Predicting native pasture growth in the Victoria River District of the Northern Territory

A thesis submitted by

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Declaration of Originality

This work contains no material which has been accepted for the award of any other degree or diploma in any university or other tertiary institution and, to the best of my knowledge and belief, contains no material previously published or written by another person, except where due reference has been made in the text.

I give consent to this copy of my thesis, when deposited in the University Library, being made available in all forms of media, now or hereafter known.

Signed:

Michael Cobiac

Date:

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Abstract

Pastoralism is the major economic activity in the Victoria River District (VRD), and is dependent on sustainable pasture use. Analysing grazing practices for sustainability requires knowledge of annual pasture production, but little quantitative data is available. A study was undertaken to develop the capacity for predicting native pasture growth in the VRD using systems modelling. Twenty one field sites were studied for two years using a standard methodology, and the Grass Production (GRASP) model was calibrated using this field data. End of growing season total standing dry matter (TSDM) was well predicted (mean = 2513kg/ha, r^2(1:1) = 0.966, RMSE = 132kg/ha, and 98% of predictions within measurement variance).

Developing generic parameters for common soil and pasture types allowed extrapolation of the model. Predictive skill declined when using generic parameters (r^2(1:1) = -0.265, RMSE = 807kg/ha and 64% of predictions within measurement variance). However, observation and prediction means were very similar, indicating that generic parameters are suitable for broad scale applications, but site-specific parameters are necessary if a high degree of accuracy is required. Parameters controlling plant water uptake largely determine pasture growth in low rainfall years, while nitrogen uptake and dilution parameters limit growth in high rainfall years. Pasture growth is constrained by nitrogen supply in 91% of seasons in the northern VRD, and in 25% of seasons in the drier south.

Example applications of the model were demonstrated. Current and expected future levels of pasture utilisation in the district were calculated, showing a current average of 16%, rising to an expected 20% in the next decade. These levels are within the safe utilisation rates recommended for the region. Economic analysis shows positive returns ($4.54 million per year) from pasture augmentation with introduced legumes if past problems with establishment and persistence can be overcome.

Model performance would be improved by accounting for simultaneous wetting of the entire profile in cracking clay soils, calculating growth of perennial and annual pasture species separately, and simulating variation in nitrogen uptake and dilution between years. Incorporation of these processes must be balanced against the increased complexity of the model and the additional data required for calibration.

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