to the diverse biological diversity (Abbas, et.al., 2017). There are 34 ungulate species reported in India (Ahmad, 2022). Out of total ungulate species 21 species are put in the protected schedule of Wildlife Protection Act-1972 (Daniel, 1991). This status of ungulates determines the ultimate need of their conservation. The formation of zoos has been one of the older concepts of animal conservation and research so far has also generated huge data on animal ecology and behavior in captivity (Hosey, 2013). However, since the conditions/conservation strategies/short term-long term management pians/etc in distant part of the world may not be applicable to the captivity status in India/Indian states. Therefore, such comprehensive studies are encouraged by the Department of Environment and Forests/Central Zoo Authority of India to generate data that may contribute to the conservation and management in captivity in Indian zoos. Keeping in view the need of research on breeding behavior of ungulates this study was conducted. Thus, the present study was conducted to determine the breeding behavior of some ungulates of central India in captive habitat.

2. Research methodology

The present study aims to study the breeding behavior of some ungulates of Kanan Pendari Zoo of Bilaspur, Chhattisgarh. The study was conducted between Jan-2023 to May-2023. Following methods were adopted to conduct this study

2.1. Study Area

Kanan Pendari Zoological Garden situated in Bilaspur of Chhattisgarh. The Zoological Garden is extended over 114 hectares of land. The garden is covered with dry and deciduous flora. The garden was established to conserve the wildlife species. The garden harbours distinct varieties of flora and fauna. The zoo was established in 2004-2005.The zoo belongs more than 50 species of animals from majestic tigers to giant hippopotemus and mischievous snakes, Kanan Pendari Zoo is a have a diverse group of animals. One of the main objectives of the zoo management is to create awareness and love for the wild life among the general public. Creating a sense of participation and attachment to the zoo animals create bonding and a sense of involvement. Adoption of zoo animals is very popular in international zoos and several Indian zoos have started this practice. Besides bonding this also provide a source of revenue for better zoo management and for better up keep of animals. it is one of the oldest zoos in the country, the cages meet the present caging requirements prescribed by the Central Zoo Authority of India.

2.2. Study Ungulates

Two species of deer and one species of antelope were studies in captive conditions. The taxonomic description of the study animals is:

Phylum : Chordata,

Class: Mammalia,

Order: Artiodactyla

Table 1 The scientific classification of sampled ungulates

S.NO	Family	Sub-Family	Genus Species	Local Name
01	Cervidae	Cervinae	*Axis axis*	Spotted Deer
02	Cervidae	Cervinae	*Cervus unicolor*	Sambar Deer
04	Bividae	Bovinae	*Antilope cervicapra*	Black Buck

2.3. Sampling Method

For present studies direct focal animal sampling was used. The selected and marked animals (male, female and fawn/sub adult, one each for each species) were continuously observed for the time period as detailed above. Time budget (mean proportions of time spent active) activity was considered for noting behavior displays and activities. Here time budget was considered for all the activities and therefore the data were recorded as actual time spent doing a particular activity (minutes per hour per day). Present observations, therefore, do not simply indicate active bouts and inactive stages but elaborately describe different activities individually.

2.4. Breeding Behavioral Patterns of ungulates Recorded During the Study

The activities and displays were classified into three major categories as general behavior patterns, reproductive behavior patterns and parental care. The movement in cages was further sub divided into short and long distance movements and running since the cage size was large in present case and therefore the animal had an opportunity of exhibiting near natural locomotory activities.

Breeding behavioural pattern was recorded for focal animal at different times of the day and night. Time spend on each activity mentioned herein was recorded and mean time invested per hour per day was calculated.

2.5. Reproductive Behavior Patterns Courtship Display

2.5.1. Courtship display

- **Chasing (Ch):** Time spent for chasing male / female / fawn, for food or mating or territory marking.
- **Conflict (C):** Time spent for fighting with other male / female / fawn.
- **Smelling (S):** Number of times it smells within the cage area and also other animals in the same cage.
- **Flehming (FI):** Number of times it displays flehmen response.
- **Scratch antler (S Ant):** Time spent for scratching antlers to remove velvety.
- **Rutting (Rt):** Time spent for rutting with other male / fawn.
- **Mating call (MC):** Number of mating calls.

2.5.2. Copulatory display

- **Mount (M):** Number of time it mounts on female (adult/sub-adult)/other males.
- **Matirijg;(Ma):** Successful mating events with females (within breeding / non-breeding seasons).

3. Results and discussion

3.1. General Description of Ungulates

3.1.1. Spotted Deer (Axis axis)

The chital or cheetal (*Axis axis)* also known as the spotted deer, chital deer and axis deer, is a deer species native to the Indian subcontinent. It was first described and given a binomial name by German naturalist Johann Christian Polycarp Erxleben in 1777. A moderate-sized deer, male chital reach 90 cm (35 in) and females 70 cm (28 in) at the shoulder. While males weigh 70–90 kg (150–200 lb), females weigh around 40–60 kg (88–132 lb). It is sexually dimorphic; males are larger than females, and antlers are present only on males. The upper parts are golden to rufous, completely covered in white spots. The abdomen, rump, throat, insides of legs, ears, and tail are all white. The antlers, three-pronged, are nearly 1 m (3 ft 3 in) long.

3.1.2. Sambar Deer (Cervus unicolor)

The appearance and the size of the sambar vary widely across its range, which has led to considerable taxonomic confusion in the past; over 40 different scientific synonyms have been used for the species. In general, they attain a height of 102 to 160 cm (40 to 63 in) at the shoulder and may weigh as much as 546 kg (1,204 lb), though more typically 100 to 350 kg (220 to 770 lb). Head and body length varies from 1.62 to 2.7 m (5.3 to 8.9 ft), with a 22 to 35 cm (8.7 to 13.8 in) tail.[4] Individuals belonging to western subspecies tend to be larger than those from the east, and females are smaller than males. Among all living cervid species, only the moose and the elk can attain larger sizes. The large, rugged antlers are typically rusine, the brow tines being simple and the beams forked at the tip, so they have only three tines. The antlers are typically up to 110 cm (43 in) long in fully adult individuals. As with most deer, only the males have antlers.

3.1.3. Black Buck (Antelope cervecapra)

The blackbuck is a moderately sized antelope. It stands up to 74 to 84 cm (29 to 33 in) high at the shoulder; the head-to-body length is nearly 120 cm (47 in). In the population introduced to Texas, males weigh 20–57 kg (44–126 lb), an average of 38 kg (84 lb). Females are lighter, weighing 20–33 kg (44–73 lb) or 27 kg (60 lb) on average. Sexual dimorphism is prominent, as males are heavier and darker than the females. The long, ringed horns, that resemble corkscrews, are generally present only on males, though females may develop horns, as well. They measure 35–75 cm (14–30 in), though the maximum horn length recorded in Texas has not exceeded 58 cm (23 in). The horns diverge forming a "V"-like shape. In India, horns are longer and more divergent in specimens from the northern and western parts of the country

3.2. Breeding Behavior of sampled ungulates

3.2.1. Smelling

is an activity almost equivalently done by the selected ungulates. Very little variations were noted among them. Even no specific seasonal or annual variations were noted. The smelling activity is a daylong activity and also associated with; -other activities. While feeding, locomotion, resting, urination and breeding displays the smelling activity is carried out. In wild this forms a significant activity as the olfactory cues are important for protection, routine movement and breeding. In captivity threat of predation is not at all there so the activity is much reduced as compared to wild. Further, in captivity the cages of different animals viz; herbivore or carnivore are nearby and therefore, the olfactory cues may be stereotype also. The movement of other animals outside the cage (like cats and monkeys), particularly during night and the presence of visitors during day induce smelling activity also, specifically in blackbuck and spotted deer. The animals smell the sites which are marked by themselves or by others. The buck smells its routine resting place also prior to occupying it.

3.2.2. Flehming

is very peculiar breeding associated activity, although overall time spent during the day is less. In wild the flehming is most prominent in buck during pre-breeding and breeding season. In captivity the buck spent least time as compared to that by doe and fawn. Probably the buck easily identifies adult doe suitable for mating and therefore, flehming of different doe is not required. The fawns of sampled ungulates which stays with the doe carries out this activity more frequently. The adult does flehmens the sub adult doe following urination and if the doe is in heat then it will be chased by adult doe and separated from the group so that opportunity of mating with dominant buck is secured. Non specific flehming by buck increases in summer. During monsoon the water washes off the sites of urination and therefore flehming is non-specific and less frequent. The antler shedding is seen during post monsoon and therefore also the flehming activity is less and non-specific. Some year-wise variations in the activity of doe and fawn were noted during the study period.

3.2.3. Scratching

antler is a direct breeding associated activity. During early winter the buck scratches the antler to remove the velvety skin of antler and then gradually sharpens the tip of main axis of antler. The initial scratching is carried out by rubbing the antlers with the fencing of the cage. Later on, this is done by scratching the antler with the stem of the trees. The activity is wild is time consuming and depends on modes of establishing dominance, the number of ungulates and the season. The ungulates in wild scratches the antlers at various places and also by doing so establish territory. However, in captivity such peculiarity of ethogram is not seen. In present study the adult doe had delivered a fawn in late winter and therefore, subsequently the doe was in heat during late winter to early summer period the next year. Correspondingly in the buck, the antler scratching activity was a bit delayed and the sharp and hard antlers were ready

following the onset of summer. The fawn also spends some time in scratching the small antler. Since this also is buck specific phenomena, comparison with other sex or age group cannot yield any noted information.

3.2.4. Rutting

is pre conflict activity in adult bucks and at times a play activity in fawn and sub adult. The growing buck fawn learns the tactics by indulging in such activities. Rutting in winter is mainly pre conflict act. Since this is and activity associated with the use of antlers it is not seen in does. The correlation between day and night activity in adult buck and the buck fawn showed a positive correlation. The average of annual activity suggested that during the two years of study the overall pattern and time spent for the activity was almost equivalent. The fawn at a younger stage did not show any such activity but when the antlers were grown in about six months after birth, the activity was seen. Therefore, absence of activity in fawn is actually because of nonexistence of antler at younger age. The rutting is mostly seen at feeding points during winter and summer and after flehming the adult doe during breeding season. The peak rutting was seen during 00.00 to 03.00 hrs, particularly in summer.

3.2.5. Conflict

The conflict is a specific feature prominently seen in wild. During winter it's for establishing dominance during breeding season and to attract the doe. During winter or monsoon, it is mainly to push away the other buck from feeding site, resting site or even just pushing away from the sub adult doe. In captivity, however, the conditions totally differ and therefore wide variations are noted. In present study, during first year two adult bucks were housed in the cage and hence conflict was seen among them, while during second year only one buck was present in the cage and the size of cage was also bigger. Therefore, no sign of conflict was seen at all for adult buck, the activity with doe, in absence of buck conflict, can be considered only a game activity. Since the activity was absent during second year precise data was not available for this activity. The conflict in captivity is usually seen during early morning and late nights. In the presence of tourist generally the activity is not seen. In the wild the defeated buck leaves the territory of dominant buck and goes away. In the captivity the defeated ungulates remain within the cage itself. Several times this irritates the winning, dominant ungulates and it attacks the defeated ungulate several times leading to severe injury that may result in death also.

3.2.6. Mounting

is preparatory activity for mating. The adult buck does mount on adult doe when it is in heat. However, it may also do so on sub adult doe during summer or any other time of the year. The fawn carries out this activity for game and play. It usually tries to mount sub adult doe, although may try out on adult doe also. In present case mounting by adult was mostly evening specific activity and avoids mounting during the day when visitors are present in front of the cage. Further, the mounting was seen maximally during summer day and night as per the heating period schedule of the doe. The average time spent between two mount is usually 5-7 min during the breeding season. A very peculiar observation was noted in present study with reference to mounting an animal. The peak breeding season of doe was delayed in present case leading to delayed expression of characteristic behavior by the buck. The mounting was significantly delayed by the buck and therefore, the doe tried to mount the buck several times and thus excite the buck.

3.2.7. Chasing

other animal is a very common behavior during non-breeding season and is comparable with running or even playing. However, during breeding season the adult doe chase other adult or sub adult do so as to push them away frorth the feeding point, resting site of ultimately away from the buck/dominant buck. Similarly, if more than one buck is seen in the group the dominant buck will chase out the subordinate buck. For fawn this is however a play activity in early age. The chasing events were more spending more time during winter and summer while considering collective value of 24 hr. Prior to the breeding season, the buck or adult doe chase out other animal to establish their dominance and to occupy their own feeding, resting or urinating/defecating site. In captivity when new animals are introduced in the cage, the old residents of the cage chase them for few days trying to keep them away from their own regular sites of occupancy. So, in such conditions the non-specific (not associated with breeding) chase increases.

4. Conclusion

An overview of the findings of present investigations justifies the role of breeding behavior of ungulates in captive conditions. The breeding behavioral responses were not precisely gender specific annually, although in breeding season some age and sex specific variations were found. The routine occurrence of these behavioral bouts and identification of any modifications there in may give a clue to further describe the captive influences. Although, compared to wild, the types, range and intensity of influencing factors significantly reduce in the captivity, an understanding of these factors

and analysis of behavioral responses of animals can have management applications that can improve reproductive success. The Kanan Pendari Zoo is a major zoo in Chhattisgarh which have a diverse group of animals. The results on breeding behavior of ungulates viz *Axis axis, Cervus unicolor*, and *Antilope cervicapra* was determined and it was found that the major breeding behavior like smelling, flehmen, scratching,rutting, conflict, mounting, chasing, and courtship were reported. Several earlier studies carried out in India on wild ungulates are descriptive and have not been able to justify quantitative behavioral responses. The general and breeding behavioral responses were analyzed for a prolonged time period of a day, enabling to understand the whole story of origin of stress, production of stress induced behavioral response and consequences of these immediate changes over a period of time noted as alterations of general and breeding biology associated behavioral characteristic.

Compliance with ethical standards

Disclosure of conflict of interest

No conflict of interest to be disclosed.

References

[1] Abbas, Z., Khan, S. M., Alam, J., Ullah, Z., Khan, S. W., & Alam, N. (2017). Species, diversity and phyto-climatic gradient of a montane ecosystem in the Karakorum Range. Pakistan Journal of Botany, 45, 223-230.

[2] Ahmad, K. (2022). Ecology and Conservation of Mountain Ungulate in the Western and Trans Himalayas, India.

[3] Champagnon, J., Elmberg, J., Guillemain, M., Lavretsky, P., Clark, R. G., & Söderquist, P. (2023). Silent domestication of wildlife in the Anthropocene: The mallard as a case study. Biological Conservation, 288, 110354.

[4] Daniel, J. C. (1991). Ungulate conservation in India—problems and prospects. Applied Animal Behaviour Science, 29(1-4), 349-359.

[5] Dolman, P. M., Collar, N. J., Scotland, K. M., & Burnside, R. J. (2015). Ark or park: the need to predict relative effectiveness of ex situ and in situ conservation before attempting captive breeding. Journal of Applied Ecology, 52(4), 841-850.

[6] Ehlers, E. L. P. W. (2022). Spatial Behavior, Foraging, and Population Dynamics of a Subarctic Ungulate. University of Montana.

[7] Hosey, G., Melfi, V., & Pankhurst, S. (2013). Zoo animals: behaviour, management, and welfare. Oxford University Press, USA.

[8] Hutchins, M., & Geist, V. (1987). Behavioural considerations in the management of mountain-dwelling ungulates. Mountain Research and Development, 135-144.

[9] Jennings, D. J., & Gammell, M. P. (2013). Contest behaviour in ungulates. Animal contests, 210, 304-320.

[10] Lewis, K., Parker, M. O., Proops, L., & McBride, S. D. (2022). Risk factors for stereotypic behaviour in captive ungulates. Proceedings of the Royal Society B, 289(1983), 20221311.

[11] Lindburg, D. G., & Fitch-Snyder, H. (1994). Use of behavior to evaluate reproductive problems in captive mammals. Zoo Biology, 13(5), 433-445.

[12] Shi, F., Liu, S., An, Y., Sun, Y., Zhao, S., Liu, Y., & Li, M. (2023). Climatic factors and human disturbance influence ungulate species distribution on the Qinghai-Tibet Plateau. Science of The Total Environment, 869, 161681.

[13] Sutherland, W. J. (1998). Managing habitats and species. Conservation science and action, 202-219.

[14] Tang, R., Li, Y., Xu, Y., Schinnerl, J., Sun, W., & Chen, G. (2020). In-situ and ex situ pollination biology of the four threatened plant species and the significance for conservation. Biodiversity and Conservation, 29, 381-391.

[15] Widén, A. (2023). Drivers of ungulate behavior in the context of human-wildlife conflicts.

[16] Yang, G., Peng, C., Yang, X., Guo, Q., & Su, H. (2024). Habitat suitability and crop damage risk caused by wild boar in Guizhou Plateau, China. The Journal of Wildlife Management, e22542.