USING PRECISION TECHNOLOGIES TO MONITOR THE GRAZING ACTIVITIES OF GOAT IN A NORTH AFRICAN WOODLAND #9515

Y. Cheblia[1], J.F. Cabarauxb[1], S. El Otmania[1], and M. Chentouf[2]
[1]Regional Center of Agricultural Research of Tangier, National Institute of Agricultural Research, Rabat, Morocco. [2]Faculty of Veterinary Medecine, University of Liège, Belgium
e-mail: youssef.chebli@inra.ma

ABSTRACT

In the North of Africa, browsing on natural pastures is the main source of feed for domestic goats. Livestock farming, particularly grazing goats, constitutes the prevalent agricultural activity in the mountainous areas of Morocco. Data on animal behavioral activities are essential for understanding their feeding and their interaction with the environment to define the optimal management intervention strategies. The recent development of precision farming technologies and the increasing availability of sensor technologies to monitor and record behavioral activities provide a real opportunity to extend our database and to understand the grazing behavior of animals. This work was conducted to understand the grazing activity of browsing goats in Northern Morocco by using the Global Positioning System (GPS) and accelerometers. Measurements were undertaken in oak cork rangeland during the three main grazing seasons (spring, summer, and fall). Grazing activity parameters were assessed using GPS collars and leg position sensors on eight experimental goats. The results showed that grazing time was higher in spring (57%) than in summer (39%) and fall (41%), respectively (p<0.001). The daily vertical distance traveled by goats increased from spring (about 0.3 km) to summer and fall (about 0.6 km), while greater daily horizontal distances were recorded over similar distances during summer-fall. The highest speeds were recorded during spring (0.198 m/s). Goats spent more time walking in fall than in spring and summer. The combination of an accelerometer and GPS collar provided the opportunity to monitor and understand the grazing activities of goats in a mountainous woodland in Northern Morocco. These results could provide useful and target information for herders and managers to enhance the grazing strategies of goats.

INTRODUCTION

In Northern Morocco, forest woodlands contribute largely to the feeding of goat herds (Chebli et al., 2018). These forest pastures constitute an important fodder reserve, guaranteeing a permanent source of fodder for goats during drought periods (Chebli et al., 2020). The grazing of animals on the rangelands is associated with very different daily activities from those of confined animals. Unfortunately, few studies have focused on the grazing activities of goats, especially in forest areas. To contribute to the spatio-temporal management of goats on rangeland, it would be essential to discover the relationship between goats and their environment.

Advances in the development and use of Global Positioning System (GPS) and sensor technology have provided useful near-real-time information on animal activity and behavior to increase livestock productivity and monitor the use of space. In this context, this study aimed to assess the potential for the adoption of smart grazing using GPS collars and accelerometers as a tool for monitoring goat grazing activities in the North African forest rangelands of Northern Morocco.

MATERIALS AND METHODS

This experiment was carried out at a goat farm located in the province of Chefchaouen. Goat grazing activity measurements were collected over three days of the three main grazing seasons (spring, summer, and fall). Winter was excluded from the study because the goats' herd is generally confined during this period.

Eight Alpine dairy goats were equipped with GPS collars and triaxial accelerometers. The GPS collar was used to estimate locomotion activities (traveled distance, speed, and altitudinal locomotion). The accelerometer was used to estimate the physical activities (animal lying or standing and the number of steps).

ArcGIS 10.x was used to calculate in meters (m) the (x,y) coordinate system for each fixed record from the GPS collars. The Euclidean geometry between two successive pairs of fixed locations L_1 (x_1, y_1) and L_2 (x_2, y_2) was used to calculate the horizontal distance.

A trial (calibration) was conducted to monitor the grazing activity of the experimental goats. Calibration was performed prior to experimentation over a period of 3 days in combination with direct visual observations of animal behavior. The data obtained was used to predict the grazing activities of each experimental goat using classification and regression tree analysis of data collected from electronic monitoring sensors.

Data analyses were performed using SAS software. Grazing activity data were analyzed according to the PROC MIXED procedure of SAS with the daily observation of each goat as the experimental unit. Parameters were compared across seasons (i.e., spring, summer, and fall). For all analyses, the level of significance was declared at $p<0.05$. In case of significant effect, the means were compared using Tukey's test.

RESULTS AND DISCUSSION

All behavioral variables showed significant differences within each measurement season ($p<0.01$). Fig. 1 shows the seasonal importance of activities of the experimental goats grazing in the studied forest rangeland. According to the classification and regression tree analysis, the percentage of time spent grazing (eating) was greater in spring (57%) than in summer (39%) and fall (41%). As reported by several authors (Safari et al., 2011; Chebli et al., 2020), the high forage availability recorded in the spring explains the increase in the time allocated to grazing. Conversely, the low forage availability recorded during the summer and fall could explain the longer time reserved for walking without grazing. During these two seasons, the plant species preferred and most selected by the goats are rare, which explains the long time devoted to the search for palatable vegetation. Walking activity is more related to the longer duration of forage search and selection by animals. The proportions of time spent lying were highest in summer (13%), followed by fall (11%) and spring (4%). In the studied forest rangeland, lying activity was more concentrated at the mid-day when the sun was highest. In summer, goats prefer to rest in the shade of trees to avoid the mid-day heat. Resting while standing was similar in all seasons (about 22%). Similarly, grazing animals are known to be more active during the early and late hours of the day but less active during mid-day due to heat and humidity.

The time reserved for locomotion activities was different according to the seasons ($p<0.001$, Fig. 2). According to the GPS collar data, the horizontal and vertical distances traveled by the experimental goats were significantly higher and similar during summer and fall. Similarly, the number of steps recorded the highest values during summer and fall (>7100 steps) compared to spring (5000 steps). The low availability of fodder leads to an increase in the time spent by the animals in search for palatable vegetation which, consequently, increases their locomotion activities such as the number of steps.

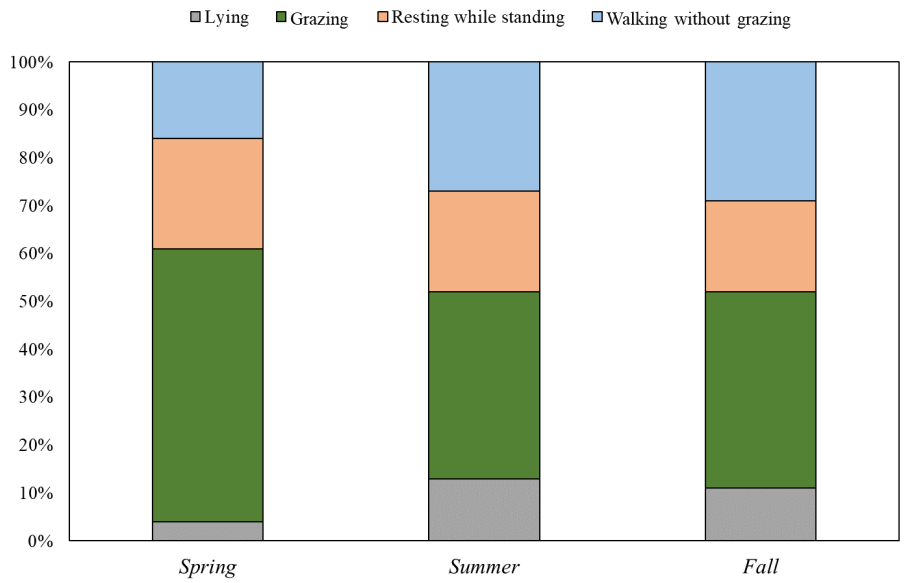

Fig. 1. Seasonal variation in grazing activities of dairy goats in a woodland of Northern Morocco.

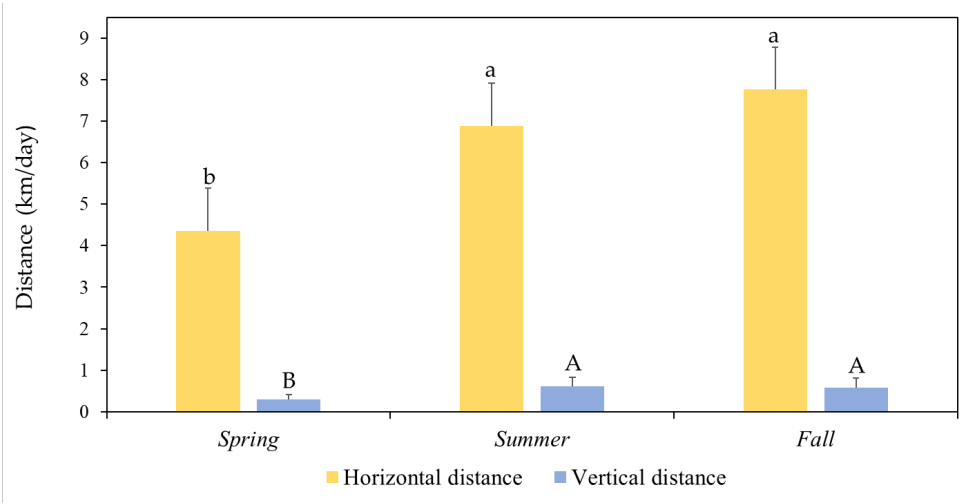

Fig. 2. Seasonal variation in displacement activity of dairy goats grazing in a woodland of Northern Morocco. The values of horizontal a-b or vertical A-B distances with different letters are significantly different ($p < 0.05$).

CONCLUSIONS

It could be confirmed that the grazing activities of goats mainly depend on the season. The combination of GPS collar and leg sensor technologies to monitor and record goat grazing activities provides useful information to understand the grazing behavior of goats grazing in the complex forest rangelands of Northern Morocco.

REFERENCES

Chebli, Y., Chentouf, M., Ozer, P., Hornick, J.L., Cabaraux, J.F. 2018. Forest and silvopastoral cover changes and its drivers in northern Morocco. Appl. Geogr. 101: 23–35.

Chebli, Y., El Otmani, S., Chentouf, M., Hornick, J.L., Bindelle, J., Cabaraux, J.F. 2020. Foraging behavior of goats browsing in southern Mediterranean forest rangeland. Animals, 10, 196.

Safari, J., Mushi, D.E., Kifaro, G.C., Mtenga, L.A., Eik, L.O. 2011. Seasonal variation in chemical composition of native forages, grazing behaviour and some blood metabolites of Small East African goats in a semi-arid area of Tanzania. Anim. Feed Sci. Technol. 164: 62–70.