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**Nutrient Distribution and Behaviour of
Livestock in an Intensively Managed
Dairy System**

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Abstract

New Zealand farmers are facing pressure to reduce nutrient losses from their farming enterprises to the environment. Research suggests that on farms the major source of nutrient loss is animal excreta, which for nitrogen (N) relates to cattle urine in particular. Most models used to predict N cycling and loss assume homogeneous distribution of bovine urine patches across paddocks. This study aims to provide baseline understanding of how dairy cows distribute urine, in regard to activity patterns and several environmental factors, by using sensor technologies to investigate the patterns of excreta distribution from dairy cows under commercial conditions.

The study took place on a commercial dairy farm, No.4 Dairy Farm, Massey University, Palmerston North, New Zealand during early autumn (March) 2009. Thirty cows in late lactation, balanced for milking order and age, in a herd of 180, were fitted with global positioning system (GPS) collars, IceTag3D[®] activity sensors and urine sensors for seven consecutive days. The herd was milked twice a day and rotationally grazed, without supplements. Animals were at pasture from 06:00 h to 14:00 h (AM grazing) and from 15:00 h to 05:00 h (PM grazing). Cows were rotated through 12 paddocks each of about ~1.1 ha.

The use of urine sensors, GPS units and IceTag3D[®]s was an effective method for capturing data on the temporal and spatial behaviour of dairy cows in a commercial herd. The majority of urine (85% of total) was deposited on pasture. Urine deposits, together with grazing, lying, standing and walking behaviour, showed non-homogenous density patterns not conforming to a uniform Poisson distribution, indicating a non-random distribution, implying that there was an aggregation of urine patches and particular behaviours within grazed paddocks. The dairy cows were observed to have distinctive time budgets where the times of sunset and sunrise, together with the removal of cows for milking, were the main factors influencing activity patterns of animals in this study. There were associations between the spatial density patterns of behaviour and urine patches, with time of day influencing the levels of association. Fitting urine patch data with a distribution that is a

function of the density of a particular behaviour variable was possible, although patterns were inconsistent. Time of day had a significant effect on the fit of an inhomogeneous Poisson process model with behaviour variables being better predictors of urine patch distribution during night hours than during day-light hours.

In conclusion a suitable methodology was developed to observe, track and analyse the behaviour of dairy cows managed on pasture under commercial conditions using GPS and sensor technologies. Dairy cows were found to deposit the majority of their urine on pasture, where urine patches were found to have a non-random distribution. Understanding of the spatial location and distribution of urine can allow for the development of management practices that target critical source areas of N leaching.

Publications

The following is a list of publications arising from this thesis:

Draganova, I., Yule, I. and Stevenson, M. (2012). The role of cows in redistributing N around the farm. In, *The Proceedings of the 25th Annual FLRC Workshop*. Massey University, New Zealand.

Draganova, I., Betteridge, K. and Yule, I. (2010). Where do cows urinate: tools to aid nitrogen emission mitigation? In, *The Proceedings of the 4th Australasian Dairy Science Symposium*. Lincoln University, New Zealand.

Draganova, I., Yule, I., Betteridge, K., (2010). Monitoring dairy cow activity with GPS-tracking and supporting technologies. In, *The Proceeding of the 10th International Conference on Precision Agriculture*. Denver, USA.

Draganova, I., Yule, I., Betteridge, K., Hedley, M., Stevenson, M. and Stafford, K. (2010). Activity patterns and nutrient redistribution in an intensively managed dairy herd. In, *The Proceeding of the 23rd Annual FLRC Workshop*. Massey University, New Zealand.

Draganova, I., Yule, I., Betteridge, K., Hedley, M., Stafford, K. (2009). Pasture utilisation and nutrient redistribution in intensively managed dairy systems. In, *The Proceedings of the 13th Symposium on the Precision Agriculture*. University of New England, Australia.

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