Testing grazing management recommendations–when is "best practice" best?

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Summary

Wool production can be highly profitable if attention is paid to the key profit drivers. Producers are often presented with recommendations for management that are promoted as "best practice", without reference to their impact on the profitability of their grazing enterprise as a whole. It is not usually feasible for a producer to evaluate the benefits for and risks to their business of a management option by means of a long-term controlled on-farm trial.

This paper demonstrates the use of the decision support tool, GrassGro^{TM} (Moore *et al.*, 1997) to help assess a recommendation to defer grazing of annual pastures in autumn for a fine wool Merino breeding flock in a Mediterranean environment. Autumn deferment was investigated for 3 periods between April and July at stocking rates of 3–11 ewes/ha. Deferment substantially increased pasture production, relative to continuous grazing, only when it was implemented after 1 June in good seasons, when it was least required. The amount of additional pasture from deferment was greater at higher stocking rates. At all stocking rates tested, deferment resulted in less risk but lower mean gross margins than continuous grazing because animal production was reduced or feed costs were higher. Deferment after 1 June coincided with late pregnancy and it was more costly to maintain ewe condition. On the south coastal sandplain of WA, which experiences erratic rainfall, there was much greater potential to improve returns by increasing stocking rate targets rather than by implementing autumn deferment.

Introduction

A partnership producing fine wool near Hopetoun, 170 km west of Esperance, Western Australia, wanted to set a profitable long-term stocking rate. The property is about 20 km from the coast, with mild winters and an annual rainfall of 525 mm. The current stocking rate was 4-5 ewes/ha or 6-8 dry sheep equivalents (dse)/ha but the producer felt that supplementary feed costs were too high. However the potential stocking rate calculated with the French-Schultz equation (French, 1987)* suggested a much higher target of 7-9 ewes/ha (14 dse/ha). The producers were concerned that the French-Schultz target was too optimistic. Using rainfall over the growing season from May-November (389 mm), rather than annual rainfall, in the French-Schultz calculation reduced the target potential carrying capacity to 7 dse/ha, which was similar to the current level. The producers wanted another means to investigate the potential stocking rate for the farm and decided to use GrassGro. They also wanted to test the effect on profits of a recommendation for "best practice" management of annual pastures, which suggested deferring grazing after the autumn "break" to improve seedling density and winter pasture supply (Devenish and Hyder, 2001; Smith *et al.*, 1973).

Materials and Methods

This study was undertaken in three stages using GrassGro, a computer program that can simulate sheep and cattle grazing enterprises on temperate pastures provided that weather, soil characteristics and pasture can be described for a location. First, the ability of GrassGro to simulate deferred grazing was tested against data from an experiment comparing continuous and deferred grazing by wethers at Kybybolite Research Centre, in south-east South Australia (Brown, 1976a). While distant in terms of kilometres, Hopetoun and Kybybolite share similar pastures (annual grasses and subterranean clover), average annual rainfall (525 vs 543mm) and rainfall distribution through the year. Second, a self-replacing Merino ewe flock grazing annual pastures at a stocking rate of 5 ewes/ha at Hopetoun was simulated, and the results were compared with on-farm records. Third, a "simulation experiment" was used to study the likely effects on the ewe enterprise at Hopetoun of varying the stocking rate between 3 and 11 ewes/ha, with and without autumn deferral of grazing. Impacts on pasture supply, animal production and gross margins were examined.

Daily weather inputs used in the simulations of wether flocks at Kybybolite were based on historical data from Kybybolite Research Centre; soil physical properties for the site were taken from McKenzie *et al.* (2000). Highly fertile annual pastures composed of annual ryegrass, barley grass, capeweed and subterranean clover (*cv* Seaton

* Potential stocking rate (dse/ha) = (annual rainfall – 250 mm) x 1.3/25

Park) were simulated. Continuous grazing of a strong wool wether flock was compared with deferment of grazing for six weeks after the autumn "break", at stocking rates of 14.8 and 20.0 wethers/ha. During deferment, wethers were removed to a feedlot and supplemented with wheat (0.46kg/head/day).

Daily weather inputs used in the simulations of the ewe flock at Hopetoun, WA, from 1966-2000 were based on historical data from the region. Annual ryegrass-subterranean clover (*cv* Seaton Park) pasture was simulated on a soil described as a well-fertilised duplex medium sand overlying a gravelly sandy clay (Northcote PPF: Dy5.82) (Overheu *et al*. 1993, Overheu 1995).

Current farm management of a self-replacing Merino ewe flock producing heavy lambs was simulated using ewes that weighed 55kg off-shears and grew a 5.5kg greasy fleece of 20 micron fibre diameter when in mid-range condition. The flock was shorn on 15 March. Merino ewe lambs were retained as replacements, first mated at 19 months and culled at 5-6 years old. The average lambing date was 12 July. Lambs were weaned at 14 weeks; wether lambs and surplus ewe lambs were sold the following August at 55 weeks of age. Lambs grazed a separate paddock to ewes from weaning until sale. Supplementary feeding of ewes with a 2:1 mixture of oats and lupins was initiated whenever the average condition of an age group fell below score 2.0 or when the poorest-condition ewes in an age group (for example those bearing twins) fell below score 1.5. Weaners were fed the same ration to maintain live weight whenever their condition fell below score 3.0. The cost of supplement was $150/t and lambs were sold for 90c/kg live weight. Wool was sold on a price grid for fibre diameter based on median prices for clean wool in each fibre diameter category from 1991-2001; 17 micron: 1500c/kg; 20 micron: 750c/kg; 21 micron: 640c/kg; 23 micron: 530c/kg (Independent Commodity Services).

The effects of continuous and deferred grazing were then tested for the above ewe enterprise at 3, 5, 7, 9 and 11 ewes/ha. During the deferral period, ewes were removed from pasture for six weeks, irrespective of the amount of pasture present, and fed a fixed amount of the oat-lupin supplement each day in a feedlot. Two levels of supplement were tested while ewes were in the feedlot (0.5 and 0.8 kg/head/day). Three periods of deferral were tested (1 April–15 May, 1 May–15 June and 1 June–15 July).

Results

The GrassGro simulations of the experiment by Brown (1976a) were an acceptable representation of the supply of green herbage under continuous grazing over most of the five-year experimental period (Fig. 1). The patterns of pasture supply and differences between deferred and continuously-grazed pastures were captured in 6 out of 10 year x stocking rate combinations. In a seventh year (1967 at 20.0 wethers/ha), the experimental data showed a negative difference between deferred and continuous grazing which was not reproducible in GrassGro. The simulations successfully reproduced (i) an increase in pasture mass during the deferral period which then diminished during spring, and (ii) the lack of a response to deferral in a drought year. Other trials have also shown the former response to deferred grazing (Brown, 1976b and 1977; McIvor and Smith, 1973; Squires, 1978) and that livestock may demonstrate compensatory live weight gains (Saul and Clark, 1981). GrassGro underestimated pasture mass in late 1967 but this was because it was not possible to mimic in the model the actual drought management employed in the experiment (paddocks were gradually destocked and animals were hand-fed). Subsequent over-grazing of seed reserves in the simulation is the most likely explanation for the under-prediction by GrassGro of the response to deferred grazing in the following autumn. Overall, the results of the simulations of the Brown (1976a) grazing trial, together with the producer's assessment of the GrassGro simulations of the current Hopetoun enterprise (not shown), gave us confidence to proceed with simulations of deferment at Hopetoun.

While three deferment periods were simulated, an appreciable "feed wedge" of additional pasture was only predicted when grazing was deferred from 1 June–15 July; we therefore present results for this deferment period only. Table 1 shows that the largest feed wedge (assessed on 1 August) was obtained at high stocking rates. In good years (90th percentile) there was relatively more pasture immediately after deferment, but these were also the seasons in which it was least needed. In poor years (10th percentile), deferment had little effect on pasture availability on 1 August. In poor seasons and at higher stocking rates, no more than 9% more pasture was available in August as a result of deferment. In good seasons, deferment produced relatively more pasture than continuously grazed pastures at the same stocking rate but deferment did not produce enough pasture to justify an increase in stocking rates because of associated costs (Fig. 2).

Deferment resulted in under-nutrition of ewes in late pregnancy if they were fed only 0.5kg lupin-oat mixture/head/day in the feedlot. On average, at a stocking rate of 5 ewes/ha, the condition score of ewes on 1

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August (2 weeks after lambing) was lower with deferment than under continuous grazing (1.3 *vs* 2.1 respectively) despite the

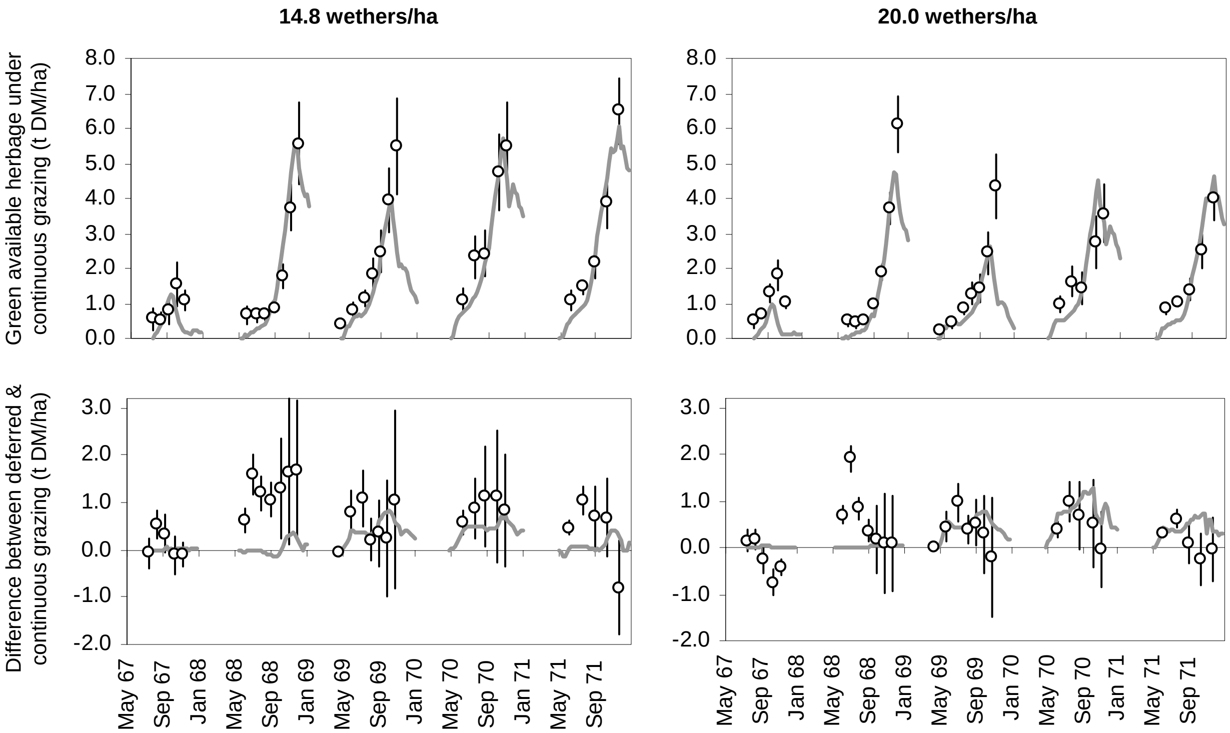

Figure 1. Yield of annual pastures at Kybybolite, SA (Brown 1976a) compared with GrassGro simulations. The upper pane shows green available herbage mass of pastures continuously grazed at 14.8 or 20.0 wethers/ha; the lower pane shows the difference in herbage mass between pastures in which grazing was deferred and those that were continuously grazed. ── GrassGro simulations; ○ measured data. The error bars show 95% confidence limits.

increase in pasture availability. If the condition of ewes was maintained in the feedlot by feeding 0.8kg/head/day, income from lamb sales and lambs wool increased but not enough to cover the cost of additional supplement (not shown).

Table 1. Percentiles for simulated green available herbage at Hopetoun, WA, on 1 August for pastures that were continuously grazed or deferred (between 1 Jun and 15 Jul each year) at stocking rates of 3 to 11 ewes/ha.

Stocking	10th percentile			50th percentile			90th percentile		
Rate (ewes/ha)	Continuous (t DM/ha)	Deferred (t DM/ha)	Relative difference (%)	Continuous (t DM/ha)	Deferred (t DM/ha)	Relative difference (%)	Continuous (t DM/ha)	Deferred (t DM/ha)	Relative difference (%)
3	0.25	0.22	-12	1.10	1.14	8	2.06	2.25	9
5	0.19	0.21	9	0.87	1.01	16	1.86	2.16	16
7	0.16	0.17	6	0.86	0.98	14	1.63	2.04	25
9	0.15	0.16	3	0.74	1.00	36	1.39	1.91	37
11	0.14	0.15	8	0.60	0.92	51	1.16	1.83	58

Under continuous grazing, mean gross margin was predicted to increase with increasing stocking rate (Fig. 2); for example, lifting the stocking rate from 5 to 9 ewes/ha increased the mean gross margin from $100/ha to $139/ha. At stocking rates of 3 to 5 ewes/ha, the opportunity to generate high incomes in a good season was limited. Increasing stocking rate from 5 to 9 ewes/ha resulted in greater potential to increase gross margin, with little increase in downside variability ("risk") if supplement cost $150/t. At 5 ewes/ha gross margins were greater than $128/ha in the best 25% of years (upper whisker), but exceeded $152/ha in these years at 7 ewes/ha. With the exception of a few extreme values, the range of gross margins was similar for stocking rates above 7 ewes/ha. At higher stocking rates, lower fibre diameter markedly increased wool income. However, increased wool and stock income failed to offset increased supplement costs at higher stocking rates. Figure 2 suggests that there were few gains from stocking rates above about 7 ewes/ha, particularly if supplement cost increased to $200/t (not shown). Note that in this analysis wool prices for finer fibre were not discounted for any associated reduction in staple strength.

Deferred grazing decreased gross margins at all stocking rates but reduced the year-to-year variability in gross margins. While deferment limited risk it also restricted the opportunity to achieve higher returns in good years.

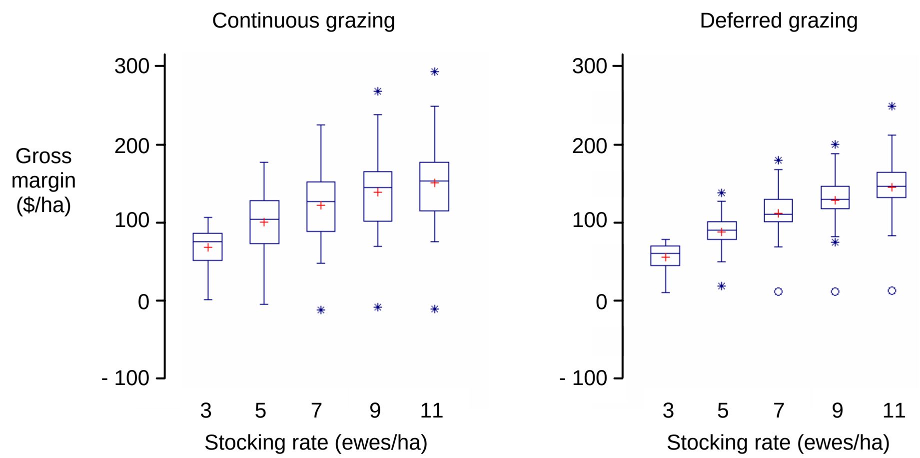

Figure 2. Distribution of gross margins from 1966-1999 for a Merino ewe enterprise stocked at 3-11 ewes/ha for continuous or deferred grazing (1 Jun -15 Jul). Supplement cost was $150/t. The length of the box shows the interquartile range. The horizontal line in the box represents the median gross margin and the cross (+) represents the mean. The lines extending beyond the ends of the box (whiskers) include gross margin values that are within 1.5 times the interquartile range. Gross margin values beyond this range are indicated by asterisks. Values more than 3 times the interquartile range are indicated by open circles. In each case, the lowest gross margin occurred in 1980.

Discussion

Analysis of the consequences of adopting alternative management practices can be difficult. In the case of deferred grazing the impact of deferred grazing on the whole system must be considered (Fortune, 1993). Simulation tools like GrassGro provide an opportunity to analyse some of the potential impacts of a management practice on the whole grazing system over a long run of seasons. The tools also provide a framework for analysing management options in the absence of local experiments or previous experience. In this study, the ability of GrassGro to simulate pasture yield under deferred grazing was tested by simulating an experiment by Brown (1976) at Kybybolite as no similar experimental evidence was available for a location closer to Hopetoun. Performance of the model at Hopetoun was checked by predicting carrying capacity of the farm, which agreed with farm practice (data not shown).

The results of the GrassGro analysis are in agreement with experimental investigations of autumn deferment. Where increased animal production or a higher stocking rate resulted from deferred grazing in autumn, gross margins were lower because of the cost of feeding during deferment (Davis and Sharkey, 1972). Deferred grazing may also increase the risk of metabolic and infectious disease, through undernutrition during deferment in breeding flocks (Brown, 1977) or through close animal-animal contact. The additional cost of labour and capital must also be included in evaluation of deferred grazing.

Simulation of a fine wool breeding flock grazing annual pastures continuously at Hopetoun WA suggested that the optimum stocking rate was about 5-7 ewes/ha. This agreed with the current stocking rate and the prediction from the modified French-Schultz calculation. GrassGro indicated that the French-Schultz prediction using total annual rainfall, (7.5-9.5 ewes/ha) was economically unsustainable if grain prices were high. Large amounts of supplement were required in this grazing system because of the length of the dry summer and retention of weaners for sale as heavy lambs and the analysis was consequently very sensitive to supplement costs. Deferment of grazing for six weeks in autumn improved the amount of pasture available in late winter-early spring by up to 58% but carrying capacity in winter was not increased. At all stocking rates tested, deferment resulted in less risk but lower mean gross margins than continuous grazing because either animal production was reduced or feed costs were higher. The GrassGro analysis indicated that it was more profitable to optimise stocking rate than to defer grazing. If deferment without supplementation is practised, the implication of this analysis is that the enterprise is possibly understocked and incurring the opportunity cost of a suboptimal stocking rate. Under specific economic circumstances, for example, low equity or high interest rates, the reduction in risk associated with deferred grazing may compensate for a small reduction in mean gross margin.

This analysis demonstrated the overall consequences, over a range of seasons, of a recommendation to defer grazing annual pastures in autumn for a fine wool Merino flock. For this farm, the benefits of deferment were small in terms of gross margin and the potential to reduce risk.

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