Development of a 2-dimensional video-acoustic tool for monitoring bite placement

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Introduction Studies of grazing behaviour conducted at the spatial scale of a feeding station demonstrate that intake rate declines with increasing depletion, a response attributed to an increase in bite overlap (Ginnett *et al.*, 1999; Ungar *et al.*, 2001). In order to understand the rules that govern bite placement, a methodology is required that can map the sequential placement of bites on the sward surface. We developed a video-acoustic tool to achieve this and report the findings of using the tool on small uniform patches of herbage.

Materials and methods Four Israeli Holstein heifers grazed patches (0.34 m^2) of Lucerne (*Medicago sativa* L.). Treatments were three depletion levels of 6, 18 and 30 bites. Grazing sessions were recorded on video with acoustic monitoring, using a microphone on the forehead of the animal. After grazing, a grid was placed over the patch and filmed as a calibration image. Each grid cell was mapped as grazed or un-grazed. From the video record, a single frame representing bite location (the position of the mouth immediately prior to severance) was extracted for each bite or chew-bite jaw movement identified from the sound track. The screen coordinate of the most forward position of the muzzle was extracted for each bite (Figure 1 (a)). Using the calibration image and appropriate geometric procedures, the screen coordinates were converted to coordinates on the sward surface. Assumptions were made regarding bite depth and the displacement between the marked point and the bite centre. The locations of predicted bite coordinates were compared to the grazed/un-grazed status of the grid cells.

Results The bite location pathways obtained were broadly S-shaped (Figure 1 (b-d)). Bite placement was neither random nor highly systematic. Inter-bite distance was consistent across depletion levels at approximately 13 cm. There was broad correspondence between the predicted bite locations and the mapped status of the grid cells (Figure 1 (b-d)). The observed pattern of grazed/un-grazed grid cells could not be predicted precisely by simply assuming a maximum distance of impact from bite centre to grid cell centre. The best balance in the number of correct predictions of grazed and un-grazed cells was achieved with a 9-cm distance of impact. Discrepancies were probably due to the fact that mouth position immediately prior to severance is not synonymous with the surface area of the vegetation grasped within the bite, primarily a reflection of tongue sweeping movements.

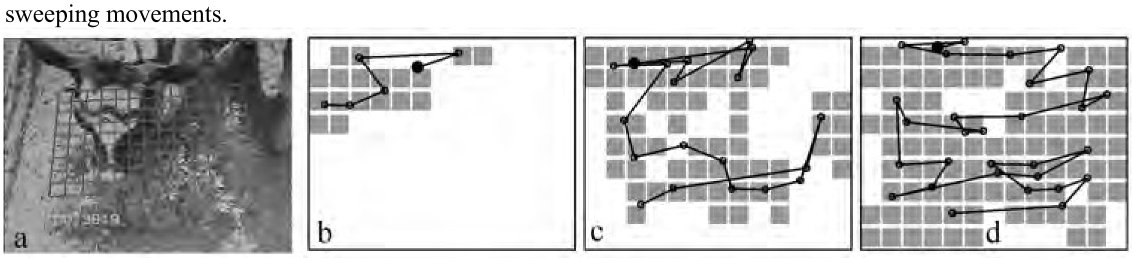

Figure 1 (a) Bite image frame with overlaid calibration grid, **(b-d)** Mapped grid cell status (shaded = grazed) and predicted centre of bite coordinate (○) for depletion levels of 6, 18 and 30 bites, respectively, for one animal. Line indicates bite sequence beginning from the solid black dot.

Conclusions The sequence and the approximate location of bites removed from a patch can be successfully determined using a single camera and acoustic monitoring. When bite depth is close to the average, the error in the estimation of the bite coordinate on the sward surface is not expected to exceed a few centimetres. The results suggest that this tool could be useful to test hypotheses regarding bite placement and inter-bite distance.

References

Ginnett, T.F., J.A. Dankosky, G. Deo, & M.W. Demment (1999). Patch depression in grazers: The roles of biomass distribution and residual stems. *Functional Ecology,* 13, 37-44.

Ungar, E.D., N. Ravid, & I. Bruckental (2001). Bite dimensions for cattle grazing herbage at low levels of depletion. *Grass and Forage Science*, 56, 35-45.