

Time-budget and location of activities in the paddock can be estimated from GPS-data

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Take home message Cow time-budget and organization of activities in the paddock can be studied efficiently without laborious observation using GPS data and GPS-located resources.

Introduction Emerging tools like embedded GPS sensors could help to optimize pasture management (Manning *et al.*, 2017), with a better understanding of the use of the paddocks by the cows. This paper aims to study (1) whether embedded GPS sensors could predict the behaviour of dairy cows and (2) enable to study the organisation of their activities during the day and its association with pasture characteristics or other elements in the paddock.

Materials & methods Fourteen Holstein cows were tracked with GPS sensors mounted on collars in a commercial dairy farm (Lion d'Angers, France). They grazed in temporary pasture, sown with a mixture of perennial ryegrass and white clover and were milked every day at 9 am and 6 pm. The distribution of cows on the pasture was studied for a whole day by computing the percentage of cows located in each 3*3 m area. In order to discriminate between resting, grazing and walking activities, behaviours were recorded by two observers for each cow successively, during the entire day. Distances and turning angles between each fixe were computed in order to calibrate a decision tree (rpart package, R). Behaviours were then predicted using the calibrated decision tree. A chi square test was performed in R to compare the time-budget per half day. The location of main activities in the field was also studied. To explore the potential link between location of predicted behaviours and resources distribution, samples of vegetation cover were collected and GPS-located. The percentage of dry matter was obtained and the ratio of perennial ryegrass, white clover and self-propagating plants were determined, other species were regarded as negligible. A multinomial analysis was performed with nnet and car packages in R to conclude on the relationship with behaviours.

Results The distribution of the cows in the paddock area was heterogeneous, with some areas avoided and others frequently visited (Figure 1a). A satisfactory calibration of the decision tree was obtained with a misclassification rate of the behaviours of 10%, as expected (de Weerd *et al.*, 2015). The time-budget was significantly different between each half day ($p < 0.0001$), with $50.4 \pm 6.2\%$ of grazing (ranging from 40.0 to 58.8% among cows) and $49.6 \pm 6.2\%$ of resting (ranging from 41.2 to 60.0%) in the morning *versus* $38.5 \pm 9.3\%$ (ranging from 27.1 to 59.2%) and $61.5 \pm 9.4\%$ (ranging from 40.3 to 72.9%) in the afternoon respectively. Cows seemed to organize their activities inside the paddock (e.g. more resting close to the drinking trough; Figure 1b). No significant relationship between behaviour and DM and floral distributions was observed.

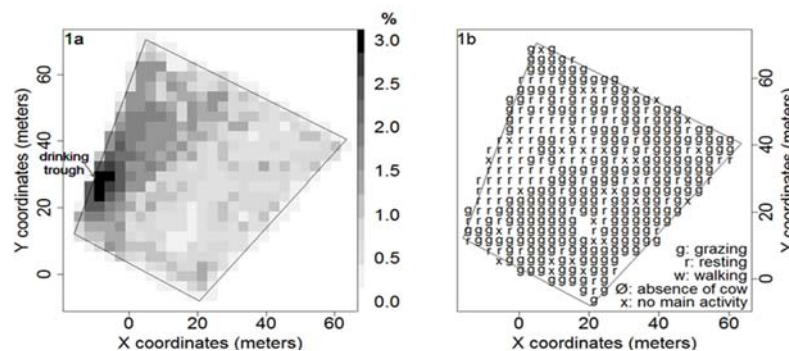


Figure 1 a) Distribution of cows (%) inside the paddock. The more the area was frequented the darker the square is. b) Dominant behaviour in the same 3*3m area predicted with a decision tree.

Conclusion The use of GPS embedded sensors highlighted a heterogeneous distribution of cows in the paddock, with some areas being preferentially used for resting or grazing. In this study, this organization of activities seemed to be influenced by structural elements in the paddock, like the drinking trough, rather than pasture characteristics.

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References

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