Determining Cattle Pasture Utilization Using GPS-collars

Bedömning av hur nötkreatur använder betesmarker – En studie med hjälp av GPS-halsband

Sanna Kjellqvist

Sveriges Lantbruksuniversitet **Skara 2008** **Studentarbete 208**
Institutionen för husdjurens miljö och hälsa
Etologi- och Djurskyddsprogrammet

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Sanna Kjellqvist

Examensarbete, 15 hp, Etologi- och Djurskyddsprogrammet

Handledare: Jens Jung, Sveriges Lantbruksuniversitet, Institutionen för husdjurens miljö & hälsa, Avdelningen för etologi och djurskydd, Box 234, 532 23 Skara.

Abstract

This study was conducted in Jaboticabal, Brazil, on Nelore cattle. Three heifers on the same pasture were equipped with GPS-collars registering position and activity, allowing us to calculate distance to the other collars and distance to the water source. After one week the GPS-collars were taken of and put on three heifers on another pasture. This was repeated on seven different pastures on total 21 heifers. The results indicate that the cattle are more active during the afternoons than in the mornings and have a shorter avtiviyu period during the night. In conjunction with the results of Einemo (2008) it is concluded that the high activity during the afternoon means the animals are mainly grazing during that period. Results show the cattle spread out when active but like to huddle up together while resting. Compared to when active, the animals also seem to prefer to rest at a distance from the water.

Sammanfattning

Denna studie skedde i Jaboticabal, Brasilien på boskap av rasen Nelore. Tre kvigor på samma bete blev utrustade med GPS-halsband som registrerade djurens position och aktivitet så att vi kunde beräkna avståndet mellan de andra halsbanden och till djurens vattenbehållare. Efter en vecka togs halsbanden av och sattes på tre andra kvigor på ett nytt bete. Totalt användes sju betesmarker och 21 kvigor. Resultaten visar att djuren är mer aktiva under eftermiddagarna än under morgon och förmiddag samt under en kortare perido på natten. Kombinerat med resultaten av Einemo (2008) drar jag slutsatsen att den höga aktiviteten under eftermiddagen betyder att djuren främst spenderar den tiden med att beta. Resultaten visar att djuren är utspridda medan de betar men vilar tillsammans i grupp. Jämfört med deras aktiva tid verkar djuren föredra att vila på avstånd från vattenkällan.

Content

Background

GPS (Global Positioning System) is a relatively new method for conducting studies on the behaviours and movements of animals (Agouridis et al. 2004). This technique is commonly used for tracking the movements of wild animals but has just recently become way of studying cattle and other domestic animals (Agouridis et al. 2004).

To track an animal's location in the field the traditional way is by visual observation (Agouridis et al.). This is a demanding method that requires hard labour and is prone to error because the observer can change cattle movement, observer fatigue can become a problem and the periods of observation are often too short to give clear results (Agouridis et al. 2004; Coughenour, 1991). With the goal of incorporating the information into cattle management practices the University of Kentucky began using GPS collars on cattle in the 1990's (Coughenour, 1991). To study landscape use by animals you require recordings of individual animals' locations over the same time period (Coughenour, 1991). The study of free-ranging animals has been held back because obtaining and comparing such data presents both technical and logistical difficulties (Coughenour, 1991). But, by using GPS-collars to track the animals' movements' researchers now have the ability to collect a larger and more accurate data set (Agouridis et al. 2004).

The precise animal location recording of the GPS-collars allow researchers to evaluate animal pasture utilization, animal performance, and the behaviour of grazing cattle (Turner et al. 2001). GPS technology can assist researchers in assessing the qualities of pastures or paddocks (Turner et al. 2001). This includes: shapes and sizes; fence designs; grazing systems; forage composition and availability; location of shade, water, and supplements; and other variables that affect beef cattle operations (Turner et al. 2001).

Many species of wildlife have previously been tracked using GPS-collars, for example: moose (Moen et al. 1996; Dussault et al. 1999), deer (Licoppe & Lievens 2001; Sibbald et al. 2001), elk (Rumble et al. 2001), caribou (Johnson et al. 2002), and elephant (Blake et al. 2001).

By using GPS-collars in combination with geographic information systems (GISs) information such as animal distribution and movement can be related to different features in a landscape (Ungar et al. 2005), this has been done with sheep (Rutter et al. 1997; Hulbert et al. 1998) and cattle (Ganskopp 2001).

Study objective and hypotheses

The aim of this study is to examine how cattle use their pastures by using GPS-collars to track their movements. Specific questions where:

- Do cattle choose between grasses of different biomass?
- How does the cattle's daily rhythm look like?
- Do the distance between the animals change during the day?

Based on that the hypothesis were:

- The cattle will choose grasses of certain biomass over others.
- The cattle will be more active during certain parts of the day, either morning or afternoon.
- The distance between the animals will change during the day.

Materials and Methods

This study was conducted as a part in a cooperation between the Brazilian university UNESP and the Swedish university SLU and was performed in Jaboticabal, Brazil. This report is part of a study together with with Anna Einemo (2008), to whch I contributed with tow weeks data collection. The study took place on the university grounds of UNESP in Jaboticabal and the herds consisted of 6-8 Nelore heifers (*Bos indicus*). The pastures had a size of approximately 1 ha and consisted of grass, without trees and with very few bushes.

GPS-Collars

GPS-collars were fastened around the neck of three of the heifers in one group for one week. After a week the GPS-collars were removed and the collected data downloaded, the GPS-collars were then reset and fastened on three heifers in a new group. A total of seven groups were used. The GPS-collars registered the animal's position on five-minute intervals. Apart from position the GPS-collars also registered the distance between each other and the water dispenser. The GPS-collars were also equipped with motion sensors to register the animals activity. The data was analysed in Excel, Minitab 15 and in ArcGIS.

Maps

To examine if the animals prefer grass of a certain biomass their positions on their pastures registered by the GPS-collars was incorporated on to maps displaying the pastures biomass. The maps display biomass by using different colours for grasses of different biomass. Six of the pastures has its own map with all positions registered by the GPS-collars displayed as dots on the map. The maps were provided by the brazilian university UNESP.

Results

Figure 1 shows the activity pattern during 24 hours. "Activity" is the index of recorded movements of the animals or their necks, "Distance travelled" are the distance between tow recordings in meters. The animals had an activity peak in late afternoon. There is also a peak (dubbelt så mycket jämfört med natten ör en rejäl ökning) in distance travelled between registered positions during that same time. Furthermore, these results seem to show that the cattle have a period of higher activity during the late hours of the night and very low activity during the early morning. However, there is a smaller activity peak after midnight.

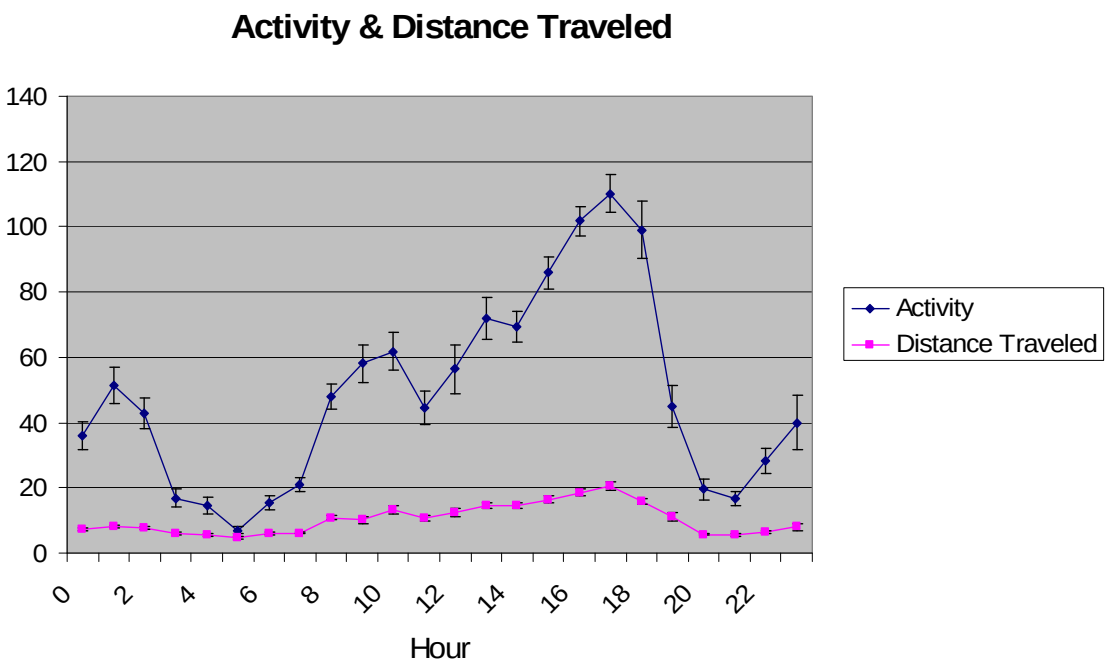


Figure 1: The activity registered by the GPS-collars movement sensors, compared to the distance traveled between GPS-positions, as means ± SE.

Looking at the distance between the animals during the day (figure 2), the cattle seem to be further apart from each other in periods of high activity and closer together during low activity. The results also indicate that the animals are in some distance from the water dispenser during the period of lowest activity.

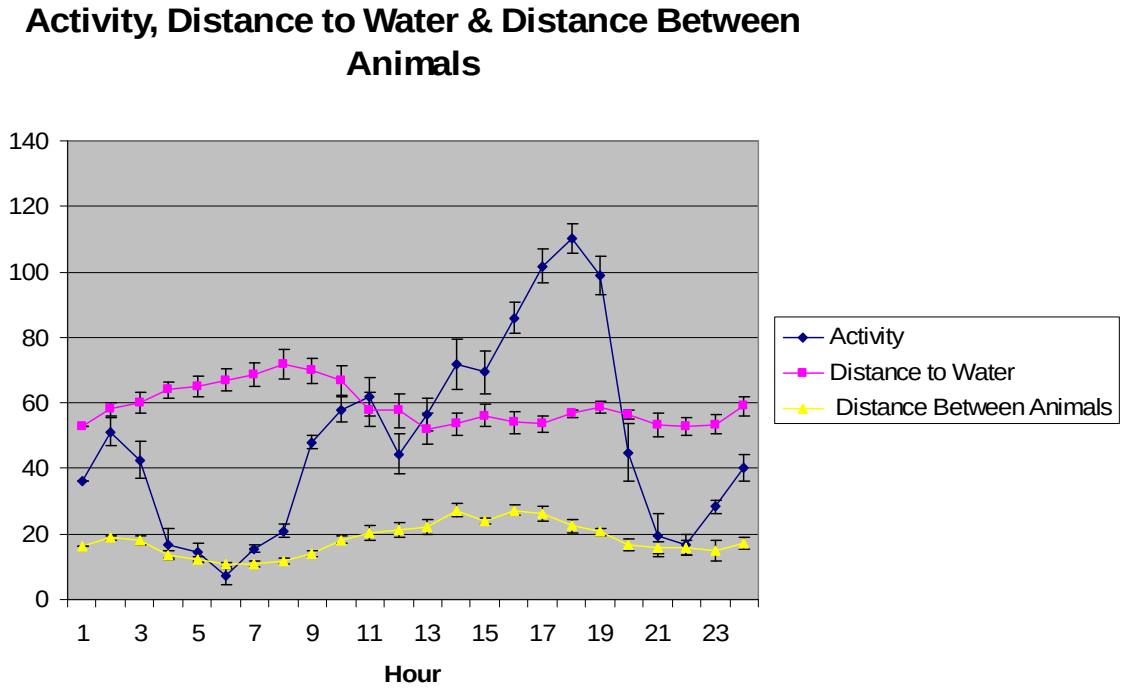
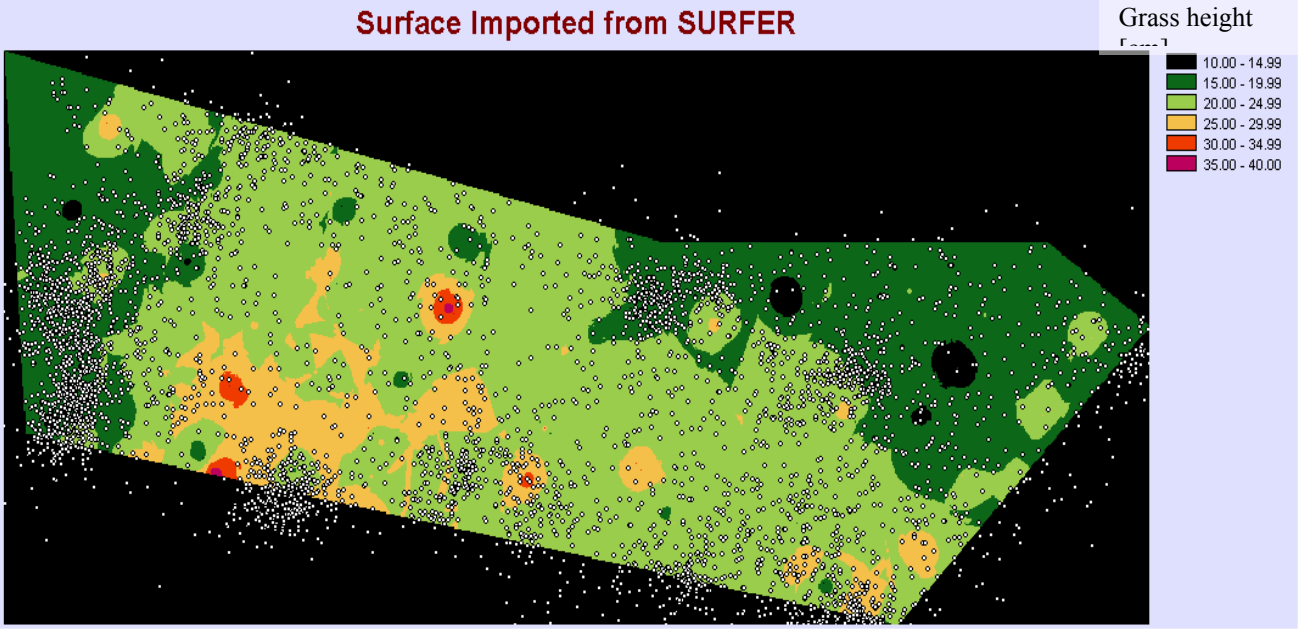


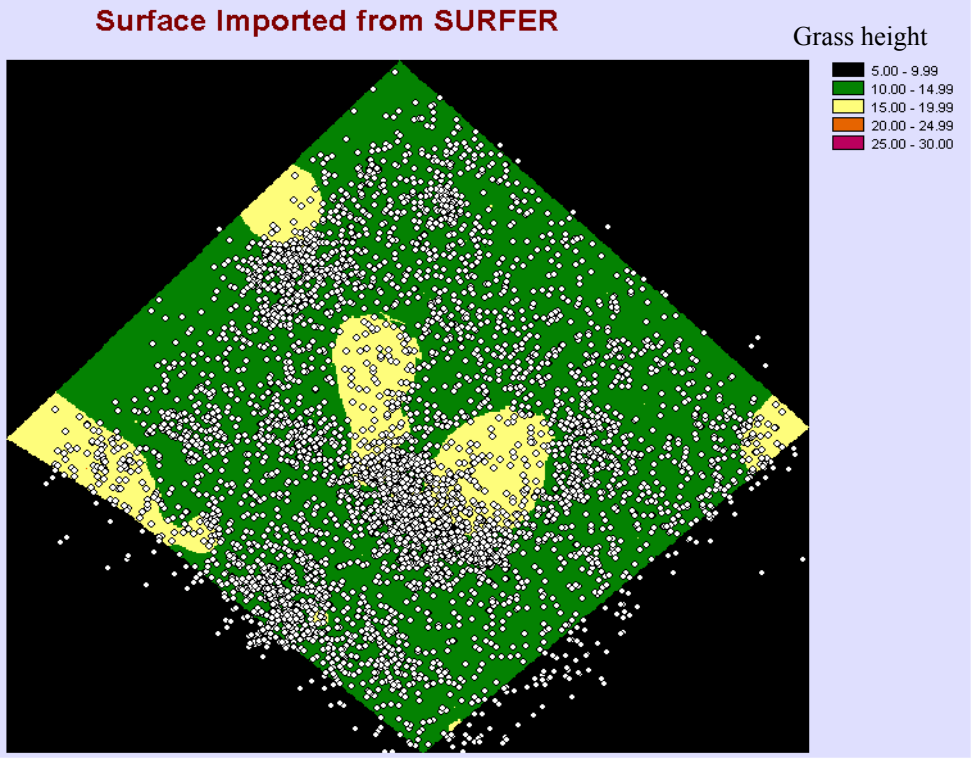
Figure 2: Distance to water and distance between animals (both measured in meters) compared to the activity index registered by the movement sensors, as means ± SE.

Biomass

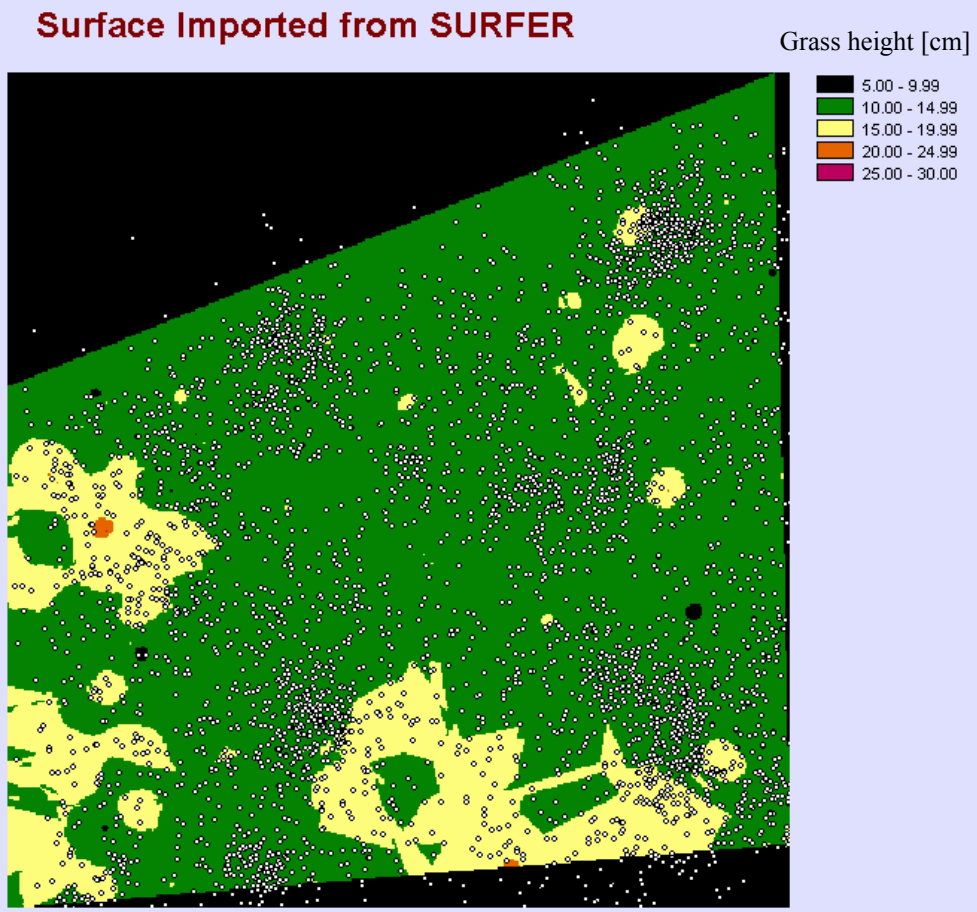
The results of the maps seem inconclusive as cattle on different pastures choose grass of different biomass. However, they seem to prefer grass between 20-30 cm. Apart from the pasture on map 4 the cattle seem to spend less time in the areas on their pastures with the highest grass (lowest biomass). Also the shortest grass in each pasture seems to be avoided.



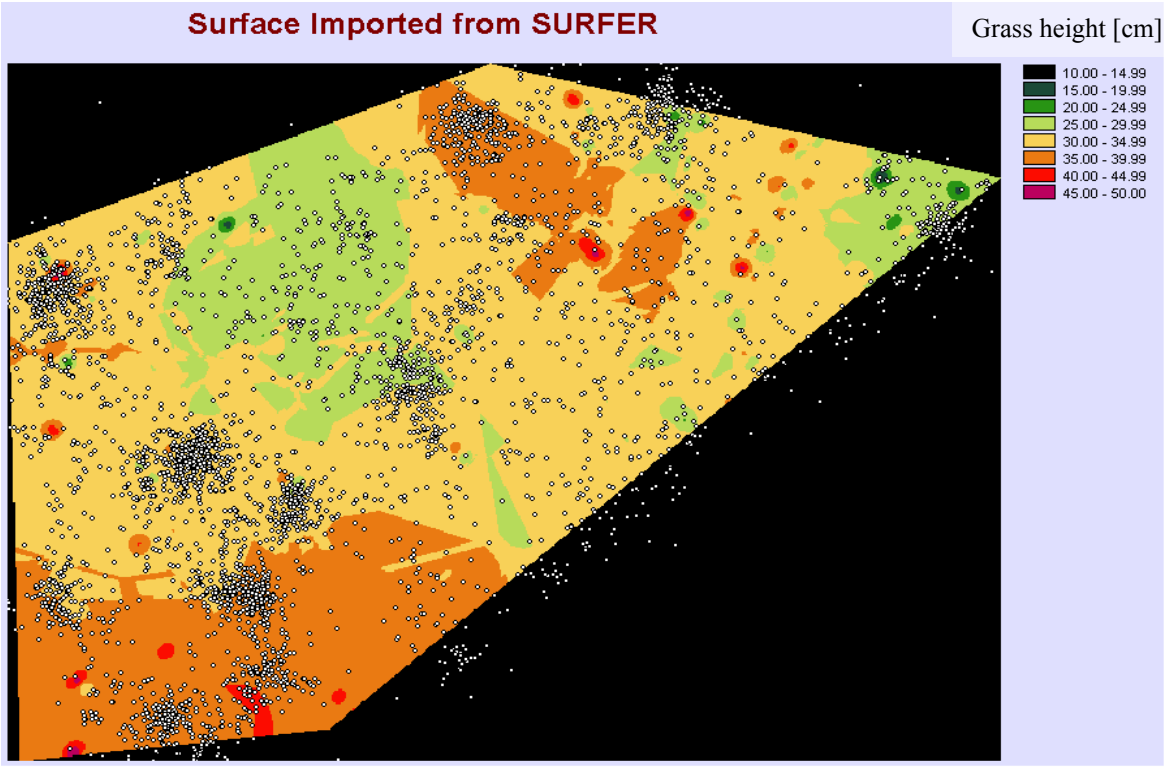
Map 1. The cattle on this pasture appeare to prefer a grass hight of 15-20 cm. The paches of grass between 10-15 cm and 30< cm seem to be avoided.



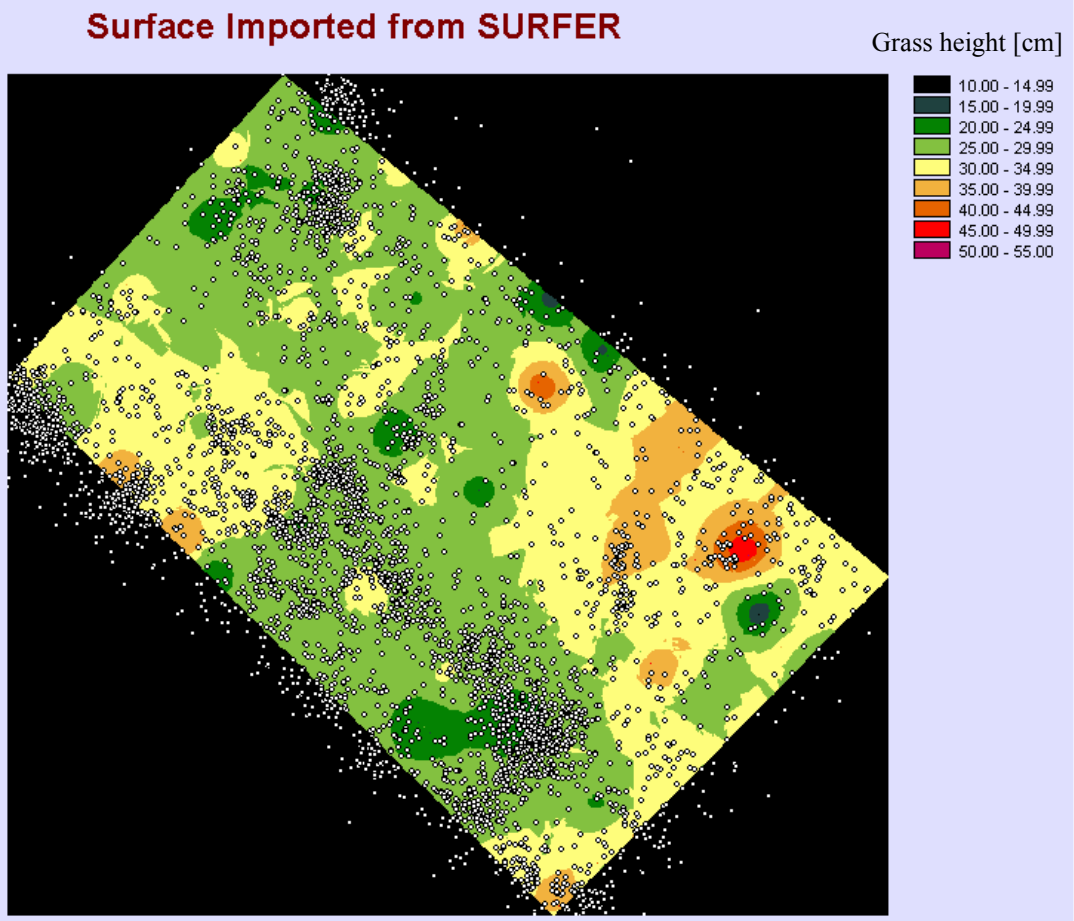
Map 2. This pasture suggests that cattle prefer a grass height of 10-15 cm.



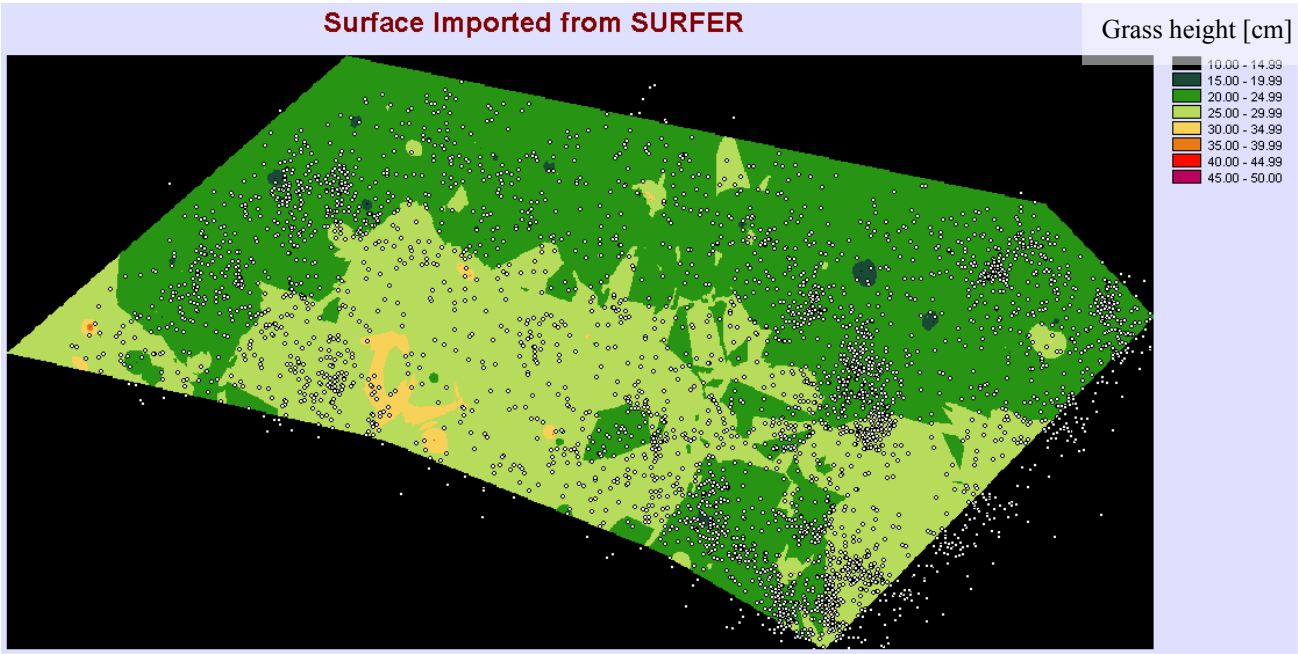
Map 3. On this pasture the cattle seem to prefer grass 10-15 cm high. Grass >10 cm and 20< appears to be avoided.



Map 4. The cattle on this pasture seem to have a slight preference for the 35-40 cm high



Map 5. On this pasture the cattle seem to prefer a grass hight of 25-30 cm. The animals avoid grass >25 cm and 35< cm.



Map 6. The cattle on this pasture seem to prefer grass of 20-25 cm and avoid higher or lower grasses than 20-30 cm.

Discussion

Activity

As seen in figure 1, the animals had a high peak in activity during the afternoon and a smaller one during the late hours of the night. They showed very low activity during the early morning. There is also a slight peak in the distance travelled during the afternoon. Looking at the distance between the animals during the day (figure 2), the cattle seem to be more spread out in periods of high activity and closer together during low activity. The results also indicate that the animals are in some distance from the water dispenser during the period of lowest activity.

These results were expected from the study of Einemo (2008) with the visual observations. It became obvious during these direct observations that the cattle hade one long grazing period during the morning. However, the main part of the grazing started around 15:00 and continued until the end of the observation period at 18:00. According to the results from the movement sensors on the GPS-collars they seem to continue to graze until it was past 19:00. Not quite unexpected due to the long night, they seemed to have a small grazing period during the late night.

Usually, cattle are most active at sunrise and sunset (Albright, 1993). The activity of the animals in my study is much higher during the afternoon (figure 1). Einemo (2008) shows that the high activity correlates greatly to the grazing behaviour of the cattle. According to Albright (1993) around 60 % of the cattle's total grazing time occurred between 07:00-15:00 and about 40 % between 17:00-04:45. The relation between the time periods remained quite constant under all weather and pasture conditions (Albright, 1993). This supports the results of this study.

Albright (1993) also found that almost 85% of the total grazing time was spent during daylight and only 15% during the night. According to Albright (1993) dairy cattle generally have six cycles of grazing: four between morning and afternoon milkings, one immediately after the cows were let out on the pasture following milking, and one or two during the night. The findings in my study also indicate that the animals do not sleep through the night but have a period during the earliest hours of the day which they most likely spend grazing. Grazing during the night could be more common in the summer and under tropical conditions because, in hot weather conditions, cattle prefer to graze when it is cooler (Albright, 1993). In my study, the daily rhythm of the focal animals was not influenced by milking.

The conclusion that the animals spend the afternoon grazing is supported by the fact that the animals moved further during the same time, as grazing requires the animals to move around more. Grazing cattle seldom stop for more than a few moments on the same patch of grass but move around continuously, probably searching for more appetizing grass (Albright, 1993). Feeding behaviour is affected by the condition of the animals teeth, the age of the cattle, the kind of feed as well as the climate (Albright, 1993). The fact that the grazing occurs during the afternoon could be because of the climate in Brazil. Under hot weather conditions, cattle prefer to graze during the mornings and evenings because it is cooler during those hours (Albright, 1993). The same may very well apply to the Nelore cattle used in this study. Since it is very hot during the days it should be more energy efficient to rest and conserve energy during the hottest hours of the day. Then when the

temperature starts to decrease the animals start grazing and seem to continue to do so until it gets dark. During the hotter midday they seek cover, rest, or rumination (Albright, 1993).

It seems the cattle are further from the water dispenser during the early hours of the morning, when the animals are most inactive (figure 2). This suggests that the animals prefer resting in some distance from the water or at least not seek the vicinity to water. In this case it could simply be because the water dispenser is stationary and the ground around it therefore trampled and unsuitable to lie down on. It could also potentially be an innate resistance to sleeping near water, so as not to contaminate it with faeces or perhaps to avoid predators.

As previously said the distance the animals travelled between GPS recordings increased during periods of high activity, in this case probably grazing. However these cattle had relatively small pastures. It would be interesting to see if you could see any difference between walking and grazing and simply travelling if the cattle had a larger pasture and further to walk between resources.

Distance between animals

When it comes to the distance between animals it was hardly surprising that the animals were close to each other when resting but more spread out when grazing. They are social animals, so it is logical they seek security in numbers. It would be interesting to see if animals in a larger herd and on a larger pasture will spread out even more. Also Albright (1993) found that while grazing, the cows generally were spread out evenly over the enclosure, but that they tend to stay close together when lying down.

Habitat choice

Apart for preference towards a grass height of 20-30 cm, the results from the biomass maps are inconclusive as the animals were to evenly spread out between the areas with different biomass. I expected here a preference for grass of medium height with at least higher than 7 cm but preferably around 15 cm (Naujeck, et al. 2005).

Every herbivore is born with behavioural predispositions that influence their decisions about where to forage, drink, rest or ruminate (Launchbaugh & Howery 2005). Together the combination of inheritance and experience result in an adaptive foraging behaviour (Launchbaugh & Howery 2005). Behavioural patterns are often complex and difficult to explain but they stem from a small number of recognizable mechanisms, including inherited attributes, individual and social learning systems, predispositions toward novel stimuli, and spatial memory (Launchbaugh & Howery 2005). When pasture quantity is ample, grazing time is long with a mixed pasture (both good and poor quality), intermediate with good quality, and short with poor quality forage (Arave & Albright, 1981). With an inadequate quantity of pasture, grazing time is long regardless of forage quality (Arave & Albright, 1981). Cattle will within a given time adapt their grazing habits to changing environmental conditions (Arave & Albright, 1981).

Animals exploit the heterogeneity of resources through selective grazing, choosing a diet which is of better quality than the average vegetation on offer (Arave & Albright, 1981). What it is that determines foraging decisions remains obscure, since many studies are largely descriptive, and fail to provide generality (Prache et al. 1998). On the other hand, the wide range of different results in these studies might just show that animals adapt their behaviour to different enviroments. Recently, increased effort has been made to develop

models of the grazing process supported by a theoretical basis (Prache et al. 1998). This approach should allow a better understanding of the determinants of animals' foraging decisions and their impact on the vegetation (Prache et al. 1998). It is important to have a clear understanding of an animal's behaviour under various environmental conditions for making an intelligent analysis of research results on physiology, nutrition, breeding, and management (Arave & Albright, 1981).

Forage selectivity is dependent on botanical composition, forage available, and presence of animal excreta (Arave & Albright, 1981). Generally cattle prefer areas with sufficient forage in close proximity to water (Senft et al., 1985). In Senft et al. (1985) diet selection was better correlated to choice of grazing areas than relative biomass. This could lead to the conclusion that the cattle's choice of plant species is more important than the vegetations biomass when cattle choose freely where to graze. Cattle in this study had relatively small pastures and limited choices and the importance of the results limited. I would like to se the difference between choice of plants and the choice of biomass being the object of further research, apart from more research on the importance of biomass.

Conclusions

Cattle in my study were more active during the afternoons than in the mornings. They most likely spend the afternoon grazing and rest during morning and midday. They spread out when grazing but like to huddle up together when resting. They also seem to prefer to rest at a distance from the water. More research on these matters should be conducted, preferably on a larger scale with more animals and in other situations. Perhaps on larger pastures or on pastures with more varied habitats. The inconclusive results from the biomass data indicates this area to needs more research to develop the method and do a larger trial to get clearer results.

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