CHAIRS' SUMMARY PAPER: Animal Intake and Grazing Systems

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INVITED PAPERS

The paper by Illius considered ingestive and digestive constraints to intake in grazing ruminants. Good progress has been made in understanding ingestive constraints. Bite mass and biting rate, when scaled for body mass, give good prediction of intake rate. New knowledge regarding jaw movements and energy costs and benefits of grazing activity may further improve the predictability of intake.

Although gut fill, as represented by NDF intake, has been a reasonable predictor of herbage intake, further improvements in prediction will require a better understanding of digestive constraints. A major research priority is to determine how to represent the animal's internal state or hunger drive.

Illius argued that constraints such as rumen load and grazing time that are mediated by the animal's cognition and affected by its state are not fixed in all circumstances. If animals will tolerate greater rumen distension when they are in a state of hunger, then the notion of fixed constraints is invalid. In the conceptual model of Illius, digestive constraints are flexible and represent an interpretation by the animal; they may even be illusory. There is a need for better understanding of the animal's "flexible space" and "preferred space" within the context of maximum constraints which are never operative under normal grazing and feeding conditions. This "state-dependence" model of intake control entails cost-benefit analyses by the animal in making grazing decisions. It requires new knowledge of the interaction of internal and external state, and challenges to researchers to bridge the gap between animal psychology and animal physiology so that knowledge of herbage intake by the grazing animal could be advanced.

The paper by Hardy considered how these principles could be applied to the development of systems to 'optimise utilisation of the resource'. Comparisons were drawn between temperate and tropical forages, the lower level of production from tropical forages providing a useful situation in which to study herbivore dynamics. For example, physical constraints to harvesting become more important, given the higher leaf tensile strength of C4 plants. Comparisons were also made between cattle and sheep and the results of models of mixed grazing systems were presented. Mixed species grazing gave the sheep greater opportunity for selection and therefore for ingestion of a higher quality herbage.

POSTER PRESENTATIONS

Intake

Animal intake is a product of intake rate (IR) and grazing time (GT) and while much has been published on factors controlling the former, understanding of factors controlling GT is less advanced. Bite mass was reported to vary more with sward structure than with biting rate (Penning et al.) but biting rate may also vary with the biomechanical properties of the plant which may correlate with resistance to insect herbivory. Henry et al. Used a bioassay of redlegged earth mites to study such resistance. The structure of the sward was studied by Mayne et al., measuring short-term (1 h) intake in fasted dairy cows. In that scenario, sward height rather than its bulk density was the major determinant of intake. Pulido and Leaver reported lower increases in intake in response to increasing sward height with cows grazing for 24 h per day, but they also reported decreases with concentrate supplementation and increases with milk yield.

The model described by Buckmaster et al. predicted supplemental feed requirements and potential animal production at grazing, from consideration of limitations due to gut fill, physiological energy demand, wet mass, herbage availability, herbage cover and allowable grazing time. The poster of Ketelaars et al. simplified the factors to be considered, by identifying a threshold ratio of dietary N:OMD below which supplementation with protein stimulated intake of low quality forage. Baumont et al. reported that NDF content, pepsin-cellulase digestibility and gas production were good predictors of rumen fill, but no so good at predicting voluntary intake. In summary, the problem of prediction remains!

Grazing systems

The importance of seasonal effects on forage quality was a major feature of the posters on grazing systems. Van Niekerk and Rethman studied the effect of maturity of *Panicum maximum* on intake and digestion, observing a very marked decrease in digestion in the intestines of the mature crop. Mir et al. reported less change in the quality of the forage, Fenugreek, as it matured, and concluded that it has potential as a forage crop for ruminants.

In a year long study with steers, Piaggio and Prates recorded major seasonal effects on the intake of grazed grass and in their prediction model, included a term to take account of the dead material. To limit wastage of biomass as dead material, Wade and Dalla Valle observed the need to demonstrate to producers how to utilize grass efficiently in time of plenty.

Finally, rather unusual grazing conditions were reported for Alaska where ease of access was one of the criteria for assessing the value of a grazing site. Potential sites included beaches and rocky outcrops!

DISCUSSION - WHERE NEXT?

Progress has been made since the last Congress: understanding of sward structure has advanced, but a key issue remaining is what determines how long the animal spends grazing. Is 'hunger drive' in the grazing animal under the same control factors as in the penned animals and if so, what are they? There is still disagreement on the costs of various non-productive activities such as walking, harvesting, chewing, ruminating and digestion, although tables of costs of exercise will shortly be published.

Considerable interest was expressed in the concept of cost-benefit analysis by the grazing animal and in understanding the metabolic signals underlying or driving intake decisions. Processes such as ammonia detoxification, VFA absorption and recently, oxygen consumption have been linked to intake control but it is clear that no one signal could account for intake control either in grazing or penned animals. The theory of additivity has been advanced to account for multiple factors controlling intake. Can cost-benefit analysis be accommodated in current models of intake regulation? This was a question arising from a spirited discussion of the state-dependence of intake constraints and a challenge for researchers modelling intake regulation.

There was a useful discussion on how relevant it was to extrapolate between grazing situations in different regions of the world. Where principles have been established, they should hold true provided that sufficient information is available, but relationships observed in the field may not. For example, in New Zealand, the relative intakes between sheep and cattle were observed to vary as the season progresses more markedly than in South Africa.

Fundamental differences between sheep and cattle in the way they ingest herbage were referred to and the consequences this might have on sward management. Some effects can be taken out by scaling to body mass, but the importance of the remaining differences depends on the objectives of the study.

Prediction of intake is still an issue B can we get more accurate predictions, especially if we are trying to predict intakes on farm, since there is a lack of data at the farm level. At present, most intake models are evaluated with data collected under experimental conditions. These data generally ignore the effects of herd dynamics, since they usually relate to intakes by individually penned animals which do not suffer from competition or experience the type of social interaction observed among animals in commercial herds.

We are reminded that at the farm level, intake predictors need to be simple, although this point was not conceded by those developing more complex models! However, logic (and practice) dictates that the inclusion of relationships for which parameters have to be guessed, will not lead to increased accuracy. The key question is what can farmers measure, or estimate, accurately? Answers are needed for these questions.