

#7594 APPLICATION OF PRECISION AGRICULTURE TECHNOLOGIES IN GRAZING: EXAMPLE OF GOATS BROWSING IN FOREST RANGELANDS OF NORTHERN MOROCCO

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ABSTRACT

The aim of this study was to characterize patterns of grazing behavior of goats in a Mediterranean forest rangeland. We conducted a one-year study in Chefchaouen region, Northern Morocco, during two contrasting seasons (spring and summer) using new technological tools. Eight goats were simultaneously fitted with GPS collars and sensors for 3 days during each season. A calibration study and classification tree analysis were used to predict other grazing activities of goats (eating, walking, and standing without grazing). During spring, goats tended to select lower elevation feeding stations (1070 vs 1200 m), traveled a short distance (5.9 vs 8.5 km), and grazed in a small area (12 vs 15 ha). Due to low forage availability and stressful conditions during summer, goats increased walking and lying activities at the expense of grazing (eating). These findings contribute to a better understanding of the grazing behavior of goats in forested rangelands. Overall, the application of precision agriculture technologies in grazing could be useful for better spatio-temporal management of herds.

INTRODUCTION

The extensive goat production system is one of the most important components of agricultural systems in the southern Mediterranean side. In Northern Morocco, forest rangelands areas have always formed an integral part of goats feeding (Chebli et al., 2018). These forest pastures constitute an important forage reserve, protecting goats during feed gaps and drought periods (Chebli et al., 2020a).

Grazing is associated with daily activities significantly different from those of animals in confinement, such as grazing and traveled distance. Several researches has been undertaken to explore the potential for precision agriculture in the livestock system. Unfortunately, few studies have focused on the grazing activities of goats, especially in the woodlands. Effective management of goats on North Moroccan forest rangelands requires understanding their grazing behavior to develop targeted decisions to improve grazing and feeding strategies. It is quite difficult to understand the grazing behavior of goats, especially in a complex Moroccan forest rangeland. A challenge for research is to analyze the grazing behavior of goats by using precision agriculture technologies.

The objective of the present study was to investigate the grazing behavior of goats in a Mediterranean forest rangeland using new technologies, considering two contrasting seasons of the year.

MATERIALS AND METHODS

The research was carried out in Chefchaouen region, which is located in Northern Morocco (35°15'N; 5°24'W). Eight alpine goats were selected from a representative goat farm

breeding a flock of 52 heads grazing year-round. The experiment was conducted during the two contrasting seasons of the year, spring, and summer.

The forage availability was estimated during each season as described by Chebli et al. (2017 and 2020a). The measurements were undertaken in the last month of each studied season. To estimate activities of goats during grazing, each one was simultaneously fitted with GPS collars (locomotion activities) and pedometer sensors (steps, the time spent lying and standing) for 3 days during each studied season. A calibration study and classification tree analysis were used to predict grazing activities of goats at 5 min intervals as described by Brassard et al. (2016). The classification and regression tree (CART) analysis were used to construct the classification trees. Data were analyzed using SAS software (SAS Inst. Cary, NC, USA). All parameters were analyzed according to PROC MIXED procedure. For all analyses, the significance level was declared at $P < 0.05$.

RESULTS AND DISCUSSION

The study area is considered as a degraded forest rangeland. It was mainly covered by heterogeneous vegetation composed of three distinct groups of plant species: herbaceous, shrubs (*Arbutus unedo*, *Calicotome villosa*, *Cistus spp.*, *Erica arborea*, *Lavandula stoechas*, *Myrtus communis*, *Phillyrea media*, *Pistacia lentiscus*, *Rubus ulmifolius*), and trees (*Quercus suber* and *Olea europaea*). The results indicated a higher forage availability during spring (1645 kg DM/ha) compared to the summer (911 kg DM/ha). This result can be explained by the growing conditions of each plant favored mainly by precipitation recorded during winter and early spring. The declines of forage availability during summer are also reported in similar studies (Schlecht et al., 2009; Chebli et al., 2020b).

Figure 1 displayed the variation of grazing activities of goats during both studied seasons. All studied parameters of grazing activities of goats varied significantly with the season ($P < 0.05$), which was confirmed by several authors (Safari et al., 2011; Rodrigues et al., 2013). During summer, goats graze in a large area (15 vs 12 ha) and traveled towards the high altitudes (1200 vs 1070 m) compared to the spring season. Due to the low forage availability recorded during the dry season (summer), goats search for more favorable feeding stations, which are located mainly in high altitudes. This was confirmed by the high vertical distance traveled by goats during summer compared to the spring (646 vs 205 m). Also, the number of steps was numerically greater (9490 vs 6983) and the horizontal distance traveled by goats was higher (8.5 vs 5.9 km) during the dry season. This result could be explained by the low abundance of preferred shrubs and herbaceous during the summer. Similarly, Zampaligré and Schlecht (2017) reported that the abundance of palatable species decreased the traveled distance of goats. Moreover, the seasonal changes in goats grazing activities could be explained by the duration of grazing day, which was shorter in spring (7 h) and longer during the summer (10 h). The goats prolonged their lying time in summer in comparison to the spring (22 vs 12 %) at the expense of standing duration. In order to increase grazing (eating) time, the herder extends the duration of grazing day of goats to recover the lost times allocated for lying and walking during the summer. Besides, increased time of lying could be also linked to the increasingly stressful conditions (high temperature and humidity) recorded during the dry season. In accordance with many relevant studies, forage availability is the major determinant of grazing activities (Schlecht et al., 2009; Zampaligré and Schlecht, 2017).

As observed in this study, goats traveled considerable horizontal and vertical distances, which could increase their energy expenditure in contrast to goats in the flat rangeland.

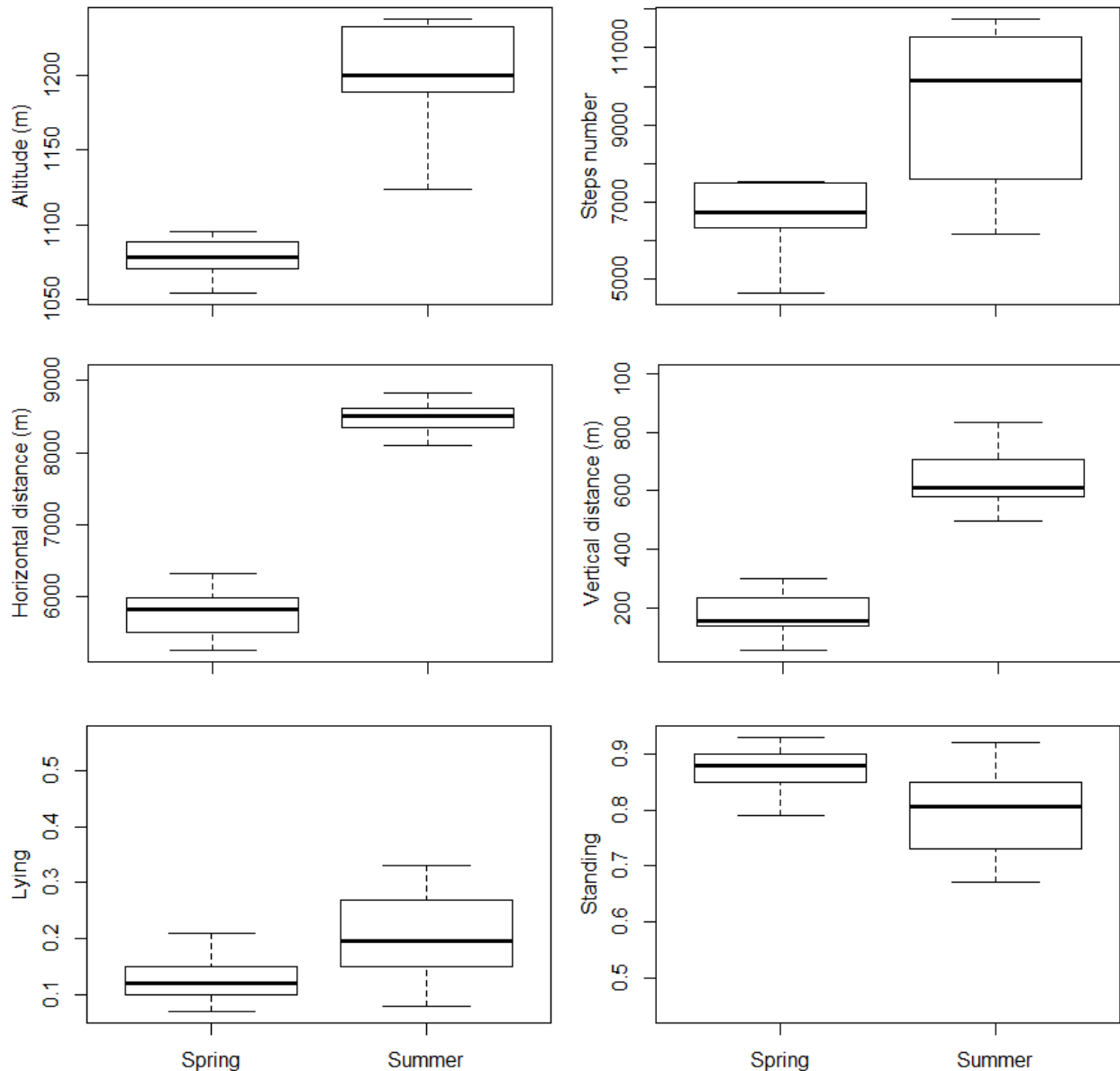


Figure 1. Grazing activities of goats in a forest rangeland of Northern Morocco.

CONCLUSIONS

The results contribute to a better understanding of the grazing behavior of goats in forest rangelands. These findings could be used as the first guide for future studies and managers interested in grazing activities of goats. Overall, the application of precision agriculture technologies in grazing could be useful for better spatio-temporal management of herds.

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