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PREDICTING NUTRIENT LOSS – WHAT TO DO WITH EQUINE PROPERTIES?

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Abstract

The majority of the commercial Thoroughbred production in New Zealand occurs within the catchment area for the Waikato Regional council, on large breeding farms ranging from 20 ha to 526 ha in size, managing up to 370 mares during the breeding season. As notified, the Waikato Regional Council's Healthy Rivers Plan Change 1 (PC1) requires large scale farming operations to calculate a nitrogen loss baseline using Overseer®. As at early 2020, it remains uncertain if the equine industry will need to calculate baseline N losses, whether under changes to PC1 or the NES-FW. At present, a number of assumptions are made about horses and equine farms systems within the Overseer nutrient management package. This paper describes some of the work completed, and proposed, to provide estimates of input parameters required to permit quantification of nutrient loss on large-scale equine properties.

At an animal level the horse is a monogastric hindgut fermenter rather than a ruminant, which has implications for voluntary feed intake, and the digestibility and utilisation of dietary protein. On commercial stud farms broodmares are managed at pasture year-round, and pasture forms the basis of the diet and the major source of dietary N. This dependence on pasture is in stark contrast to management systems in many countries.

Prospective data collected on commercial farms and data sourced from the published literature were used within a deterministic model and identified that the faecal N loss remained consistent (20-25%) across a variety of diets, whereas urinary N loss increased with daily N intake and percentage of pasture in the diet. Total N excreted by a Thoroughbred broodmare was estimated to be 0.48 g N / kg bodyweight. In contrast, assuming an average BWT of adult dairy cattle, beef cattle, and sheep are 600 kg, 500 kg, and 65 kg respectively, the N excreted would be 0.52 g/kg BWT, 0.40 g/kg BWT and 0.62 g/ kg BWT.

In contrast to ruminants horses are selective browsers, effectively utilising only 70% of the pasture on offer. The remaining 30% of the pasture are "roughs" or latrine areas, and this percentage of pasture as latrine area appears consistent across different equine livestock classes and production systems. At present we lack data on the concentration of N captured in faecal

piles within the latrine areas, or the N leaching potential of the faecal piles. Under commercial management systems the stocking rate during spring and summer doubles to 2 mares / ha (1,000 kg liveweight / ha) and the impact of these changes in stocking density on N leaching have not yet been modelled. Thus, to be able use Overseer effectively for Thoroughbred stud operations, further estimation of equine specific parameters is essential.

Introduction

New Zealand has a relatively high level of horse ownership compared to many other countries with ~100,000 horses or ~30 horses / 1,000 persons (in contrast Ireland has 11 horses / 1,000 people) (Rogers *et al.*, 2016). The major equine industry in New Zealand is the Thoroughbred industry accounting for approximately 23% of horses but, accounts for the majority of the contribution of the equine industry to Gross Domestic Product, and to exports in particular, with just under half the annual foal crop exported. This commercial export-based focus and a pasture-based management system influences the size and focus of commercial breeding operations with breeding farms ranging from 20 ha to larger entities of 550ha, ~ 6 stallions and responsible for the management of over 600 broodmares during the height of the breeding season. The large scale of these breeding enterprises places them within the definition and scope of properties that require a nutrient management plan. Implementation of a nutrient management plan based on the non-equine livestock is relatively straight forward. However, to date defining and applying nutrient management to an equid has been largely ignored, in part due to lack of collated industry production data and tight technical data within the Overseer^{TM} nutrient management programme for pasture-based equines.

The majority of the commercial thoroughbred breeding activity in New Zealand is concentrated in the Waikato basin, with approximately 60% of all Thoroughbred broodmares located in the catchment under the control of Waikato regional council (Rogers *et al.*, 2016). As notified, the Waikato Regional Council's Healthy Rivers Plan Change 1 (PC1) requires large scale farming operations to calculate a nitrogen loss baseline using Overseer®. As at early 2020, it remains uncertain if the equine industry will need to calculate baseline N losses, whether under changes to PC1 or the NES-FW. As part of a proactive programme by industry and the regional council this paper described some initial deterministic modelling of potential nutrient loss in different equine farming systems and classes of livestock and compares these to the estimates based on assumptions used within Overseer®

Current situation

Within the nutrient management software Overseer® the default reference for a livestock unit is the relative stock unit (RSU). The relative scaling of livestock based on RSU works on the relative per kg DM pasture consumed per animal (1 RSU (a mature ewe raising 1 lamb) = 600 kg pasture DM / year). Within the current release of Overseer® the following RSU units are used for the different classes of equine livestock (table 1).

Table 1 : Definition of horses as relative stock units (RSU) within OVERSEER®

Stock Class	Relative Stock Units
Pony in light work or turned out	6
Pony broodmare an foal	8
Small hack (up to 15.2 hands) in light work	8
Large (500-600 kg) hack in light work	10
Yearling thoroughbred	12
Large hack broodmare and foal	14

Across a number of publications different classes of equine livestock generally can reach maintenance with pasture DMI at ~2% bodyweight (Grace *et al.*, 2002a, Grace *et al.*, 2002b, Grace *et al.*, 2003). Within these guidelines, and with correction for the inefficient use of pasture by horses (only 70% of pasture utilised -(Rogers *et al.*, 2017)) a 600 kg hack would be 9.5 RSU (5,694 kg DM / year) rather than the 12 RSU (8,200 kg DM / year). Based on this simple scaling exercise the RSU conversion within Overseer® would provide an over estimate of pasture consumption and N loss of ~25%. Compounding this over estimate is the failure to identify that the horse in a hindgut fermenting monogastric, rather than a ruminant, and therefore the horse has greater protein digestibility (~76% vs. 70%) than that observed with ruminants. These preliminary observations highlight the potential need for equine specific data to input into Overseer®.

Deterministic modelling

Deterministic modelling for the different equine livestock classes have been calculated and reported in detail by Chin *et al.* (2019a) and will be briefly reported here. A unique aspect of the New Zealand equine production system, particularly the commercial breeding farm, is that pasture forms the major component of the diet of broodmares and growing youngstock. Whereas, sport horses and racehorses are managed in a more intensive systems analogous to the European production systems where pasture provides a minor, or insignificant, component of the diet. Using data sourced from the literature Chin *et al.* (2019a) described 5 major classes of equine livestock, based on pasture as a component of the diet and mature versus growing livestock, for which they calculated N turnover.

Table 2: Categorisation of the different equine production systems and livestock categories within these production systems.

Production systems			
Thoroughbred stud farm		Sport horse	Racing
Young horses	Broodmares	Adult horses	Adult horses
Weanlings Yearlings	Pregnant Lactating	Eventing Show jumping Dressage	Thoroughbred racehorses
Pasture and concentrates	Pasture only	Pasture and concentrates	Little or No pasture – All supplementary feed, intensive management

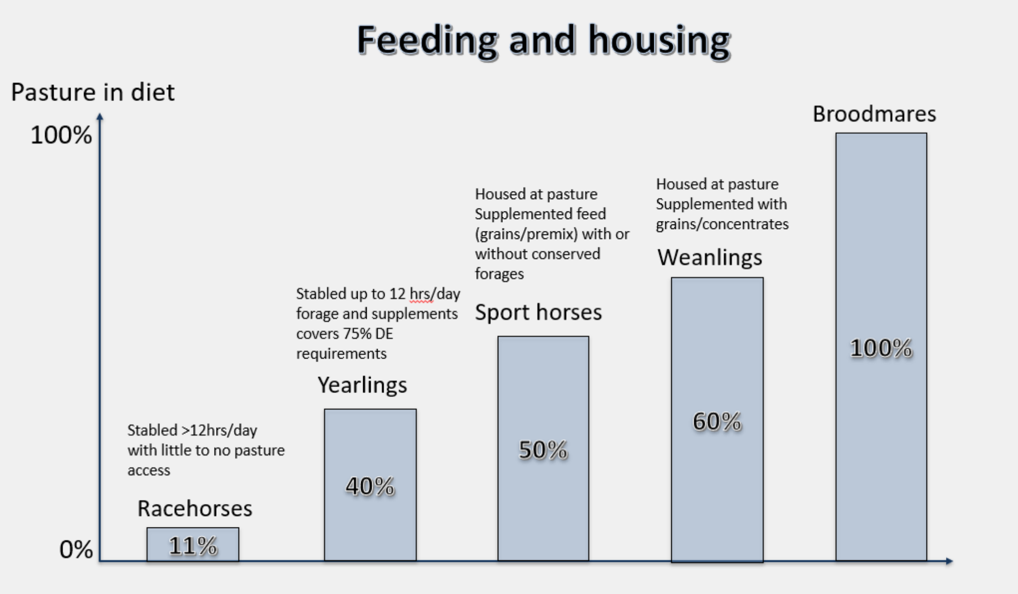
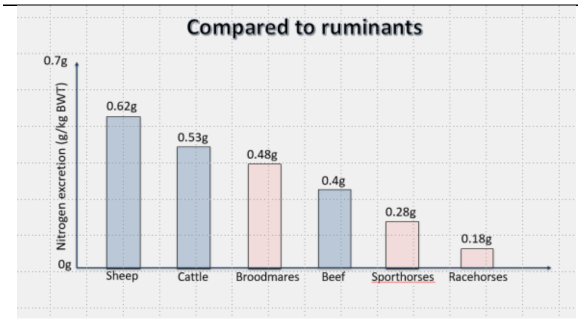


Figure 1: Different equine livestock categories and the proportion of pasture within diet based on weighted estimates from published literature.

Within the models the greater the pasture component of the diet the greater the N loss, in part due to greater protein as a percentage of the diet in New Zealand pastures, than in concentrate equine feeds (~ 22% vs 13%). In broodmares it was estimated the daily N intake was 0.23 kg N / day whereas sport horses with 50% of the diet provided as supplements were down to 0.15kg N / day. Faecal and urine N loss in pasture kept horses accounted for 57% of total N intake, with 24% lost in faeces and 33% lost in urine. The lower protein intake in the sport horses meant less N loss and less N loss as a percentage of protein intake with 34% of daily N intake being excreted (14% in urine and 21% in faeces). To be able to compare horses to ruminants requires calculation of N turnover at the animal level and then as a per kg bodyweight (BWT) value to provide a comparable basis. When these values are corrected for bodyweight the comparisons presented in Figure 2 for mature and growing livestock are possible. Both the mature and the growing livestock figures demonstrate the greater efficiency in N utilisation in horses compared to ruminants. This data demonstrates that even at per kg bodyweight level utilising RSU as the basis for equids within overseer would results in overestimation of N loss by ~30% for broodmares and overestimation by 38% for weanlings.

a) Mature animals - horses and ruminants	b) Growing livestock - horses and ruminants



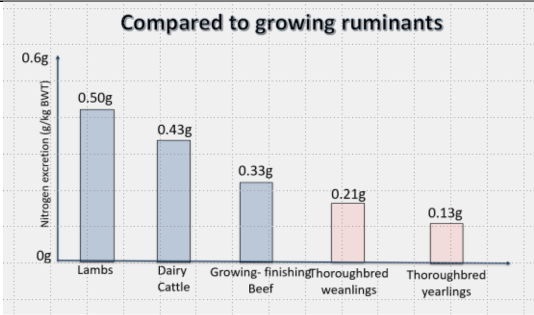


Figure 2: Comparison of N loss as a per kg bodyweight for ruminants and horses in the differing livestock and production classes.

Farm level and Production systems data

Limitations in the animal level data and estimates of N loss in horses are further exacerbated by lack of farm or production system level data. The horse is a cursorial browser as opposed to a grazer, like a ruminant. This difference is reflected as selective pasture utilisation and the generation of lawns (preferred grazing areas) and roughs (latrine areas) within horse pasture. This unequal distribution of urine and faecal material within pasture may alter the relative loading and potential for N leaching, particularly during periods of high stocking density, such as the breeding season.

At present all equine operations are modelled as upscaled sheep and beef farms. While these provide a broad framework, and a quick fix within the nutrient management plan, they ignore some of the fundamental differences between a thoroughbred breeding farm (pasture based) and a high density sport horse or racing training yard with intensive management of horses (stabling) and limited or no access to pasture. Given the disparity in these production systems there is a need for a systems categorisation based on intensity of management systems and use of supplementary feed such as the DairyNZ systems grading (system 1 (predominantly pasture and low supplement input / intensity) to system 5 (high supplementary feed use and intensity). The categories used by (Chin *et al.*, 2019a, Chin *et al.*, 2019b) provide a good starting point. However, there is a need for detailed documentation of the characteristics of the production systems to provide the precision required to differentiate systems based on production characteristics and risk profile for N leaching. The collation and characterisation of these farm profiles is now the focus of future work.

Conclusion

In contrast to other pasture-based livestock systems, we have a paucity of collated data on pasture-based equine production systems. This deficit in published literature is in part due to the unique position of the equine industry in New Zealand where pasture can provide a significant component of the horses diet. To accurately model nutrient turnover on equine properties there is a need for additional animal and farm level / systems data. Collection of this robust input data will permit testing and validation of the assumptions used within the current nutrient management programmes used by regulatory bodies within New Zealand.

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