Monitoring Urine Distribution by Grazing Livestock

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The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

Presenter Information

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Key words: GPS, urine sensor, animal behaviour, nitrogen

Introduction Urine patches are a significant source of leaching and gaseous N losses in grazed pastures. N losses increase as urine patch load (g N/m^2) increases, and modelled N losses increase if urine is returned as discrete patches rather than at uniform rate across the pasture. The tools we describe will help to quantify urination frequency and urine distribution patterns within large paddocks.

Materials and methods A urine sensor was developed which comprised a tube placed in the vagina of sheep and cattle, using a CIDR[1] device. It contains two electrodes which measure conduction (mV), measured as conduction (mV) in the presence of urine passing through a tube anchored in the vagina, (Trials 1 and 2). Urine created a voltage spike in logged data. In Trial 3 temperature (as mV) elevation to near body heat due to urine in the tube was monitored instead of conductance. Voltage, temperature and time were continuously logged. A custom-built GPS unit was part of the sheep urine sensor circuit. Movement was continuously monitored, and logged when the new position exceeded 3 m from the previous position, and upon urination. The GPS and sensor box was clamped to the fleece on the back of the sheep. The cow urine sensor circuit was located within the vagina and the GPS was attached to a collar. Using mature animals, urination frequency and urine distribution by 15 sheep (Trial 1, 2) and of 20 sheep and 18 cows (Trial 3) was determined.

Results and discussion

Trial 1 (summer): On the first day in a flat paddock, urinations were generally easily detected by the mV spike, but by the second day it became increasingly more difficult to differentiate urination events, as the background voltage often did not return to zero because of contamination of the electrodes. Intermittent visual observations showed all 350 sheep in the mob exhibited co-ordinated resting, walking and grazing behaviour, with 2 of the 15 monitored sheep demonstrating Leadership" characteristics, e.g. commencing new grazing bouts after periods when all sheep had rested. Of the 149 urinations detected, 30% were close to or under the shade of a large tree. **Trial 2 (autumn):** There was no shade available in this 10 ha moderately-rolling to steep paddock. Monitored sheep spent little time on the steep hill where pasture quality was poor and available herbage mass low. Camping behaviour during four days in the same paddock, though present, was less apparent than in Trial 1 when shade was sought. Interestingly, over the four days sheep congregated on east-facing aspects of the paddock between 8 to 10 am and on west-facing aspects 12 hours later (Figure 1). We surmise that raised ambient temperature may have mediated this response. Urination frequency over 96 hours in autumn averaged 24 (range 11 to 36) urinations/day. **Trial 3 (early summer):** Sheep and cattle grazed two separate steep hill country paddocks over 5 days. Little time was spent on steep slopes by either group, and cattle walked along well-defined stock tracks on the steepest areas. Cattle urine patches were concentrated around water troughs and at campsites (Figure 2). Cows averaged 13 (7 to 25) urinations per day. Compared to cows, sheep urinated less around their water trough but did camp, as indicated by the congregation of urine patches. Sheep averaged 18 (5 to 28) urinations/day.

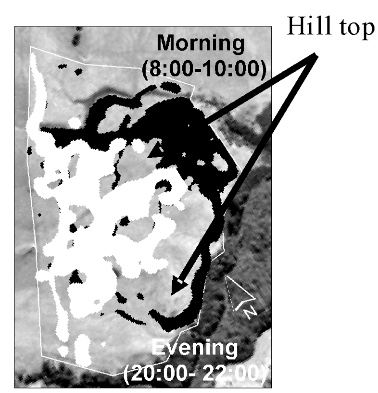

Figure 1 *Distribution of 15 sheep in a 10 ha paddock on 4 days during specified times.*

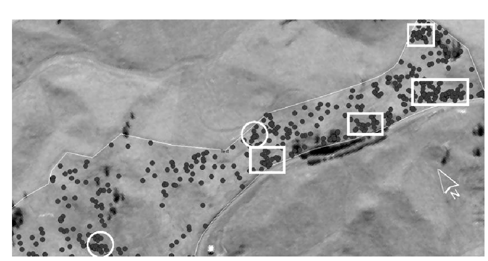

Figure 2 *Urine patch distribution of 16 cows over 5 days on hill country pasture. Circles indicate water troughs and oblongs flat-land camp sites.*

As the temperature sensor is unaffected by contamination, it is preferred over the paired-electrode sensor for detecting urination events.

Conclusions These relatively inexpensive GPS/urine sensor units allow, for the first time, the mapping of urine distribution by a number of ewes and cows in large paddocks. This may allow the identification of critical source areas of pollution on farms. These could be targeted for application of N-loss mitigation practices thereby reducing cost and increasing efficiency.

[1] CIDR Controlled Intra-vaginal Drug Release device, InterAg, Hamilton, New Zealand.