

A COMPARATIVE STUDY OF EUROPEAN BISON (*BISON BONASUS*) BEHAVIOR IN SEMI-LIBERTY, ALIGNING FIELD OBSERVATIONS WITH REFERENCE ETHOGRAMS

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Abstract. The present study investigated the seasonal behavioral patterns of European bison (*Bison bonasus*) maintained under semi-liberty conditions in the Hațeg–Slivuț Reserve, Romania. Ethological observations were conducted throughout all four seasons in order to evaluate the daily activity budget and the main categories of behavior, including feeding, resting, exploration, social interactions, reproductive behavior, and agonistic activities. Behavioral observations were organized into seasonal ethograms that reflected the temporal distribution of activities during a 24-hour cycle. The results demonstrated significant seasonal variation in behavioral expression. During spring, summer, and autumn, European bison exhibited two major feeding peaks, occurring in the early morning and late afternoon, while midday periods were predominantly associated with resting and rumination behaviors. In contrast, winter activity patterns were characterized by reduced locomotor activity, prolonged resting periods, and concentration of feeding behavior around supplementary feeding sites. Feeding behavior also varied seasonally according to vegetation availability. Fresh grasses, shoots, and herbaceous plants dominated the diet during spring and summer, whereas bark, twigs, dry plant material, and supplementary fodder became increasingly important during autumn and winter. Social interactions were more frequent during the breeding season, particularly among males, where agonistic displays contributed to hierarchy establishment and reproductive competition. Grooming and reciprocal licking behaviors were also observed, emphasizing the importance of social cohesion within the herd. Overall, the observed behavioral repertoire corresponded closely with reference ethograms described in the scientific literature for free-ranging European bison populations. The study highlights the adaptive behavioral flexibility of *Bison bonasus* under semi-liberty management conditions and supports the importance of ethological monitoring for conservation and welfare assessment programs.

Keywords: European bison; *Bison bonasus*; ethology; seasonal behavior; feeding behavior; semi-liberty conditions

INTRODUCTION

The European bison (*Bison bonasus*) is the largest terrestrial herbivore in Europe and a flagship species for wildlife conservation and reintroduction programs. After its extinction in the wild in the early twentieth century, the species recovered through captive breeding, translocation, and carefully managed reintroduction efforts, leading to the establishment of several free-ranging and semi-free-ranging populations across Europe (Pucek et al., 2004; Krasińska & Krasiński, 2013). Because these populations are increasingly maintained in

human-influenced landscapes, behavioral monitoring has become essential for understanding how the species adapts to semi-liberty conditions and how management practices affect its welfare and ecological function (Kuemmerle et al., 2011; Kowalczyk et al., 2013).

Behavior in semi-free-ranging bison is strongly shaped by seasonal variation, habitat structure, food availability, and human disturbance. Previous studies have shown that European bison allocate much of their daily activity to foraging and resting, while locomotion and social interactions vary with temperature, snow cover, and habitat quality (Kerley et al., 2012; Hediger, 1950; Schulze-Delitsch et al., 2015). In winter, animals often concentrate around feeding sites or management points, whereas in warmer seasons they use a broader range of vegetation patches and spend more time grazing in open areas (Daleszczyk & Krasíńska, 2009; Schmidt et al., 2019). These patterns indicate a flexible behavioral strategy that allows the species to persist in environments that differ from its historical forest and woodland habitats (Kowalczyk et al., 2011; Kuemmerle et al., 2011).

Ethograms are particularly useful for comparing field observations with established behavioral reference frameworks. In bison, ethological studies have documented categories such as feeding, resting, locomotion, social contact, vigilance, agonistic behavior, and maternal care, providing a basis for evaluating behavioral changes under different management conditions (Kaczor et al., 2025; Jakubas et al., 2019). Such reference ethograms help identify whether observed behavior reflects natural flexibility or potential stress responses caused by enclosure size, supplemental feeding, visitor presence, or habitat simplification (Schulze-Delitsch et al., 2015; Lampa et al., 2018). This comparative approach is especially relevant in semi-liberty reserves, where animals are not fully wild but are also not fully captive.

The Hațeg-Slivuț Bison Reserve in Romania represents an important site for behavioral observation because it combines controlled management with relatively natural habitat features. Established in 1958, the reserve provides a semid-open landscape with mixed deciduous vegetation, forest patches, and grassy clearings, conditions that support seasonal changes in foraging and movement behavior (Slivuț Bison Reservation, 2024). Previous descriptions of the site emphasize its value for conservation education, species maintenance, and the observation of bison in a managed setting that still permits many natural behavioral expressions (Slivuț Bison Reservation, 2024; Traveller With Camera, 2023). This makes the reserve suitable for studying how behavioral budgets shift across seasons and how social organization is expressed in a semi-free-ranging herd.

The present study aims to analyze the behavior of European bison in the Hațeg-Slivuț Reserve over a one-year period and to align field observations with reference ethograms reported in the literature. Specifically, it focuses on daily activity rhythms, feeding behavior, resting patterns, social interactions, exploratory movements, and seasonal adjustments. By comparing observed behavior with established ethological descriptions, the study seeks to contribute to a clearer understanding of behavioral adaptation in semi-liberty and to provide practical insight for bison management and conservation planning (Pucek et al., 2004; Kaczor et al., 2025).

MATERIAL AND METHODS

This study was conducted in the Hațeg-Slivuț Bison Reserve, Hunedoara County (Figure 1), Romania, over a 12-month period. Observations were carried out twice per season to capture seasonal variation in behavior.

Data were collected through direct observation from fixed points and pre-established trails, using binoculars, photo cameras, and video recordings. A standardized observation sheet

was used to record feeding, resting, social interactions, exploratory movements, reproduction, and defensive behavior.

The herd was observed at a distance to avoid disturbing natural activity. In addition, information on habitat structure and available food resources was noted, with special attention to seasonal vegetation, grazing areas, and supplemental feeding sites.



Figure 1. The Hațeg-Slivuț European Bison Reserve

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RESULTS AND DISCUSSIONS

Ethological observations conducted in the Hațeg–Slivuț Bison Reserve revealed how *Bison bonasus* adjusts its behavior in response to seasonal changes. The activity budget of the herd was influenced by environmental conditions, food availability, and human presence. European bison exhibit a complex, well-structured social behavior that includes feeding, resting, exploration, reproduction, and diverse social interactions essential for group survival and cohesion.

Field observations revealed clear seasonal variation in the daily behavior of European bison kept under semi-liberty conditions. During spring, summer, and autumn, the animals showed two main feeding peaks, one in the early morning and another in the late afternoon, while the middle of the day was dominated by resting behavior. Similar activity budgets, characterized mainly by alternating foraging and resting phases, have been reported in semi-free-ranging and free-living European bison populations.

Seasonal differences in feeding behavior were also evident. In spring, bison mainly consumed fresh grasses, shoots, and young leaves. During summer, grazing intensity increased in open areas with abundant herbaceous vegetation. In autumn, feeding activity intensified further, probably reflecting increased energy intake before winter, while in winter the diet shifted toward bark, twigs, dry plant material, and supplemental fodder. This seasonal flexibility confirms the adaptive feeding strategy of the species under managed habitat conditions.

The comparison between warm and cold seasons suggests that European bison in the Hațeg-Slivuț Reserve respond efficiently to seasonal constraints by modifying movement, feeding intensity, and resting duration. Such flexibility is important for survival in semi-liberty systems, where natural habitat conditions are partly maintained but management interventions, especially feeding, may influence behavioral expression. Overall, the observed behavioral pattern was in agreement with the reference ethograms described in the literature for the species.

Figure 2 shows the daily activity schedule of European bison during spring, summer, and autumn over a 24-hour period. The most active feeding periods occur in the morning (06:00–09:00) and in the late afternoon (16:00–19:00). During midday, between 11:00 and 14:00, resting dominates. Nighttime is mainly devoted to rest and low activity, accounting for a continuous 9-hour block, which is the longest resting period within the daily cycle. Feeding is the main activity in the early morning and the afternoon, occupying a substantial proportion of the active time. Resting and rumination typically occur around noon, in shaded or secluded areas. Social interactions and play are more frequent in young individuals and are usually observed in quiet, undisturbed zones. These patterns reflect efficient adaptations to semi-open habitats, combined with a clearly defined social hierarchy.

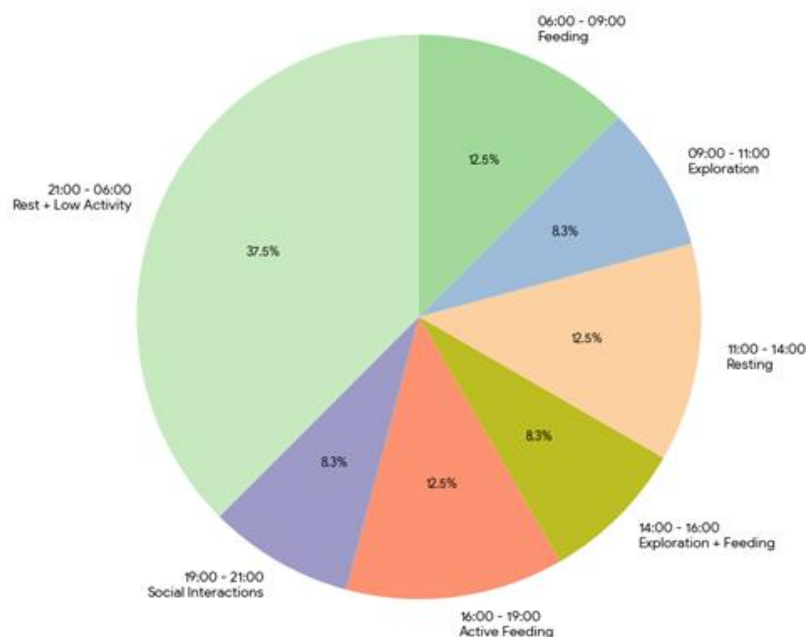


Figure 2: The daily activity of European bison during spring, summer, and autumn

In summer, resting occurs frequently in shaded locations as a thermoregulatory behavior to avoid heat stress. The European bison alternate periods of rest with active grazing (Figure 3).

Exploration is a behavior associated with foraging and adaptation to environmental conditions (Figure 4).

In summer, grazing becomes more intense as vegetation is abundant. The bison prefer open areas, such as montane grasslands, where they find dense grass and various herbaceous plants. A diversification of their diet is observed, including leaves and tree bark (Figure 5).

In autumn, hyperphagia is present, as bison significantly increase the amount of food consumed to build up fat reserves before winter. A preference for fallen fruits (acorns, chestnuts) and dry vegetation residues is observed. Additionally, supplementation with concentrated fodder at specially designed troughs becomes necessary (Figure 6).

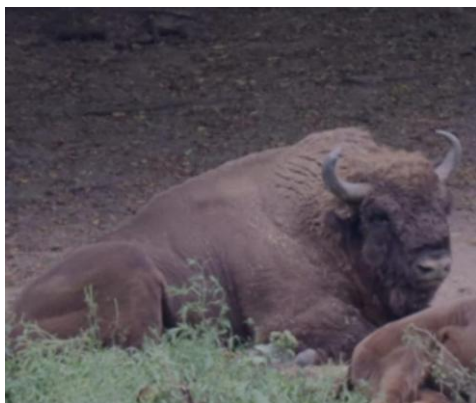


Figure 3: Resting behavior of European bison during the summer

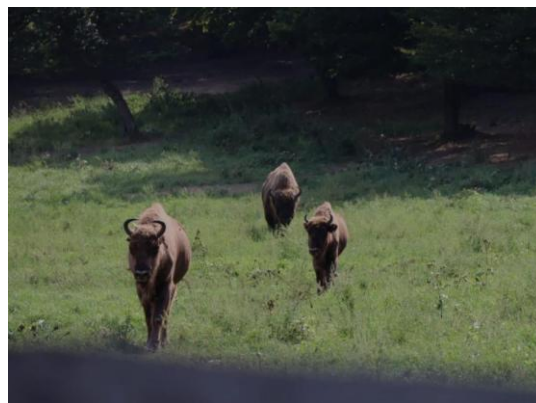


Figure 4: Exploratory behavior in European bison (*Bison bonasus*)



Figure 5: Feeding behavior on foliage in *Bison bonasus*



Figure 6: Feeding behavior, supplemental feeding at the trough

In winter, the behavioral rhythm became more restricted, with longer resting periods and shorter exploratory movements. Feeding activity was concentrated around accessible food sources, including natural vegetation and supplementary feeding points. This pattern is consistent with previous studies showing that snow cover and winter feeding reduce locomotor activity and increase the time spent near feeding areas.

Figure 7 represents the winter daily activity schedule of European bison over a complete 24-hour cycle, illustrating the temporal distribution of behavioral activities under cold climatic

conditions. The activity pattern reflects pronounced adaptation to winter environmental constraints, characterized by a clear alternation between periods of concentrated activity and extended resting phases. The day begins gradually between 06:00 and 08:00, with slow awakening and progressive activation of the animals, followed by an intensive feeding period between 08:00 and 11:00, when the bison search for accessible food resources, frequently near supplementary feeding areas managed by reserve staff. Between 11:00 and 13:00, activity decreases considerably, and the animals retreat to sheltered resting sites in order to conserve energy. During the afternoon, from 13:00 to 15:00, limited exploratory movements occur as the bison search for additional plant resources within nearby protected areas. A second active feeding phase is observed between 15:00 and 17:00, corresponding to the relatively warmer hours of the day. As evening approaches, between 17:00 and 21:00, the animals progressively gather in sheltered locations and prepare for nocturnal rest, forming compact groups that enhance both thermal protection and group safety. Throughout the night, between 21:00 and 06:00, deep resting predominates, although occasional vigilance behaviors and minor movements may still occur, reflecting herd social dynamics and environmental monitoring behavior.

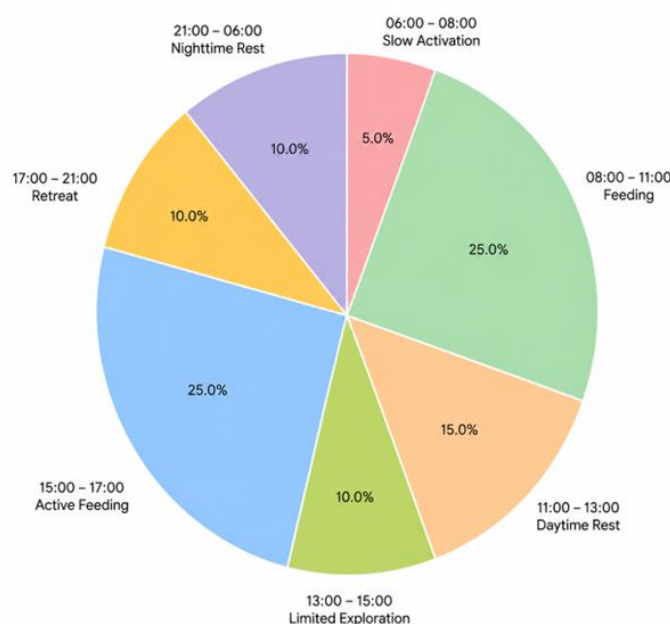


Figure 7: The daily activity of European bison during winter

Overall, the figure highlights the strong influence of winter climatic conditions on the daily activity budget of European bison, emphasizing energy conservation strategies, reduced locomotor activity, and the concentration of feeding behavior around predictable food resources.

Licking behavior has also been observed in European bison, it is multifunctional, playing an essential role in both individual hygiene and parasite defense, as well as in maintaining social cohesion within the herd. In addition to self-grooming, bison also practice reciprocal grooming. This social behavior is important for strengthening social bonds; mutual

licking helps consolidate relationships within the herd, expresses affection, and ensures the cleaning of hard-to-reach areas, as one bison can assist another in grooming spots it cannot reach on its own (Figure 8).



Figure 8: The daily activity of European bison during winter

Agonistic behavior among male European bison (*Bison bonasus*) constitutes a fundamental component of their ethological profile, particularly during the breeding season, or rut. These interactions are critical for the establishment of dominance hierarchies and are directly correlated with individual reproductive success. Such behavioral patterns often escalate from ritualized displays to physical confrontations, serving as a selective mechanism for genetic (Figure 9).

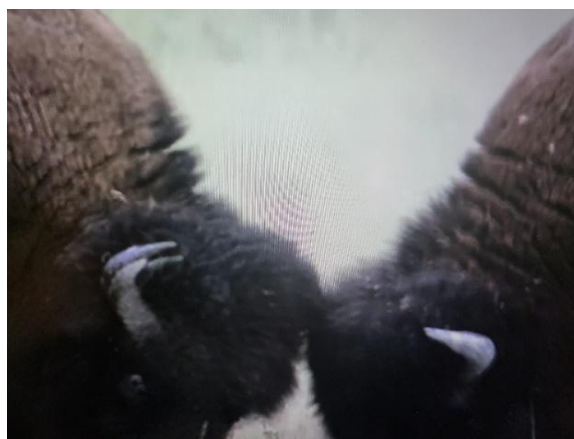


Figure 9: Agonistic behavior and dominance displays between male European bison (*Bison bonasus*)

The observed herd also displayed a stable social structure throughout the year. Social interactions were more frequent during low-disturbance periods, especially in the evening, when group cohesion increased before nocturnal rest. Young individuals showed more play and

exploratory behavior, whereas adults were more frequently involved in feeding, resting, and vigilance. Comparable findings have been described in studies of semi-free bison herds, where most of the daily time budget is allocated to feeding and resting, while social interactions occupy a smaller but behaviorally important proportion.

The behavioral patterns observed in the European bison herd from the Hațeg–Slivuț Reserve are generally consistent with the ethological characteristics described in the scientific literature for both free-ranging and semi-free populations of *Bison bonasus*. The alternation between feeding and resting phases represented the dominant component of the daily activity budget, confirming previous observations reported by Krasieńska and Krasieński (2007), who described feeding as the principal daytime activity in European bison, especially during periods of high vegetation availability.

The two distinct feeding peaks identified in spring, summer, and autumn — during the early morning and late afternoon — correspond closely with activity rhythms reported in other semi-natural reserves and forest ecosystems. Similar circadian patterns were documented by Cabon-Rackzyńska et al. (1983), who observed that European bison avoid intense daytime heat by concentrating grazing activity during cooler periods of the day. The prolonged resting phase observed around midday, particularly during summer, appears to represent an adaptive thermoregulatory strategy aimed at reducing heat stress and conserving energy.

Winter behavior in the Hațeg–Slivuț herd also showed strong agreement with previous studies. Reduced locomotor activity, increased resting duration, and the concentration of feeding activity around supplementary feeding stations are frequently reported adaptive responses during periods of snow cover and reduced food accessibility. Kerley et al. (2012) demonstrated that winter supplementary feeding significantly influences spatial distribution and daily movement patterns in European bison populations, often leading to reduced exploratory behavior and greater aggregation around feeding areas. The present observations support these findings, as winter exploratory movements were limited and the animals remained close to sheltered forest areas and artificial feeding sites.

Seasonal variation in feeding behavior observed in this study is likewise consistent with published ecological data. During spring and summer, the predominance of fresh grasses and herbaceous vegetation in the diet agrees with the findings of Borowski and Kossak (1972), who identified grasses, sedges, and herbaceous plants as the primary dietary components during the vegetation season. The increased autumn feeding intensity and hyperphagic behavior observed before winter reflect a well-known physiological adaptation for energy storage. Similar seasonal increases in food intake have been described in free-ranging bison populations inhabiting temperate forest ecosystems.

The social behavior recorded during the observations also corresponds to established descriptions of European bison herd dynamics. Increased social interactions during evening periods, the formation of compact groups during winter, and the intensification of agonistic interactions among males during the rutting season are all characteristic features reported in previous ethological studies. Krasieńska et al. (2000) emphasized that social hierarchy and group cohesion are fundamental components of European bison survival strategies, particularly under fluctuating environmental conditions.

Agonistic behavior among males, especially during the breeding season, followed patterns commonly described in the literature, including dominance displays, territorial patrols, ritualized confrontations, and occasional physical conflict. These behaviors play a crucial role in establishing reproductive hierarchy and ensuring selective mating success. Likewise, grooming and reciprocal licking behavior observed within the herd confirm the importance of

affiliative interactions in maintaining social cohesion and reducing social tension, as previously documented in large social herbivores.

CONCLUSIONS

The present study showed that European bison in the Hańteg-Slivuț Reserve display a behavioral pattern that is broadly consistent with reference descriptions reported for semi-free-ranging and reintroduced herds. Feeding and resting were the dominant activities throughout the year, while movement, exploration, and social interactions varied according to season and resource availability.

Seasonal changes were especially evident in winter, when the animals reduced locomotion, extended resting periods, and concentrated their activity near accessible food resources and supplementary feeding sites. Similar responses have been documented in other studies, indicating that European bison show considerable behavioral plasticity under managed conditions.

The observed herd maintained social cohesion and showed stable adaptation to a semi-liberty environment, suggesting that the reserve provides conditions that allow the expression of species-typical behavior. These findings support the value of behavioral observation as a practical tool for welfare assessment, habitat management, and conservation planning in European bison populations.

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