Sampling to inform the development of a model to predict the impact of intensive livestock farming on water quality in the southwest of England

Mack, K.; Brazier, R.E., University of Exeter, UK. km296@ex.ac.uk*
Macleod, C.J.A., North Wyke Research,
Haygarth, P.M., Lancaster University, UK.

The presence of grazing cattle can modify the risk of phosphorus (P) and sediment mobilisation through the combined effects of treading, defoliation and defecating (see Fig 1). The significant forces exerted by walking cattle can compact soil which can increase surface runoff into poached areas, leading to a risk of high concentrations of suspended solids (SS) and associated P in overland flow.

There is a need to differentiate between the variable responses of different soil types. This is apposite in relation to grassland responses to grazing (see Fig 2). This poster describes the plans for a new NERC-funded project (ref: NE/F017863/1) between North Wyke Research (BBSRC) and the University of Exeter. The experiment is in early days and this poster aims to encourage feedback and discussion on advancing our understanding of the temporal and spatial impacts of livestock grazing on the mobilisation and delivery of SS and P to surface waters. It describes a series of experiments designed to examine the effects of grazing on different soil types in the southwest of England by collecting datasets to inform the development of a predictive model.

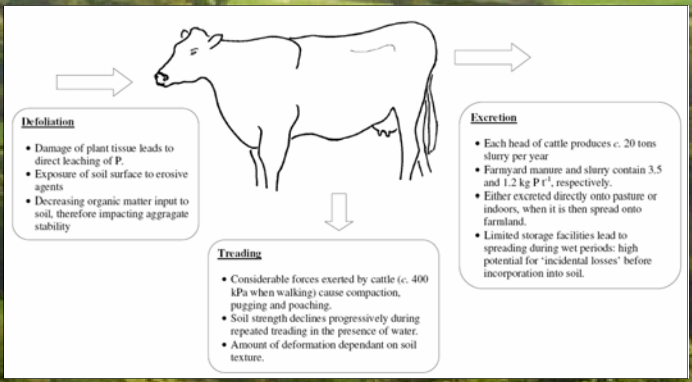

Figure 1: The effects of grazing cattle (see Bilotta et al. (2007) for comprehensive review)

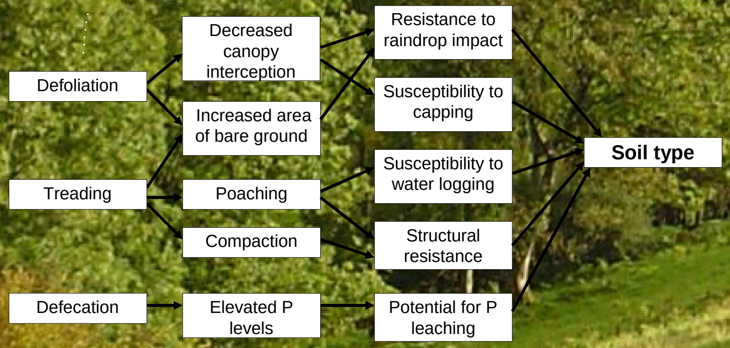

Figure 2: The importance of soil type in controlling the potential for SS and P mobilisation

The geomorphological impact of grazing cattle will be assessed concurrently to sampling water quality at the headwater catchment scale. These results will then be compared with data from rainfall simulation on bounded plots designed to quantify the potential for SS and TP mobilisation from areas suffering from different degrees of degradation. The diagram below illustrates the series of steps involved in this experiment (Figure 3).

Data to be collected	Purpose of data
Monitor stream at catchment outlet for: i) Flow depth ii) Suspended solids (SS) iii) Volatile organic matter (VOM) iv) Total phosphorus (P) v) Turbidity vi) Conductivity	Automatic flow-proportionate sampling to observe temporal patterns of SS, VOM and TP transfer during storm events Weekly baseflow sampling to assess contribution of point sources, tile drainage and in-stream processes
Collect high-resolution rainfall data at each monitoring site	Indication of actual rainfall intensities contributing to storm events
Farm diary detail field stocking rates and fertilising	Place water quality data in context. Potential for input to agent-based modelling
Employ a geospatial sampling strategy to determine the distribution and variability of soil P	Important model parameter. Test hypothesis that areas cattle congregate are a control on soil P
Employ a geospatial sampling strategy to determine the distribution and variability of: i) Infiltration rates ii) Bulk density	Aid in interpretation of hydrological response
Map degrees of visible degradation of the pasture throughout the grazing year	Provide qualitative dataset of pasture degradation and information on connectivity
Use a portable rainfall simulator to assess the potential for mobilisation of TP, SS and VOM from areas representative of different degrees of degradation	To provide a dataset to parameterise a spatial-explicit water quality model. To be used in conjunction with the degradation maps to assess the potential for mobilisation within the whole catchment

Figure 3: Data to be collected during the proposed experiment

Two catchments have been identified, *c.* 16 km apart. The Den Brook catchment is 48 ha and characterised by slowly permeable seasonally waterlogged clay soil (stagnogley). The Drewston catchment is 22 ha and characterised by a well-drained fine loamy soil (brown podzolic soil). An experiment designed to assess the spatial distribution of soil P in the two catchments in October 2002 focussed on soil P in relation to the topographic index (see Fig 4 and 5) (Page *et al.* 2005). The results led them to hypothesise that areas where cattle congregated may be a key control of soil P variability. This experiment collects data to test this hypothesis and provide input to develop a model of hydrology, sediment and nutrient fluxes.

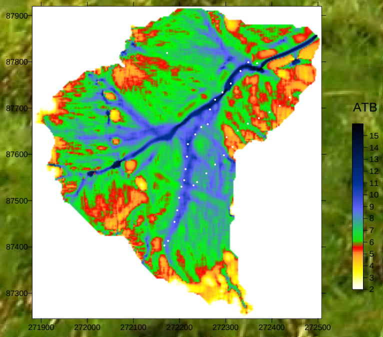

Figure 4: Drewston a/tanb map with transects marked with white circles

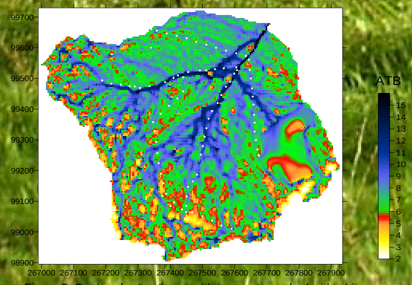

Figure 5: Denbrook a/tanβ map with transects marked with white circles

Bilotta, G.S., R.E. Brazier and P.M. Haygarth, 2007: The impacts of grazing animals on the quality of soils, vegetation, and surface waters in intensively managed grasslands. *Advances in Agronomy*, **94**, 237-280.

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