Operator bias associated with visual assessments of pasture yield for forage budgets on native pasture

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Abstract

Adjusting stocking rates to match changes in pasture availability is a key recommendation for sustainable management of grazing lands. 'Stocktake Plus', an application for smart devices, has a forage budget component to assist graziers with short term (<1 year) stocking rate calculations. It requires an estimate of pasture yield, typically determined visually. Operator bias associated with visual assessments of yield and percentage (%) of unpalatable yield was examined in the late dry season near Charters Towers. Ten operators assessed twenty-seven sites representing a range in yields across three landtypes. Estimates were compared to actual yields calculated from pasture cuts.

In general, operators over-estimated yield when actual yields were low (<1000kg/ha) and under-estimated yield when yields were high (>3000kg/ha for Box and Brigalow landtypes). There was a large amount of variation (up to 100%) between operators in their visual assessments of the % of unpalatable pasture yield.

The present results show that estimates of stocking rate derived from visual estimates of pasture yield should be used as approximate guides rather than highly precise estimates for setting stocking rates.

Introduction

Australia's northern beef industry is underpinned by extensive grazing lands on both grasslands and open woodlands. Sustainable management of this natural feedbase is challenging given the highly variable rainfall and hence pasture production of the region. A key recommendation to manage for this variability is to adjust stocking rates to match forage supply (O'Reagain *et al*., 2014; Ash *et al*., 2000). 'Stocktake' is a forage budgeting system (Aisthorpe *et al*., 2004), widely used and promoted to assist graziers make short-term (<1 year) adjustments of stocking rate. Although it can be used at any time, Stocktake budgets are typically calculated at the start of the dry season, to ensure sufficient forage for stock until the first rains. An app 'Stocktake Plus' has also been developed for use on smart devices (http://www.stocktakeplus.com.au/).

The first requirement for the Stocktake Plus forage budget is a reliable estimate of pasture yield. The proportion of unpalatable yield is also estimated. The forage budget is based on 'available' pasture, calculated (Stocktake Plus, 2013; Col Paton, *personal communication*):

Available pasture (kg/ha) = start yield – detachment – unpalatable – residual + anticipated growth

where 'start yield' is the total standing dry matter assessed in the paddock, 'detachment' is pasture wastage that can be expected as a result of trampling, decay, leaf drop and consumption by insects, 'unpalatable' is the % of pasture not normally selected by livestock, 'residual' is the residual yield required to ensure adequate groundcover and pasture mass at the start of the wet season and 'anticipated growth' is an estimation of pasture growth foreseen for the budgeted period.

The key determinant of the accuracy of such forage budgets is obviously the accuracy and precision associated with visual estimates of pasture yield. However, although the method of Stocktake forage budget is widely promoted, these aspects do not appear to have been investigated. Accordingly the degree of error associated with stocking rate estimates, the variation between and within operators, and the extent to which estimates are affected by factors such as landtype and the amount of yield present are unknown.

Thus, this study examined operator bias associated with the visual assessment of total standing dry matter (DM) and the percentage of unpalatable yield and the extent to which these were affected by landtype and starting yield. These findings as well as further work planned for the coming season will form the basis of recommendations to improve the estimation of yield and the use of forage budgets in setting stocking rates.

Methods

In October 2014, twenty-seven sites (each 25m^2) were marked out at the Wambiana grazing trial, 70 km SW of Charters Towers (see O'Reagain *et al*., 2009 for more detail). Three landtypes (Box, Ironbark and Brigalow), spanning two treatment paddocks, were used to provide a range of pasture yields from very low to very high across all landtypes. Ten operators of varying ages and with previous experience in estimating pasture yield and using pasture photo standards were recruited.

Each operator was given a set of eight pasture photo standards to use when estimating pasture yield. These included seven common Desert Uplands pasture photo standards and one Basalt pasture photo standard. Operators made independent assessments at each site of standing DM yield (kg/ha) and the percentage of unpalatable yield. For the later, this referred to the amount of pasture (species and parts) unlikely to be selected by cattle. Operators were randomly allocated to one of three independent groups with each group assessing the marked sites in a different sequence.

Actual yields for each site were estimated from the mean of 3 x 1m^2 pasture cuts, distributed over the site so as to represent the average yield as far as possible.

The difference between the objective yield and the estimated yield was calculated for each operator for each site as an estimate of the bias of measurements from the true yield value. For each vegetation type, a grouped linear regression was performed using GenStat (17.1 ed. VSN International) to assess the operator effect over the increasing yield values. Because of an apparent consistent overestimation from graphs of the data, a split line model was fitted to assess at what yield value the trend would change from this consistent over estimation to continual underestimation. The model was fitted on the combined data to allow a constant linear trend of overestimation for the lower yield values, then a linear decreasing trend thereafter.

Results

Estimates for pasture yield

Figure 1 shows the distribution of operator yield estimates for different yields and landtypes. Clear yield categories can be distinguished, although an increased overlap in yields occurred for medium and high sites for Brigalow.

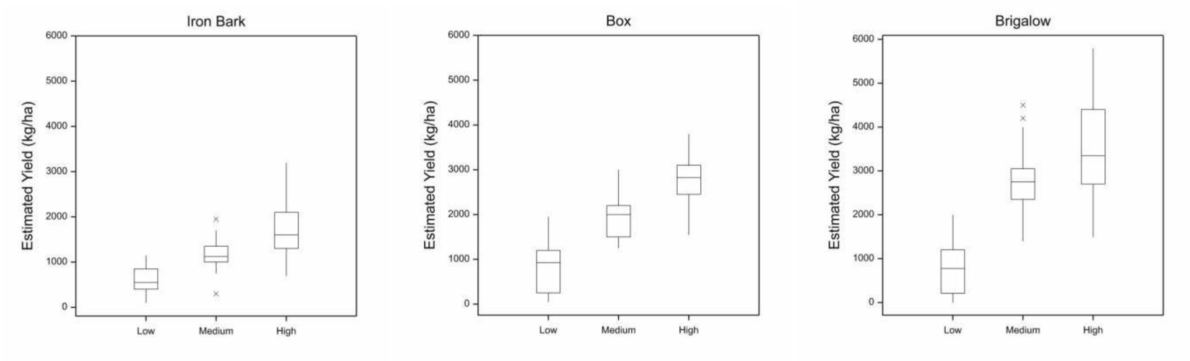

Figure 1. Boxplots of operator’s yield estimates according to yield category for each landtype.

Figure 2 shows operator performance across the range of yields. Some operators showed higher variability across the range of yields, others showed higher levels of consistency, and many showed a downward trend in yield estimates over an increase in actual yields.

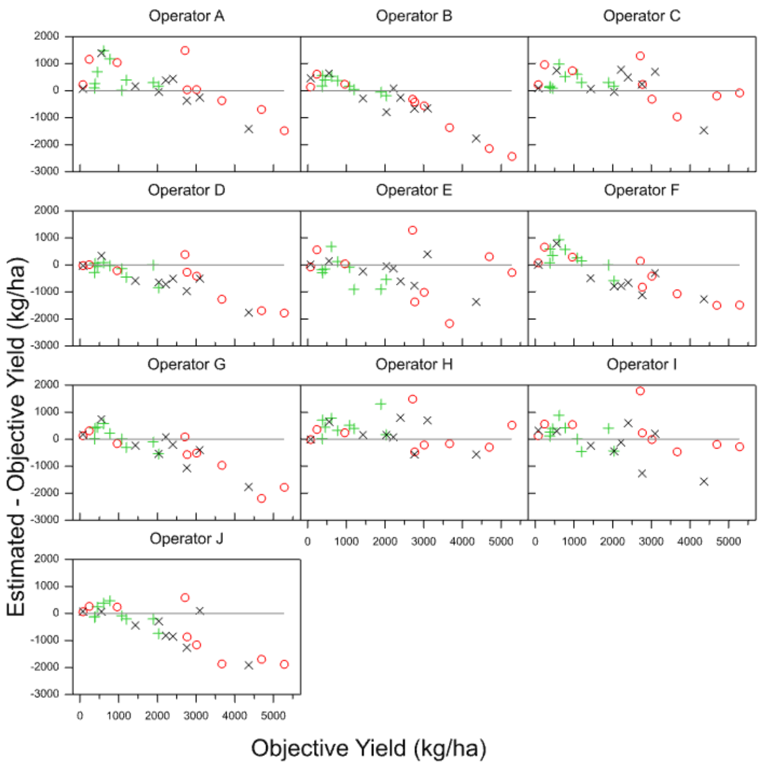

Figure 2. Individual operator performance across the range of yields is shown by plotting the estimated yield minus actual yield against actual yield for three landtypes (+ Ironbark, x Box, o Brigalow).

Trends in operator bias

The interaction between operator and the estimated yield was not significant ($p>0.05$) for any of the three vegetation types. The main effect of operator was significant for all vegetation types ($p<0.001$) showing that the rate of increasing underestimation was consistent for operators but the amount by which they underestimated differed ($p<0.05$). Table 1 quantifies the effect of this operator bias.

Table 1. Predicated values (kg/ha) for three landtypes for the difference between the actual and estimated yield are presented for the lowest (min) and highest (max) actual yield. Positive values indicate overestimation of the true yield while negative values indicate underestimation.

Landtype	Objective yields		**Predicted values** Min	Max
Ironbark	Min	378	-71	695
	Max	2035	-555	212
Box	Min	75	135	909
	Max	4359	-1400	-626
Brigalow	Min	75	67	1024
	Max	5281	-1519	-562

The split line model showed that at low actual yields operators overestimated by an increasing rate of 0.579 (+/- 157) kg/ha up to an objective yield 592 kg/ha. The over estimation amount at this point was 435kg/ha (+/- 66.7). Above this yield, operators tended to continually underestimate by 0.378 (+/- 0.0313) kg/ha. This regression explained 40% of the total variation in the data.

Estimated percentage of unpalatable yield

The median estimated percentage yield unpalatable was 50, 25 and 33% for Ironbark, Box and Brigalow, respectively. The estimated percent unpalatable yield varied markedly between operators (data not shown). The ranges in the difference between operator estimates of percentage yield unpalatable, at any one site, were 65% (minimum) and 100% (maximum).

Discussion

This study examined the bias associated with operator visual assessments of pasture yield. A key finding was the trend for operators to overestimate yield when actual yields were low but to underestimate yields when actual yields were high (Figure 2 and Table 1). The practical implication of this is that stocking rates for paddocks with low yields would be overestimated, which could have serious negative consequences on productivity and land condition. Conversely, for higher starting yields, this feed would be under-utilised. These biases were more apparent for the Box and Brigalow landtypes when compared to Ironbark.

The assessment of the proportion of unpalatable yield was problematic, with the greatest difference amongst operators assessing the same site being as high as 100%. The unpalatable yield for forage budgeting includes unpalatable species, such as *Aristida* spp., and plant parts (regardless of species) generally avoided by cattle, such as stem. To make an assessment requires plant identification skills and knowledge of feeding behaviour in cattle, but ultimately is bound by the operator's own subjective interpretation. The opportunity to standardise this assessment for operators is apparent.

Conclusion

Setting stocking rates based on visual estimates needs to be done with caution. The errors associated with yield estimates are expected to be further exacerbated in large spatial paddocks. There is the need to develop a standardised approach that will improve the accuracy of forage budgeting, as despite the challenges associated with a forage budget it encourages proactive management of pastures.

References

Aisthorpe, J., Paton, C., and Timmers, P. (2004), ‘Stocktake: Balancing Supply and Demand.’ (ueensland Department of Primary Industries and Fisheries: Brisbane, Qld.

Ash, A.J., O’Reagain, P.J., McKeon, G., and Stafford Smith, D.M. (2000). Managing climate variability in grazing enterprises: a case study of Dalrymple Shire, north-eastern Australia. *In*: ‘Applications of Seasonal Climate Forecasting in Agricultural and Natural Ecosystems: the Australian Experience’. (Eds G.L. Hammer, N.Nicholls and C. Mitchell.) pp. 253-270. Kluwer Academic Publishers: Dordrecht, The Netherlands.

O'Reagain, P.J., Bushell, J.J., Holloway, C.H. and Reid, A. (2009.) Managing for rainfall variability: effect of grazing strategy on cattle production in a dry tropical savanna. *Animal Production Science* **49**, 1-15.

O’Reagain, P., Scanlan, J., Hunt, L., Cowley, R. and Walsh, D. (2014). Sustainable grazing management for temporal and spatial variability in north Australian rangelands – a synthesis of the latest evidence and recommendations. *The Rangeland Journal* **36**, 223-232. doi: 10.1071/RJ13110

Stocktake Plus (2013) http://www.stocktakeplus.com.au/wp-content/uploads/2013/01/StocktakePlus_Calculations.pdf)