
10.11609/jott.2026.18.2.28262-28454
www.threatenedtaxa.org

26 February 2026 (Online & Print)
18(2): 28262-28454
ISSN 0974-7907 (Online)
ISSN 0974-7893 (Print)

ISSN 0974-7907 (Online); ISSN 0974-7893 (Print)

Publisher
**Wildlife Information Liaison Development Society**
www.wild.zooreach.org

Host
**Zoo Outreach Organization**
www.zooreach.org

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**Cover: Digital illustration of *Impatiens chamchumroonii* in Krita by Dupati Poojitha.**

Journal of Threatened Taxa | www.threatenedtaxa.org | 26 February 2026 | 18(2): 28406–28412
ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)
https://doi.org/10.11609/jott.9576.18.2.28406-28412
#9576 | Received 23 December 2024 | Final received 28 December 2025 | Finally accepted 07 January 2026
COMMUNICATION
OPEN ACCESS

# Activity budgets of a zoo-housed Mishmi Takin *Budorcas taxicolor taxicolor* (Mammalia: Artiodactyla: Bovidae) herd

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**Abstract**: The Himalayan Caprine *Budorcas taxicolor taxicolor*, generally known as the Mishmi Takin, is a globally 'Vulnerable' species per IUCN Red List and categorised under Schedule I of the Wildlife (Protection) Act, 1972. Information on their behaviour is limited, and this study was undertaken at Padmaja Naidu Himalayan Zoological Park, Darjeeling, to investigate the activity budgets of a herd of seven Mishmi Takin in captivity, with emphasis on reproductive and maternal behaviours. Ethograms developed based on a literature review and preliminary observations were used to observe animals for one year. Data analysis was conducted using descriptive statistics. It was observed that the takins spend the majority of their time feeding, standing, ruminating, resting or in locomotion. Reproductive behaviours comprised less than 1% of the activity budget. The study provides preliminary data on the behaviour of the Mishmi Takin in captivity, and could be utilised by zoo management to strategize animal enrichment and welfare.

**Keywords:** Behaviour, captivity, feeding, Himalayan Caprine, locomotion, observations, Padmaja Naidu Himalayan Zoological Park, ruminating, seasonality, zoo management.

**Editor:** Tiger Sangay, Ugyen Wangchuck Institute for Forestry Research and Training, Bumthang, Bhutan. **Date of publication:** 26 February 2026 (online & print)

**Citation:** Ghosh, N., P. Gupta, J. Dey & B.S. Holeyachi (2026). Activity budgets of a zoo-housed Mishmi Takin *Budorcas taxicolor taxicolor* (Mammalia: Artiodactyla: Bovidae) herd. *Journal of Threatened Taxa* 18(2): 28406–28412. https://doi.org/10.11609/jott.9576.18.2.28406-28412



**Funding:** The project was funded by West Bengal Zoo Authority. The grant number is 104/WBZA/T-18(j)/21-22 dated 15.06.2021.

**Competing interests:** The authors declare no competing interests.

**Author details:** Nabanita Ghosh, project fellow for the project. Affiliated to Padmaja Naidu Himalayan Zoological Park while working on the project. Pranita Gupta is the current zoo biologist in Padmaja Naidu Himalayan Zoological Park, Darjeeling. She is in charge of writing new projects and supervising them, overlooking animal records and education outreach. Joy Dey is the zoo veterinarian in charge of animal health. Basavaraj S. Holeyachi is the ex-director and one of the supervisors of this project.

**Author contributions:** NG: methodology, data collection, data analysis, manuscript writing and editing. PG: manuscript editing. JD: partial supervision. BSH: supervision.

**Acknowledgements:** I would like to acknowledge Barkha Subba (ex-zoo biologist) for the initial conceptualization of the project, Prishka Pariyar (ex-project fellow) for collecting the ad-libitum data and making the ethogram, zookeepers for their guidance during observations and data collections, Bedan Chettri (ex-assistant librarian) for providing study and reference material from the library and Shiwangi Rai (ex-project fellow) for helping with sampling the study.

## INTRODUCTION

The Mishmi Takin *Budorcas taxicolor taxicolor*, is a large Himalayan even-toed member of the Bovidae, with three recognized subspecies: Bhutan Takin *B. t. whitei*, Grey or Sichuan Takin *B. t. tibetana*, and Golden or Shaanxi Takin *B. t. bedfordi* (Neas & Hoffmann 1987; Sharma et al. 2015). Elongated in structure with lunate horns, adult males weigh up to 350 kg and females up to 280 kg (Neas & Hoffman 1987). These generalist herbivores are primarily browsers, foraging on a wide variety of plants (Schaller et al. 1986). They occur in mountainous terrain and move in herds that typically migrate to higher elevations during summer (Schaller et al. 1986; Adkin et al. 2012). Breeding is observed in July–August, when they often inhabit higher altitudes (Allen 1940; Schaller et al. 1986; Zeng et al. 2008); the gestation period ranges 7–8 months (Neas & Hoffmann 1987).

The IUCN Red List categorizes the Takin as 'Vulnerable', and Wildlife (Protection) Act, 1972, identifies it as a Schedule I animal (Song et al. 2008; Sharma et al. 2015). In India, it is found in the remote hills of Mishmi in Arunachal Pradesh, most of which is not legally protected (Sharma et al 2015). Information about its behaviour is scant in the literature, owing to the inaccessible, uneven, and rugged terrain takins occupy. Observational studies in zoo research programs have provided insights into animal habits and behaviour (Mench et al. 1997), and this study was an attempt to generate baseline behavioural data for a captive herd of Mishmi Takin at PNHZP. The activity budgets were specifically prepared based on observations made during the active daylight period, spanning from early morning to early evening hours for each herd member. Subsequently, the influence of seasonal variation were quantitatively evaluated on these activities. Reproductive behaviour of the group and maternal care of a pregnant female takin were also investigated as part of the research objective. This study hopes to provide data that can be utilised by zoo management to support effective animal welfare and maintain viable captive breeding populations.

## METHODS

Observations of captive Mishmi Takins took place at the Padmaja Naidu Himalayan Zoological Park (PNHZP), Darjeeling, India (27.050 $^{0}$N, 88.261 $^{0}$E) from March 2022 to May 2023. The animals were housed in three enclosures of similar design and area. All the enclosures were outdoor yards comprising a separate feeding and drinking area, makeshift wooden platforms and in-built shelters for extreme weather conditions (Figure 1). Takin feed comprised fodder from the forest and supplementary feed from the zoo animal feed section. Supplementary feed provided to the takins, to meet the nutritional requirements, included a mixture of crushed maize, crushed wheat, gram, barley, pulses, turmeric, salt, and molasses (during winters) and was fed daily during morning hours (0900 h) by the zookeepers. The takins were fed fodder twice a day, typically around 0930 h in the morning and 1500 h in the afternoon. It comprised of a variety of plants like *Cyathea chinensis* Copel., *Artemisia vulgaris* L., *Rhaphidophora glauca* (Wall.) Schott, *Selaginella pennata* (D.Don), *Tradescantia fluminensis* Vell, *Saurauia napaulensis* DC., *Hedychium gardnerianum, Piper suipigua* Buch.-Ham. ex D.Don, *Pouzolzia sanguinea* (Blume) Merr., *Acer laevigatum* Wall., *Maesa chisia* D.Don, and *Leucosceptrum canum* Sm.

Initially, Male 1, Male 3, Female 1, and Female 3 were housed together. Male 2 was housed alone. Female 2 and Female 4 were housed together. After three months, Male 1 was housed with Female 2 and Female 4. Male 3, Female 1 and Female 3 were shifted to Male 2's enclosure. Female 3 and Female 4 were transferred to a different zoo six months after the initiation of the observation period (Table 1). The decision to shift the takins and reduce the enclosures occupied from three to two was a zoo management decision pertaining to logistics.

One-hundred-and-eight hours of preliminary observations were conducted on the captive herd of seven takins in March–April 2022 (Table 1). The ad libitum data from these observations, along with data provided in the literature was used to curate an ethogram for behavioural observations (Powell et al. 2012). A total of 37 behaviours were listed under five different categories, namely active, inactive, social affiliative, social aggression, and reproductive (Table 2).

To assess activity budgets, daily behavioural observations were collected on members of the captive herd using the instantaneous scan sampling method (Altman 1974). Hourly observations at 10-minute intervals were done by the observer from an elevated position. Observations were made 5–6 days per week, for 2–3 hours each day between 0700–1700 h. For the first three months, observations of the third enclosure were performed by a zookeeper after conducting an observer reliability test (Crockett 1996).

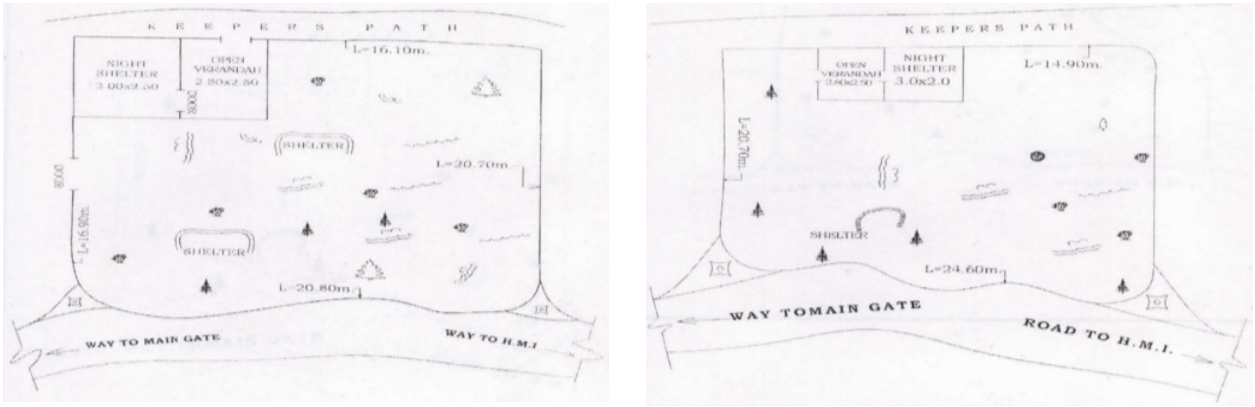


**Figure 1. Takin enclosures at the Padmaja Naidu Himalayan Zoological Park.**

**Table 1. Mishmi Takin individuals housed at the Padmaja Naidu Himalayan Zoological Park.**

| | Animal | House name | Sex | Date of birth | Age as of 2023 (in years) | Stage | Dam | Sire | Date of acquisition |
|---|---|---|---|---|---|---|---|---|---|
| 1. | Male 1 | Danny | Male | 19.iii.2016 | 7 | Adult | | | 20.i.2019 |
| 2. | Male 2 | Rock | Male | 11.ii.2016 | 7 | Adult | | | 20.i.2019 |
| 3. | Female 1 | Claire | Female | 18.iii.2016 | 7 | Adult | | | 20.i.2019 |
| 4. | Female 2 | Ramona | Female | 16.iii.2017 | 6 | Adult | | | 20.i.2019 |
| 5. | Female 3 | Lucky | Female | 29.iii.2020 | 3 | Sub-adult | Claire | Danny | |
| 6. | Female 4 | Diana | Female | 07.ii.2021 | 2 | Calf | Ramona | Rock | |
| 7. | Male 3 | Canny | Male | 25.i.2022 | 1 | Calf | Claire | Danny | |
| 8. | Female 5 | Donna | Female | 25.v.2023 | 0.5 | Calf | Ramona | Danny | |

The activity budgets of five takins (three males and two females) ranging 1–7 years old have been reported in this study. Female 2 got pregnant during the observation period and gave birth at the end of the observation period. Two female sub-adult takins (Females 3 & 4) were transferred to another zoo in the sixth month of the study period; hence, they couldn't be assessed further.

A total of 400 hours of behavioural data were collected in June 2022–May 2023, and subsequently categorised according to individual takins and seasons. Descriptive statistics were utilised to prepare activity budgets, which were represented graphically. The time that the members were out of sight has been excluded while calculating the time budgets, as the activities during that duration were not visible to the observer. The normality of the data was tested using the Shapiro-Wilk test. To examine potential differences between pregnant and non-pregnant females, the activity patterns of two adult females were compared using the Wilcoxon rank-sum test. For males, the Kruskal-Wallis test was applied to investigate potential age-related differences, with post-hoc comparisons conducted by Bonferroni's method. Additionally, seasonal variations in activity patterns were assessed for the herd across four seasons: monsoon (June, July, August), autumn (September, October), winter (November, December, January), and summer-spring (March, April, May) using the Kruskal-Wallis test. February was excluded from the analysis to accommodate hormonal analysis conducted as part of the same study. Preliminary maternal care observations were made using ad libitum notes following Female 2's parturition in the last week of May 2023. Data compilation, sorting, and statistical analyses were done in MS Excel and R.

## RESULTS

The overall activity budgets (Figure 2) of the zoo-housed Mishmi Takins showed that they spent 54.6% of their time in active behaviour, 42.2% in inactive behaviour, 2.4% in social affiliation, and 0.3% being socially aggressive and 0.3% of reproductive acts. Active

**Table 2. Ethogram for behaviour observation of Mishmi Takin.**

| Behavior | Description |
|---|---|
| **Inactive** | |
| Ruminating | Movement of the mouth similar to chewing |
| Standing rest | Standing with its head lowered, facing the ground, or positioned straight |
| Sternal rest | Lying on the stomach, with head lowered or near ground level |
| Lateral rest | Completely resting on one side of its body, with head resting on the ground or on its back |
| Alert position | Being attentive with eyes open and fixated on the source |
| Bipedal stand | Standing on its hind limbs with forelimbs resting on the enclosure wall |
| **Active** | |
| Locomotion | Movement for a minimum of two steps |
| Foraging | Searching and sniffing foliage in the enclosure |
| Feeding | Actual consumption of food items and drinking water |
| Maintenance | Scratching the body with the hoof, licking the fur, rubbing the body against an erect object in the enclosure, shaking the head or entire body, self-nibbling, slowly rubbing the horns on an object without any force |
| Object manipulation | Investigates and moves around an object in the enclosure |
| **Social aggression** | |
| Head down | Displaying a lower head while drawing their rear legs forward, and arching their back |
| Head bud | Intertwining horns with force |
| Object horning | Thrashing vegetation, gouging large tree trunks with horns, and aggressively horning and manipulating inanimate objects inside the enclosures |
| Head shake | Shaking its head in the direction of another individual aggressively |
| Dominance posture | Standing rest position |
| Chasing | Pursuing another individual at a rapid pace |
| Submissive | Moving away from a charging individual |
| **Social affiliation** | |
| Social play | Juveniles running, jumping and head-butting each other |
| Contact with conspecifics | Face sniffing, nuzzling, licking and nudging |
| Snorting | Expelling air through the nose when threatened |
| Bellow | Sound coming from an open mouth as the call is produced deep in the throat |
| Maternal care | Suckling and protecting the calf |
| Facilitate nursing | Giving a call to the calf for nursing and allowing it to suckle |
| Allo-parenting | Non-maternal infant care, such as licking, protecting, nuzzling, and guiding by other members of the herd |
| **Reproductive** | |
| Flehmen | Sniffing the anogenital area, or urine, with head upright and nostrils flared |
| Mounting | Males attempting to mount females by throwing their forelegs onto the back of the females |
| Copulating | Occurs while mounting and is identified by agitated movements of the hind region |
| Following conspecific | Following the conspecific, especially after scent sampling |
| **Others** | Yawning, sneezing, defecating, and urinating |
| **Out of sight** | An animal cannot be observed from the data collector's location |

behaviours entailed feeding (79.8%), locomotion (14%), maintenance (3.6%), and foraging (2.6%). Inactive behaviours included standing (43.14%), ruminating (31.2%), resting in sternal position (21.67%), resting in lateral position (1.52%), bipedal stands (0.96%), and alert (0.74%). In social aggression, there were 10 instances of head butt, six instances of chasing, one act of dominance and three acts of submission. Social affiliative behaviours included eight instances of social play, six instances of contact with conspecific, 18 instances of maternal care and two instances of female nursing. Vocalisations that were also included in social affiliation included 145 bellows and four snorts by the individuals. Reproductive behaviour included five instances of scent sampling, two instances of mounting and 15 instances of following.

Since feeding, resting, ruminating, and locomotion occupied the majority of the behaviours displayed, they were assessed further to examine whether these activities were affected by changing weather conditions (Figures 3 & 4). In the overall activity budget for the herd, feeding ($\chi^2 = 17.85$, df = 3, $p < 0.01$) and resting ($\chi^2 = 9.9$, df = 3, $p = 0.01$) showed a statistically significant difference across the four seasons. On assessing the time budgets of the members, comparatively, monsoons saw the highest percentage of time spent in feeding (females: 49% & males: 55%), followed by winters (females: 46.64% & males: 47.95%). This trend took a dip in autumn (females: 44% & males: 37%) and was the lowest in spring-summer (females: 40.97% & males: 39.42%). Herd members rested the highest percentage of time in spring-summer (females: 32.5% & males: 36%), followed by autumn (females: 30% & males: 31.7%). Monsoon saw a dip in resting (females: 26% & males: 31.4%), as did winters (females: 26% & males: 26.7%).

Wilcoxon rank-sum tests were conducted to compare the activity patterns (in percentage) between Female 1 and Female 2. Significant differences were observed in resting ($W = 0$, $p = 0.029$) and locomotion ($W = 16$, $p = 0.029$), indicating that the two females differed in the percentage of time spent on these activities. On examining their activity patterns, it was found that time utilised in resting was higher in Female 2 (33%) compared to Female 1 (24%), and time spent in locomotion was higher in Female 1 (14%) compared to Female 2 (6.6%). However, no significant differences were found for feeding ($W = 15$, $p = 0.057$) or ruminating ($W = 6$, $p = 0.68$).

For males, there were no significant differences among the three individuals except for locomotion patterns. The Kruskal-Wallis test revealed a statistically

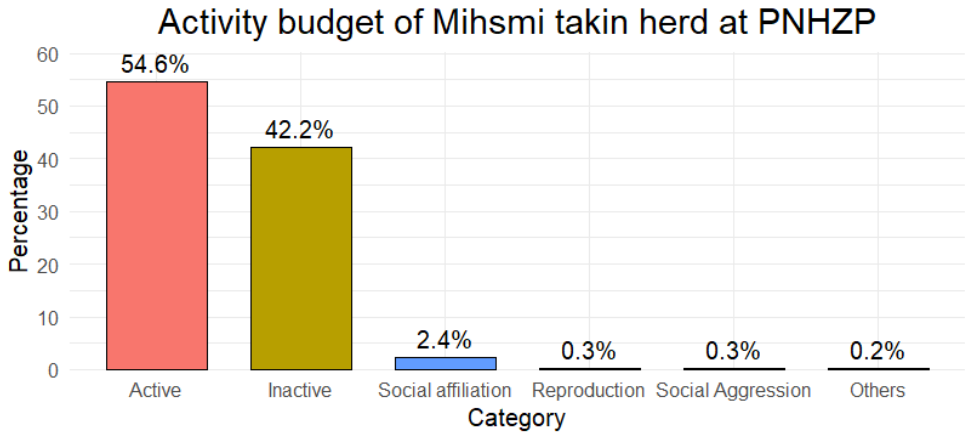


**Figure 2. Activity budget of Mishmi Takin herd at the Padmaja Naidu Himalayan Zoological Park for one year.**

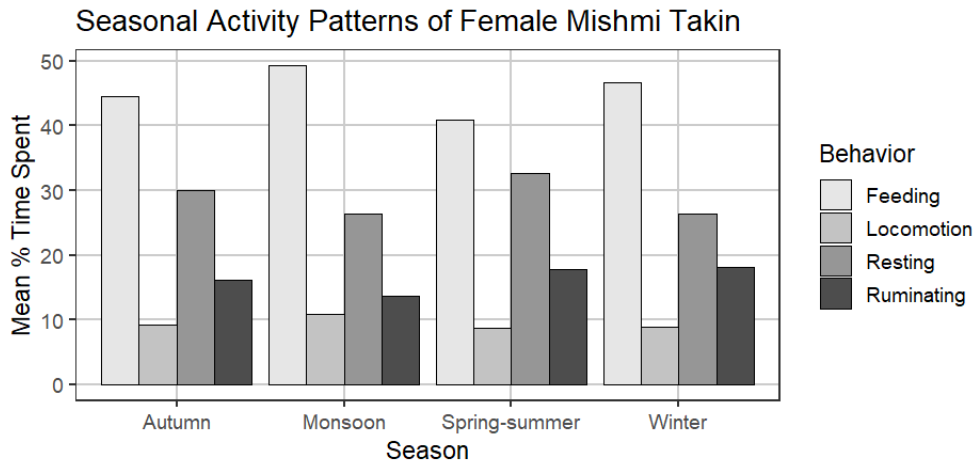


**Figure 3. Selected behaviours for female takins at the Padmaja Naidu Himalayan Zoological Park.**

significant difference in locomotion percentages among the three males ($\chi^2$ = 6.5, df = 2, p = 0.03). However, post-hoc pairwise comparisons using Dunn's test with Bonferroni adjustment found no statistically significant differences between any pairs of males (all adjusted p-values > 0.05). These results suggest that, while there maybe trends in locomotion activity in males, no specific pairwise differences were statistically robust after correcting for multiple comparisons.

Female 2 gave birth in the last week of May. After birthing, the mother immediately started licking the infant and kept guard. It sniffed the newborn takin from time to time. The infant stood up after almost 45 min and started suckling. It would spend time either sleeping or suckling. The mother was always in close vicinity of the newborn. These behaviours were prominent for 3–4 days after the takin's birth and began declining after a week.

## DISCUSSION

The activity budgets of the captive herd of Mishmi Takin were assessed in this study at PNHZP. The study covers active daylight time observations. The individuals spent most of their time feeding, ruminating, resting and in locomotion. The effect of different seasons was also assessed and it was seen that feeding peaked during monsoons in both female and male members and females spent more time feeding as compared to males. This is in accordance with the findings of its wild counterpart, the Golden Takin, that spent 60–80% of their time feeding, resting and walking (Zeng & Song 2001) as well as its family group member, Bison *Bison bison*, in which lying, standing and feeding dominated 87.9% of the time budgets (Robitaille & Prescott 1993). Seasonal variations in feeding patterns can be attributed to availability of quality forage at different altitudes. Powell et al. (2013)

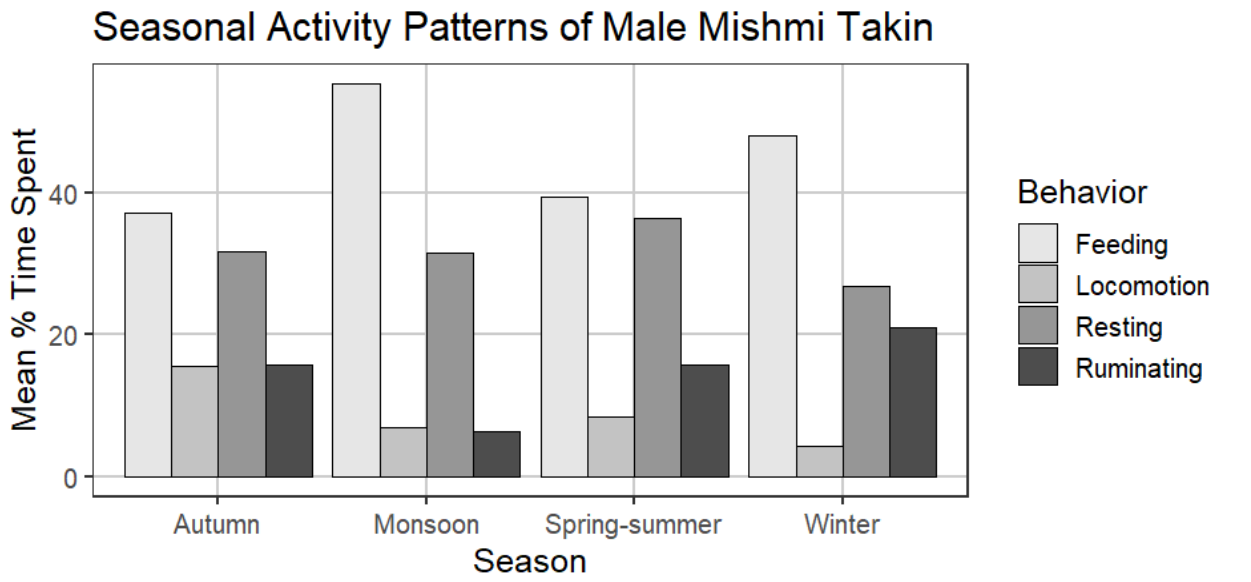


**Figure 4. Selected behaviours for male takins at the Padmaja Naidu Himalayan Zoological Park.**

reported that the captive takin herd in The Wilds in Cumberland, Ohio, spent 35% of their time feeding with females, comparatively spending more time than males in winter. Studies on activity budgets of the Bovidae family member, the Common Bushbuck *Tragelaphus scriptus decula*, revealed that they spent most of their time feeding, which was comparatively higher during the wet seasons as compared to the dry seasons (Bayih & Yihune 2018). Previous research on seasonal feeding patterns of another bovid family member, Bison *Bison bison*, has reported that diet quality and preferences peak from June to September in colder or wetter regions due to high abundance of quality forage (Craine 2021). In females, it was observed that the pregnant female (Female 2) spent comparatively more time resting than the non-pregnant female (Female 1). This could be attributed to a prepartum behavioural change, including increased transition from lying to standing or vice versa, among other tendencies such as seeking isolation, which facilitates a calm parturition and creates an optimal environment for birthing (Rørvang et al. 2018; Nervard et al. 2022).

Reproductive behaviour displayed by the takin herd in PNHZP constituted 0.3% of the annual activity budget, reflecting the limited temporal occurrence of reproductive activities outside the breeding season. Takins are seasonal breeders (Yoshida et al. 2024). The lack of display of reproductive behaviours could be attributed to the fact that these acts are only prominent during the breeding season. During the study period, 22 instances of such behaviours were recorded, reflecting findings by Adkin et al. (2012), who observed that reproductive behaviours accounted for 0.01% to 1.1% of the time budget during a 2.5-year study of Sichuan Takin at Lincoln Park Zoo, Chicago. Flehmen is a common behaviour observed in bovids, such as Bison, characterised by lip curling while sniffing the vulva or urine of a female. Mounting in bovids, including Bison, is often the initial step of the copulatory sequence, typically followed by soft panting. However, this sequence is rarely completed as females often step away when the act begins (Estes 1974). In the observations conducted at PNHZP, these behaviours were exclusively performed by Male 1 and occasionally by Male 2. None of the females exhibited such behaviours during the study period.

Social aggression in the herd accounted for a small portion of the activity budget (0.3%), with only 20 instances recorded over a one-year period between Male 1 and adult female (Female 1) or juvenile male (Male 3). The low counts of aggression could be attributed to the captive conditions that are exceedingly different from wild conditions. Additionally, the placement of the two adult males into different enclosures could also lead to less aggressive counts. Aggressive behaviours are typically observed in bulls or bison during periods of male-male competition, often as part of dominance establishment. Serious fights are highly frequent, with passive avoidance frequently substituting physical confrontations, particularly during the rut (Estes 1974). In the current study, social affiliation, including vocalisations, made up 2.4% of the takins' activity budget. Similarly, in the study of the captive takin

herd at The Wilds, social behaviours were observed to constitute a very small percentage of the activity budget (<6%) (Powell et al. 2013).

This study at PNHZP had several limitations. Observations of the study sample were limited to behaviour in captive conditions. The sample size decreased from seven to five midway through the observation period due to the transfer of two sub-adult females. Additionally, the members were housed in separate enclosures, which prevented the exploration of collective herd behaviour, such as social hierarchical dynamics. The lactating and non-lactating females were also kept in separate enclosures, resulting in comparisons being divided by space and time. Furthermore, the maternal behaviour described in this study was based on ad libitum observation, limiting the depth of behavioural analysis. Future studies could focus on a more systematic investigation of mother-infant interactions to better understand this aspect of takin behaviour. The results of this study provide a preliminary understanding of the activity budgets of takins in captivity. Future research could further explore aspects such as diet preferences, enclosure utilisation, and social dynamics to create a more comprehensive framework for enrichment and welfare planning.

## REFERENCES


**Adkin, A., D. Bernier & R.M. Santymire (2012).** Characterizing the behavior and reproductive biology of zoo-housed Sichuan Takin *Budorcas taxicolor tibetana* using non-invasive techniques. *Theriogenology* 78(3): 483–494. https://doi.org/10.1016/j.theriogenology.2012.02.006

**Allen, G.M. (1940).** The mammals of China and Mongolia. *American Museum of Natural History, New York* 2: 621–1350.

**Altmann, J. (1974).** Observational study of behaviour: sampling methods. *Behaviour* 49: 227–67. https://doi.org/10.1163/156853974X00534

**Bayih, W. & M. Yihune (2018).** Population status, feeding ecology and activity pattern of Common Bushbuck *Tragelaphus Scriptus decula* in Sekele Mariam Forest, West Gojjam, Ethiopia. *Journal of Ecology and The Natural Environment* 10(5): 69–79. https://doi.org/10.5897/JENE2018.0689

**Crockett, C.M. (1996).** Data collection in the zoo setting, emphasizing behavior, pp. 545–546. In: Kleiman, D. (ed.). *Wild Mammals in Captivity*. University of Chicago Press, Chicago.

**Craine, J.M. (2021).** Seasonal patterns of bison diet across climate gradients in North America. *Scientific Reports* 11(1): 6829. https://doi.org/10.1038/s41598-021-86260-9

**Estes, R.D. (1974).** Social organization of the African Bovidae. The behaviour of ungulates and its relation to management 1: 166–205.

**Lovari, S. & M. Apollonio (1994).** On the rutting of the Himalayan Goral *Nemorhaedus goral*. *Journal of Ethology* 12: 25–34. https://doi.org/10.1007/BF02350077

**Mench, J.A. & G.J. Mason (1997).** Behavior, pp. 127–142. In: Appleby, M.C. & B.O. Hughes (eds.). *Animal Welfare*. CAB International, Wallingford, CT.

**Neas, J.F. & R.S. Hoffmann (1987).** *Budorcas taxicolor*. *Mammalian Species* No. 277. pp.1–7. https://doi.org/10.2307/3503907

**Nevard, R.P., S.D. Pant, J.C. Broster, S.T. Norman & C.P. Stephen (2022).** Maternal behavior in beef cattle: The physiology, assessment and future directions—a review. *Veterinary Sciences* 10(1): 10. https://doi.org/10.3390/vetsci10010010

**Powell, D., B. Speeg, S. Li, E. Blumer & W. McShea (2013).** An ethogram and activity budget of captive Sichuan Takin *Budorcas taxicolor tibetana* with comparisons to other Bovidae. *Mammalia* *77*(4): 391–401. https://doi.org/10.1515/mammalia-2012-0076

**Robitaille, J.F. & J. Prescott (1993).** Use of space and activity budgets in relation to age and social status in a captive herd of American Bison, *Bison bison*. *Zoo biology* *12*(4): 367–379. https://doi.org/10.1002/zoo.1430120407

**Rørvang, M.V., B.L. Nielsen, M.S. Herskin & M.B. Jensen (2018).** Prepartum maternal behaviour of domesticated cattle: a comparison with managed, feral, and wild ungulates. *Frontiers in Veterinary Science* 5: 45. https://doi.org/10.3389/fvets.2018.00045

**Reinhardt, V. (1985).** Courtship behaviors among Musk-Ox males kept in confinement. *Zoo Biology* 4: 295–300. https://doi.org/10.1002/zoo.1430040311

**Song, Y.L., A.T. Smith & J. MacKinnon (2008).** *Budorcas taxicolor*. The IUCN Red List of Threatened Species 2008: e.T3160A9643719. https://doi.org/10.2305/IUCN.UK.2008.RLTS.T3160A9643719.en. Accessed on 12 February 2026.

**Schaller, G.B., W. Pan Teng, Z. Qin, X.H. Wang & Shen'Heming (1986).** Feeding behavior of Sichuan Takin *Budorcas taxicolor*. *Mammalia* 50: 311–322. https://doi.org/10.1515/mamm.1986.50.3.311

**Sharma, D., T. Wangchuk, G.S. Rawat & A.J.T Johnsingh (2015).** Takin, *Budorcas taxicolor*. In: Johnsingh, A.J.T. & N. Manjrekar (eds.). *Mammals of South Asia*, *Vol. 2*; Chapter 5. Orient BlackSwan, 766 pp.

**Yoshida, T., Y. Shimokawa, M. Ohta, M. Takayanagi & S. Kusuda (2024).** Reproductive seasonality, estrous cycle, pregnancy, and the recurrence of postpartum estrus based on long-term profiles of fecal sex steroid hormone metabolites regarding zoo-housed female Golden Takins *Budorcas taxicolor bedfordi*. *Animals* 14(4): 571. https://doi.org/10.3390/ani14040571

**Zeng, Z.G., A.K. Skidmore, Y.L. Song, T.J. Wang & H.S. Gong (2008).** Seasonal altitudinal movements of golden takin in the Qinling Mountains of China. *Journal Wildlife Management* 72: 611–617. https://doi.org/10.2193/2007-197

**Zeng Z. G., & Y.L. Song (2001).** Daily activity rhythm and time budget of golden takin in spring and summer. *Acta Theriologica Sinica* 21(7): 13.

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NAAS rating (India) 5.64



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Tamil Nadu 641006, India
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Journal of Threatened Taxa

www.threatenedtaxa.org



**ISSN 0974-7907 (Online) | ISSN 0974-7893 (Print)**

**February 2026 | Vol. 18 | No. 2 | Pages: 28262–28454**
**Date of Publication: 26 February 2026 (Online & Print)**
**DOI: 10.11609/jott.2026.18.2.28262-28454**



**Publisher & Host**

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