



Original Research Paper

Seasonal Drought and Habitat Disturbance Shaping Foraging Efficiency and Social Behavior in Small Grassland Mammals

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Key Words

Grassland ecosystems, Seasonal drought, Habitat disturbance, Foraging efficiency, Social behavior.

Abstract

The grasslands are facing increasing threats from seasonal droughts and anthropogenic disturbances to habitat, which significantly affect the behavioral ecology of small mammals. The objective of this study was to determine the effects of both seasonal drought and anthropogenic disturbances in habitats on the foraging efficiency and social behavior of small grassland mammals in natural or semi-natural grassland ecosystems. Disturbances were classified into undisturbed, moderately disturbed, and highly disturbed areas based on vegetation density, grazing levels, soil disturbance, and human activities. Data collection involved behavioral observations using methods such as focal sampling, direct observation, and use of camera traps. Various parameters were considered, including food-searching time, feeding duration, movement distance, aggressive territoriality, vigilance behavior, group cohesion, and grooming behavior. The results indicate that there were notable changes in animal behavior under high levels of environmental stress. For example, mammals from highly stressed ecosystems showed increased foraging effort, taking an average of 13.5 ± 1.7 minutes and covering an average of 58.8 ± 4.4 meters, with a lower frequency of food consumption, averaging 7 events per day. Regarding social behavior, it was noted that animals from such habitats were less tolerant, engaging in higher levels of territory defense (9.7 ± 0.8 events per day) and higher vigilance levels (12.6 ± 1.1 events per hour), while group bonding (3.4 ± 0.4) and grooming activity (3.1 ± 0.4 per day) dropped significantly. According to statistical analysis, there was a negative correlation between drought intensity and foraging efficiency, and a positive correlation between habitat stress and stress-related social behavior.

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Introduction

The grasslands are highly dependent on climatic variability, especially seasonal drought, as well as anthropogenic disturbances. Small grassland mammals, such as rodents and lagomorphs, play an extremely important role as seed dispersers, soil aeration agents, nutrient recyclers, and food for other predatory species (Fisher et al., 2021). Yet, due to climate change, which causes increased drought, and anthropogenic activities such as habitat fragmentation, overgrazing, conversion to agriculture, and human disturbance, the availability of resources in grasslands has changed (Kauffman et al., 2021; Patil, 2018; Rajan & Chawla, 2024). This can negatively affect both foraging ability due to decreased food availability and increased energy costs and social behavior, including group cohesiveness, territorial defense, communication, and predator-avoidance strategies (Rajan & Chawla, 2024). The main aim of this study is to examine how drought, seasonally, together with habitat disturbance, affects the foraging and social behavior of small mammals in grasslands. The current study seeks to assess behavioral changes arising from reduced resources and environmental disturbances that change vegetation cover in grassland habitats.

While many studies have focused on the effects of either drought or habitat disturbance on mammal ecology, there is very little evidence on the joint effects of both factors on the foraging behavior and social interactions of small mammals inhabiting grassland environments. Most existing studies focus on population decline

and habitat use, while fewer efforts have been devoted to behavioral flexibility and social adaptation to changing environments. It is also not clear whether there are any differences in the behavior of specific species at various stages of seasonal succession in tropical and semi-arid grassland ecosystems (Fox, 2011).

Based on the hypothesis, drought and habitat disturbance will lower foraging efficiency due to limited food sources and habitat complexity. They will also bring significant changes in social behavior, such as increased competition and territorial behavior.

The results of this experiment offer an ecological insight into how climatic stress and habitat disturbance affect the behavioral adaptations of grassland mammals. These results might be useful in behavioral ecology, conservation, and climate-resilience research by identifying behavioral indicators linked to environmental disturbances and adaptive behaviors in wildlife.

This paper is divided into six main parts; Introduction, Literature Review, Methodology, Results, Discussion, and Conclusion. In Section 1, there is an introduction to the ecological issue, objectives, gaps in literature, and the hypothesis. The previous findings on the effects of drought and habitat disturbances are summarized in Section 2. The description of methodology and techniques used for behavioral observations is covered in Section 3. Results include behavioral modifications in section 4, while their ecological significance is discussed in section 5. The last section covers conclusions from the research.

Literature Review

Seasonal drought and disturbance are major factors that impact the ecology of small grassland mammals, their foraging effectiveness, and social behaviors. Changes in rainfall, productivity of plants, and disturbance of the habitat lead to changes in resource availability and consequently affect movements, competition, and survival behaviors of mammals in grasslands (Kauffman et al., 2021). Research conducted to study the behavioral ecology of ungulates and mammals has revealed that factors like drought and disturbances result in changes in migration and behavior of mammals, thereby highlighting the importance of resource distribution in the ecology of animals (Kauffman et al., 2021). Additionally, fragmentation has been found to moderate or accentuate the impacts of drought on animals (Szangolies et al., 2025).

Studies involving mammals of drylands and grasslands have shown that low vegetation cover during droughts leads to limited availability of food sources, which makes the mammals expend more effort searching for food (Fox, 2011). Areas referred to as drought refugia have been shown to play an important role in ensuring survival of small mammals during climatic events due to their provision of stable sources of food and moisture. Social, burrowing herbivores play an important role in nutrient recycling, soil aeration, and ecosystem engineering, but these processes become less effective under high levels of disturbance (Davidson et al., 2012).

The adaptations in the activity and individual behaviours of African drylands suggest that environmental signals both diurnal and annual

can influence the behaviour of herbivorous mammals (Berry et al., 2025). Disturbances in the habitats owing to human disturbances, excessive grazing and ecological unbalance also lead to variations in trophic relationships and the use of resources by small mammals (Fox, 2011). Community-based strategies for conservation and restoration were recommended as an ideal approach to enhance sustainability and adaptability of the environment and the wildlife within a fluctuating climate (Dixit & Raje, 2024; Dickman et al., 2011). Also, climatic change can influence disease transmission and animal movement in pastoral environments (Reginald, 2024).

In summary, previous researches collectively confirm that the presence of seasonal droughts and disturbances can significantly impact foraging and energy dynamics of small grassland mammals.

Methodology

Study Area Selection

The experiment will take place in selected grassland biomes that exhibit different levels of seasonal drought conditions as well as habitat disturbances. The experimental locations will be selected based on their degree of habitat disturbance, either low, medium, or high, as a result of grazing activities, farming activities, or other human activities. Climatic factors like rainfall, temperature, and soil moisture will be monitored in order to establish the extent of seasonal droughts.

Selection of Study Organisms

The small mammals found on the grasslands, such as rats and other herbivorous or omnivorous animals, will be chosen according to their abundance and ecological relevance in the area being studied. The identification process will use traditional methods from textbooks. These animals will be observed in their natural environment without disturbing their natural behaviour.

Habitat Disturbance Assessment

Disturbance of habitats will be determined using ecological parameters like vegetation cover loss, grazing pressure, frequency of human presence, and soil degradation. Vegetation biomass, canopy cover, and resources of foods will be measured by quadrats and transects. The level of disturbance will be classified in three categories including low, moderate, and high levels of disturbances.

Behavioural Observation and Foraging Analysis

Observations will be made at times of peak activity using field observations, camera traps that are sensitive to movement, and focal animal sampling. Foraging efficiency will be measured using food search time, food consumption time, distance traveled, and food consumption frequency. The various behaviors like vigilance behavior, territorial behavior, grooming behavior, social interaction, and communication behavior will be documented during various seasons.

Seasonal Drought Monitoring

The data will be collected during periods of maximum activity through methods such as field observations, camera traps, and focal animal sampling. The foraging efficiency will be determined by means of measures such as time taken to find food, time taken to consume food, distance covered, and food consumption frequency. Behaviors like vigilance behavior, territorial behavior, grooming behavior, social behavior, and communication behavior will be recorded in different seasons.

Data Analysis

Data related to both behavioural and environmental factors will be analyzed statistically through the use of behavioral and ecological software packages. ANOVA analysis, regression models, and correlation analysis will be employed in order to determine the influence of both droughts and disturbance on foraging efficiency and social behavior. Behavioral indices and analyses of activity patterns will also be conducted.

Results

Variation in Habitat Conditions Across Study Sites

There were notable effects brought about by seasonal droughts and habitat disturbance on the grassland environments within the selected research sites. The highly disturbed habitats recorded low vegetation density, less soil moisture content, and less availability of food resources than the undisturbed habitats. The moderately disturbed habitats had conditions that

fell between those of the highly disturbed and the undisturbed habitats.

Changes in Foraging Efficiency During Seasonal Drought

The ability to forage efficiently in small grassland mammals was greatly hindered by

periods of drought. Highly disturbed environments had animals taking more time foraging since there were fewer resources available due to less vegetation. On the other hand, undisturbed regions had animals demonstrating a constant foraging pattern and low energy consumption.

Table 1: Effect of Seasonal Drought and Habitat Disturbance on Foraging Behaviour

Habitat Category	Mean Food Search	Feeding	Mean Movement	Food Intake Frequency
	Time (min)	Duration (min)	Distance (m)	(events/day)
Undisturbed Habitat	5.2 ± 0.8	18.4 ± 1.5	24.6 ± 2.3	15.8 ± 1.2
Moderately Disturbed Habitat	8.9 ± 1.1	14.2 ± 1.3	39.5 ± 3.1	11.6 ± 1.0
Highly Disturbed Habitat	13.5 ± 1.7	9.6 ± 1.1	58.8 ± 4.4	7.3 ± 0.9

From table 1, it is evident that both drought and disturbance of habitats had a significant effect on the foraging efficiency of small mammals found in the grassland ecosystem. Mammals living in disturbed habitats took longer to search for food, covered longer distances, and

had less frequent feeding than those in undisturbed habitats.

Alterations in Social Behaviour Under Environmental Stress

Significant changes in social behaviour were observed during the drought season.

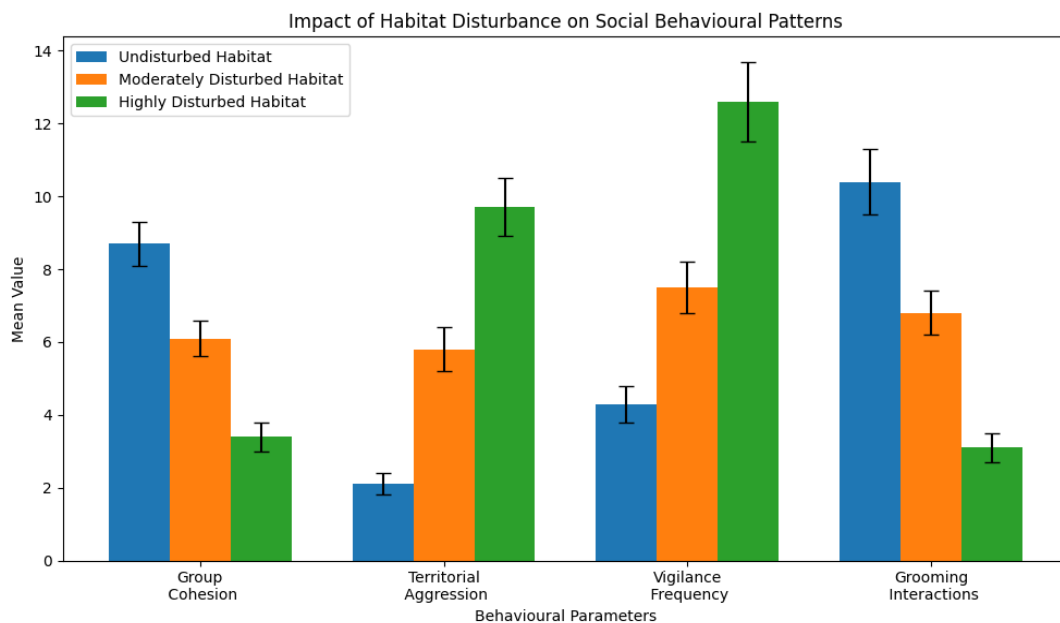


Figure 1: Impact of Habitat Disturbance on Social Behavioural Patterns in Small Grassland Mammals

The mammals living in the highly disturbed environment showed signs of increased aggression toward territory, high vigilance, and low cooperation among the groups. On the other hand, the mammals living in an undisturbed environment retained constant group cohesiveness, grooming, and less stress interactions.

Figure 1 can help show variations in social behavioral parameters depending on the level of disturbance from undisturbed to moderately disturbed and highly disturbed environments. These include the decrease in cohesion and grooming behavior and an increase in territoriality and vigilance behavior.

Relationship Between Drought Severity and Behavioural Adaptation

Analysis through statistics showed there was a significant negative correlation between drought intensity and feeding success, whereas social stress factors had a significant positive correlation with habitat disturbances. The effects of droughts on behavior and feeding habits were seen to increase due to drought intensity. This shows how environmental stress affects behaviors of small grassland mammals.

Discussion

The current study showed that seasonal drought and habitat disturbance had significant effects on the foraging efficiency and social behavior of small grassland mammals. Highly disturbed habitats showed higher values for the duration of food searching (13.5 ± 1.7 min), the distance moved (58.8 ± 4.4 m), and lower number of feeding incidences

(7.3 ± 0.9 events/day). In terms of social behavioral measures, increased numbers of territorial attacks (9.7 ± 0.8 events/day), as well as vigilant activities (12.6 ± 1.1 events/hour), were observed, accompanied by decreased group cohesion (3.4 ± 0.4) and grooming (3.1 ± 0.4 interactions/day). From the above, it is clear that stress resulting from environmental changes such as drought and degradation of the habitat affected behavioral adaptations in small grassland mammals. Vegetation cover became low, and therefore food availability was low, and it meant that animals had to move longer distances to obtain food. Additionally, due to the limited resource availability, more competition occurred, leading to aggressiveness and vigilant behaviors among animals; cooperation was not common in the stressed environment. The current study provides useful information about the field of behavioral ecology that might help in developing conservation measures in relation to climate change. The study had been confined to some particular areas of grasslands and was based on observations during different seasons. No detailed study had been conducted about the physiological reactions and gene adaptations of the particular species along with the population dynamics. Moreover, factors like the presence of predators and interspecific competition may also affect the behavior of organisms. Further researches are recommended that should include long-term observations, biochemical stress markers, and molecular biology techniques.

Conclusion

The current research focuses on the issue related to the ecology concerning seasonal

droughts and habitat disturbance impact on the foraging and social behavior of small mammals living in grassland ecosystems. As the environmental conditions deteriorate due to the decreased number of vegetation and food sources and habitat destruction, behavioral instability becomes an evident threat for the life of animals. According to the results, foraging efficiency and social behavior of small mammals in highly disturbed habitats were characterized by elevated values of food searching time (13.5 ± 1.7 minutes) and movement distance (58.8 ± 4.4 meters) with a decrease in the number of food intake attempts per day (7.3 ± 0.9 times). In relation to the social behavior, the increased rates of territorial aggression (9.7 ± 0.8 times/day) and vigilance (12.6 ± 1.1 times/hour) occurred simultaneously with the reduction in group cohesiveness (3.4 ± 0.4) and grooming contacts (3.1 ± 0.4 times/day). Thus, this experiment showed that seasonal drought and habitat disturbances have a significant effect on the behavioral changes of small grassland mammals by increasing their energetics, competitiveness, and defense behavior, but not cooperation. The major lesson learned from this research is that good habitat quality and stable climate are necessary for sustaining ecological equilibrium and behavioral flexibility within mammalian populations in the grasslands. The results of the research underscore the significance of preserving grasslands, restoring habitats, and adopting climate adaptation methods to conserve biological diversity.

Author contribution

Conflict of interest

The authors declare no conflict of interest.

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Ethical Consideration

All behavioural observations were conducted under natural conditions without causing harm, stress, or disturbance to the animals or their habitats. Field investigations followed ecological research ethics and biodiversity conservation guidelines to ensure minimal environmental impact.

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