SALTBUSH – THE BITTER TRUTH

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Introduction

Interest in the establishment of saltbush based pasture systems has escalated in recent years due principally to drought conditions. Often touted as a 'living haystack', questionable and/or spurious claims relating to the nutritive value of saltbush and its role in a whole farm system have circulated. The following paper looks at saltbush feed value, water requirements and animal production on saltbush based grazing systems and issues relating to the use of such systems for prime lamb finishing over summer/autumn months in southern NSW.

Background

This project falls into the Saltland Systems R&D component of the LWA/AWI initiative "Sustainable Grazing on Saline Lands". It is a collaboration between the WA Department of Agriculture, CSIRO, NSW Department of Primary Industries and various farmer groups.

Twenty (20) hectares of Old Man Saltbush was established in September 2003 at Grong Grong, Southern NSW. Despite drought conditions at time of planting establishment and survival of the saltbush seedlings was high. The area planted borders Cowabbie Creek (predominantly dry) and surrounding salt affected paddocks (cropping). The saltbush was planted in a NE/SW direction with 2 to 5m row spacings.

The site was fenced with subdivisions providing four (4) treatment plots and an internal laneway for paddock and yard access during weighing. Plot areas range from 1.6ha to 3.0ha. Lambs were introduced to the site in February in 2005 and 2006, allocated to one of four treatments, periodically weighed and slaughtered at trial completion. Liveweight gain, supplement intake, fat score, carcase weight, dressing percent, skin weights, carcase GR, urine specific gravity and carcase pH and temperature information were collated. Grazing patterns/time (2005) and daily water intake information (2005/06) were also collected.

Treatments studied included:

- saltbush with access to stubble (Plot 1),
- saltbush only (Plot 2),
- saltbush with grain supplement (Plot 3) and
- stubble with grain supplement (Plot 4).

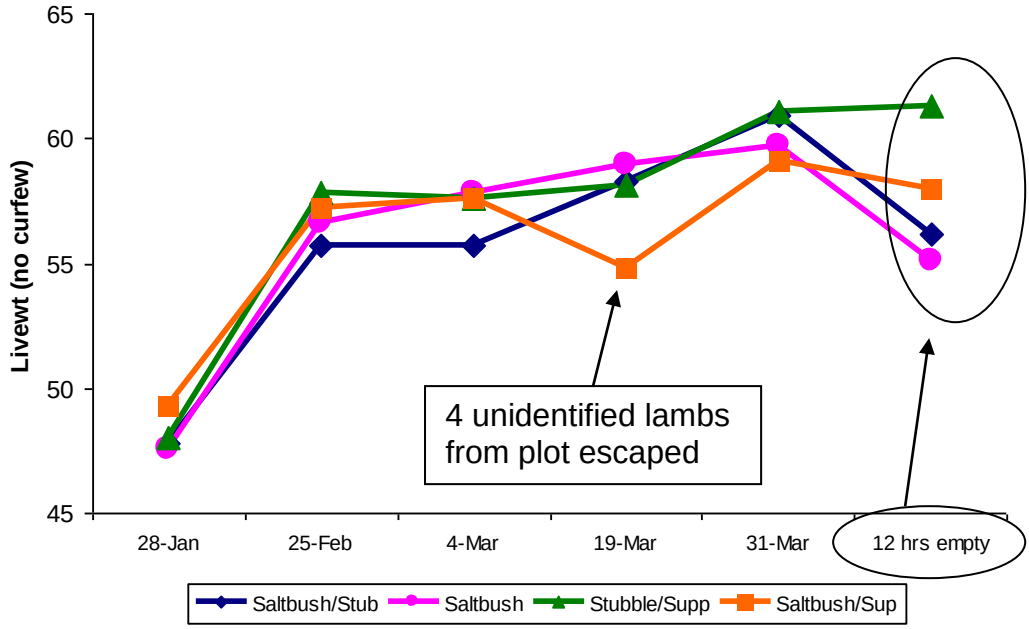
Treatments were the same for both years other than supplementation of the saltbush (Plot 2) only treatment with Lucerne hay in 2006.

2005 Protocols and Results

Although external and subdivision fencing and water to site were completed by December 2004 grazing was deferred following a severe hail storm in January 2005 which led to between 30 to 40% leaf loss in saltbush plots.

Second cross mixed sex lambs were introduced to the site on 31/1/05 and allowed to graze the three (3) saltbush plots for 4 weeks to remove existing understorey and acclimatise lambs to saltbush grazing. Lambs were allocated to treatments (16/plot) on February 25, 2005, weighed fortnightly directly off feed and slaughtered on April 27, 2005.

Group Average Liveweights (2005)



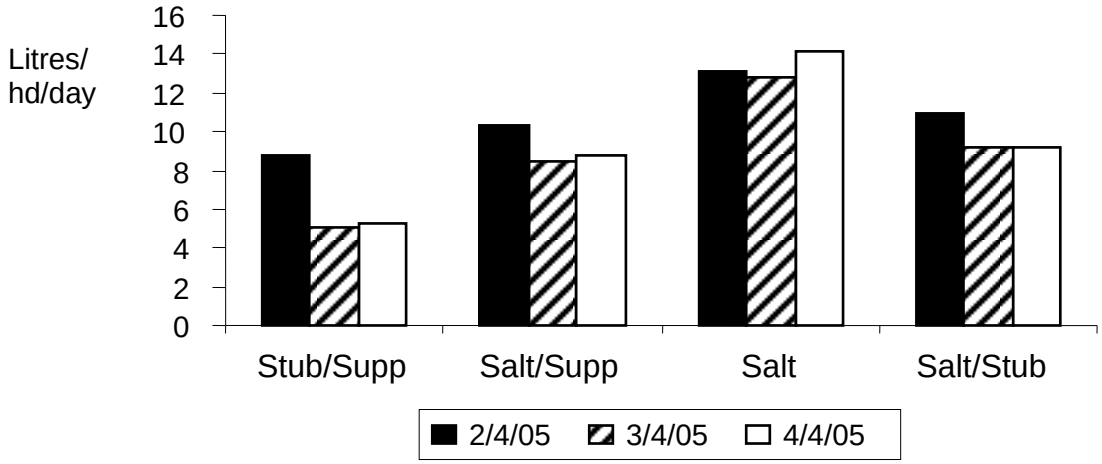
Slaughter Information (2005)

	Saltbush	**Saltbush/Stubble**	**Saltbush/Oats**	**Stubble/Oats**
Average Lwt (12hr curfew)	55.1kg (48.5-60.5)	56.2kg (47.0-64.5)	59.9kg (55.0-67.5)	61.3kg (57.0-70.5)
Average HSCW	23.3 (19.4-26.2)	24.4kg (20.8-27.6)	26.3kg (23.4-31.8)	27.5kg (24.2-30.8)
HSCW and shrink (24hrs)	0.968kg 4.1%	0.970kg 4.0%	0.969kg 3.8%	0.970kg 3.5%
GR	7.5mm (3-13mm)	9.6mm (4-14mm)	13.1mm (7-22mm)	16.4mm (8-22mm)
Dressing Percent	42.3% (36-46)	43.5% (41-46)	43.9% (41-47)	44.8% (41-48)
Skin Weight	6.0kg	5.7kg	6.0kg	6.0kg
Skin as % Lwt	10.9%	10.04%	10.0%	10.14%
Av USG	1.022	1.031	1.041	1.035
pH at 1hr 24 hrs	6.0 5.7	6.0 5.7	6.0 5.8	5.9 5.7
Carc Temp 1hr 24hrs	26.4º 6.0º	26.8º 6.1º	29.0º 6.1º	29.7º 6.3º
Grid Return	308c/kg	301c/kg	297c/kg	275c/kg
Carcase (grid$)	$71.65	$73.72	$75.33	$75.42
Carcase 300c/kg	$69.98	$73.31	$78.99	$82.43
Carcase 350c/kg	$81.55	$85.40	$92.05	$96.25
Oats Intake/lamb			60.3kg	73.3kg
Oats Intake/day			1.2kg	1.4kg
Oats as % Lwt			2.0%	2.3%
Oat Cost/Lamb			$7.24[2]	$8.80[2]

[1] = Grid price (no fat penalties) 310c/kg (20-26kg) and 270c/kg (>26kg)
[2] = Oats valued as $120/tonne
At all carcase price scenarios Saltbush/Stubble appears to have equal merit as a grazing option compared to supplementing on Saltbush or Stubble with Oats when valued at $120/t and labour and establishment costs are not taken into account

Water intakes were measured between April 2 to 4, 2005 by securing float valves within each treatment plot, marking water levels and refilling after lambs had had access to the troughs for a 24 hour period. In-line meters were purchased in 2006 to improve measurement accuracy and reduce labour requirements necessary when recording water intakes using the method described in 2005.

Daily (24 hour) water intakes



As % of Lwt	10.3 %	15.6 %	22.3 %	15.1 %	

On April 3, 2005 a 12 hour grazing habit study was undertaken. The grazing pattern, time spent grazing versus rumination/resting, time spent at self feeders (2 groups only) and time at water troughs were studied and noted between 0600 and 1800 hours.

Grazing Patterns and Periods (2005)

	Grazing Periods	Resting Periods	Total Time Grazing over 12 hours	Average time spent grazing
Saltbush	0600-0830 1600-1800	0830-1600	270 minutes	37.5%
Saltbush/Stubble	0600-0830 0930-1100 1600-1800	0830-1600	365 minutes	50.7%
Saltbush/Oats	0600-1015 1610-1800	1015-1610	330 minutes	45.8%
Stubble/Oats	0600-1030 1610-1800	1030-1610	360 minutes	50.0%

2006 Protocols and Results

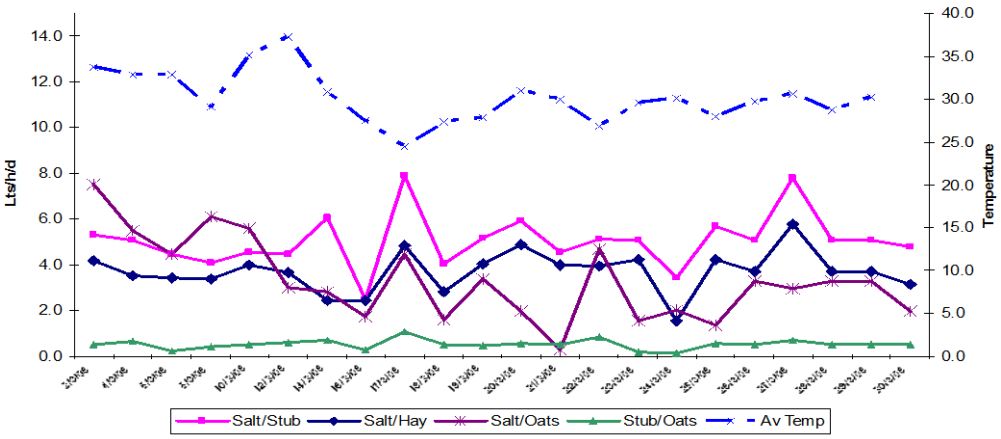
Grazing was again deferred in 2006 due to limiting saltbush leaf in saltbush plots. Grazing trial was eventually started on 16 February 2006.

Treatments were the same as for 2005 except for Paddock 2 which received between 250 to 400g/h/d of Lucerne hay. In 2005 no supplements were offered in this treatment.
Two (2) genotypes were investigated in 2006. These were White Dorper/Merino wether and Poll Dorset/Merino mixed sex lambs. Lambs were shorn, vaccinated and drenched (Weanerguard), weighed and allocated to treatments prior to moving to the Grong Grong Saltbush site on February 2 and 18 respectively.
In-line water meters were purchased and fitted to water troughs within each plot to record daily intakes. Results from 2005 suggested significant differences between treatments for daily intakes and may have contributed to difficulties associated with estimating dressing percent and carcase weights between treatments in 2005 when lambs were weighed directly off feed. Lambs were weighed fortnightly a minimum of 16 hours off-feed in 2006 to minimise gut fill effect (water and feed) when estimating carcase weights.
Due to pre-trial grazing and increased grazing pressure in 2006 (41 vs 16 lambs per plot in 2005) Plot 3 (Saltbush and Oats) was supplemented with harvested saltbush from a neighbouring stand every 2nd day from 15 March 2006 until 3 April 2006. At this time due to concerns for saltbush stand survival in Plot 3 and reducing availability of saltbush in all saltbush plots a decision was made to remove lambs from the site.
Lambs greater than 38kg (White Dorper/Merino) and 39kg (Poll Dorset/Merino) liveweight were selected for slaughter.

Average Daily Growth Rates (g/day)

	Genotype	28-Feb	15-Mar	28-Mar	Overall
Saltbush/Stubble	**WD**	136	132	-6	105
	PD	-27	90	84	47
Saltbush/Hay	**WD**	19	235	99	88
	PD	-167	133	88	49
Saltbush/Oats	**WD**	41	296	104	116
	PD	-191	298	154	93
Stubble/Oats	**WD**	94	100	58	88
	PD	-93	12	-66	-40

Daily (24 hour) water intakes and Temperatures (max)



Note: Troughs cleaned 2/3, 16/3 and 28/3. Algal blocks added to water 16/3/06
400g/h of hay fed to Plot 2 until 23/2 and 250g/h per day thereafter

Average Daily Water Intakes (Litres/head/day)

Period	Saltbush/Stubble	Saltbush/Hay	Saltbush/Oats	Stubble/Oats	Temp (max)
02-30/3/06	5.2	3.8	3.2	1.4	30.1º
2005	9.8	13.3 (no hay)	9.2	6.4	29.1º

Intakes were substantially less than 2005 readings in all treatments. This may be due to several factors including live weight of lambs (60 vs 42kg averaged across groups) between years and method of measurement in 2005 where troughs were cleaned daily during intake measurement period. The latter can be supported by looking at water intake changes post cleaning of troughs in 2006 where intakes increase by over 300% immediately after cleaning.
The addition of lucerne hay to the Saltbush Only treatment in 2006 appears to have reduced water intakes relative to the Saltbush/Stubble treatment in 2006. 2005 results showed greatest water intakes in the Saltbush Only treatment compared to other plots. This is likely to occur given supplemented hay represented from 25 to 40% of total estimated intake (based on lambs consuming a minimum of 2% of Liveweight daily) with saltbush contributing the remainder.
A similar pattern of decreasing or reduced water intake can be seen in the Saltbush/Oats treatment (Plot 3) shown in Figure 6 with lambs consuming less water on a daily basis as saltbush availability declined within the plot. Water intakes were seen to increase the day after feeding harvested saltbush from a neighbouring stand within plot 3. Grain intake increased during the period as expected
Average water intakes as a percentage of liveweight immediately prior to slaughter were lower compared to 2005 findings. This may be due to declining saltbush availability in 2006 leading to greater intakes of understory and/or supplements and a lowered water requirement.
Of total lambs 65% (62 of 96) and 15% (10 of 68) White Dorper/Merino and Poll Dorset/Merino cross lambs were selected for slaughter based on a 38 and 39kg empty live weight respectively. No Poll Dorset/Merino data is shown in Figure 4 due to insufficient numbers
Dressing percentages and ultimate carcase weights were overestimated when selecting lambs despite using a 16 hour curfew (feed and water) period prior to weighing. Gut fill was noted at slaughter to be an issue in saltbush treatments in particular and have conceivably led to difficulties with estimating carcase weights.
Plot 2 (Saltbush/Hay) dressed 3% less and were 1 to 3mm leaner than all other treatments. Similar results were found in 2005 when Saltbush Only lambs were slaughtered suggesting that supplementing lighter lambs grazing saltbush stands with 250g/h/d of Lucerne hay is inadequate in terms of prime lamb production.

White Dorper sired lambs outperformed their Poll Dorset sired counterparts in terms of:

- Growth rate
- Liveweights at slaughter
- Carcase weights (not shown for Poll Dorset)
- Numbers reaching target slaughter weights

Discussion

Dressing Percentages

Results from 2006 are similar to those found by Pearce et al (2004) with a 39 to 42% range found between saltbush and stubble grazed lambs of similar live weights. Dressing rates were

higher in 2005 than those reported by the same authors due to supplementation and higher fat scores (average of 7mm across groups) prior to entering the demonstration site.
Both years (2005, 2006) presented problems with accurately estimating dressing percentage and ultimate carcase weights particularly on saltbush grazed treatments. Differences between estimated and actual dressing percentages ranged from 2.2 to 3.5% (2005) and from 4 to 6% in 2006. Gut fill (despite 12 to 18 hour curfews), water intake and (conceivably) water retention may affect accurate estimation of dressing percent on saltbush based pastures. The latter are supported by MacFarlane et al (1967) who found that the greater the water intake the greater the amount of water remaining in the gut and extracellular space.

Water Intakes

Water intake from forages is dependent on type of animal, radiation load (Wilson 1974), ambient temperature, forage moisture and forage mineral content (Ru et al 2005). Stock grazing saltbush or fibrous, less digestible feed require extra water to maintain the movement of the coarse feed in the gut (Markwick 2002) and to help with an increased urinary excretion of sodium (El Aich, 1987). Wilson (1978) estimated that maximum water-intakes vary from 4 litres/day in the summer of a good season to 12 litres/day during a drought. MacFarlane et al (1967) reported water intakes for Merino and Border Leicester wethers of between 4.8 to 13.7l/day when grazing saltbush and water intakes, as a percentage of live weight, of 7.7 and 10.8% respectively. These are similar to 2005 (Table 5, Figure 2) and 2006 (Table 10 Figures 6 and 7) intakes despite differences in mean live weights and water intake found per day in both years.
Lowered water intakes in 2006 Saltbush Only (plus hay) plots compared to 2005, when daily water intakes were highest of all plots, may be due to the availability of additional roughage. This is supported by similar findings of Alicata et al (2002) where feeding of wheat straw led to an increase in the DOM intake and a reduction in water consumption in pen fed rams.

Grazing Patterns

Despite feed test dry matter digestibility's in excess of 79% (Table 6) laboratory digestibility predicts a much higher use of the feed than actually happens with the real digestibility of saltbush leaf and small stem frequently below 50% (Warren et al, 1995). Struth's (2006) assertion that animals will reduce daily grazing time as digestibility of forage available declines and retention time of digesta increases is supported by the 2005 grazing times (Table 6) where saltbush only treatment lambs spent considerably less time foraging than other treatments with access to supplements (oats) and native pasture or weeds.
Sensory receptors on the rumen wall sensitive to distension are thought to play a role in altering intake through transmitting signals to the hypothalamus indicating a feeling of fullness/satiety. The result is a decline in intake depending on the degree of rumen fill. As rumen fill is influenced by forage digestibility and the rate of passage at which feed particles pass from the rumen, poorly digested feeds such as saltbush may conceivably lead to a feeling of satiety, a reduction in grazing time and ultimately body weight gain as found in the 2005 grazing study.
Masters et al (2001) estimated that intake of saltbush by sheep ranges from 0.5kgDM/day to 1.9kgDM/day. If the plant contains 16% NaCl, as is commonly the case with saltbush species, salt intake on the Grong Grong site could be well above the maximum tolerable levels of 100-150g/day for sheep. Abouheif et al (2000) has suggested that Na intake in excess of 40g/day had adverse effects on rumen microflora, leading to impaired digestion, which again may explain poor body weight gain in sheep grazing saltbush as found in the current demonstration.
Alicata (2002) has shown that palatability is reduced as ash and sodium chloride contents increase. The saltbush's high ash content (28.6%) supports such findings and may, with gut

fill and slow turnover rates, also lead to a reduction in intake and overall productivity in un-supplemented saltbush treatments.

Weight

Most grazing trials examining sheep performance on *Atriplex spp* observe an initial period of rapid weight gain, followed by slower gain and ultimately weight loss due to body water accumulation associated with the high salt diet (Warren et al 1995, Casson et al 1996). Rapid weight gain prior to plateauing was found in 2005 (see Figure 1) when lambs were weighed without a curfew and, to a lesser degree, in White Dorper sired lambs in 2006. Poll Dorset sired lambs did not demonstrate a rapid initial increase in live weight (see Figure 3) and may have conceivably preferentially grazed available under-story grass and weeds in initial stages of the demonstration. The 18 hour curfew of lambs in 2006 prior to weighing may have also reduced overall stomach fluid content lowering live weight and may, in part, explain the lower initial weight gain found in 2006 compared to that found in 2005

Supplementing lambs grazing saltbush with cereal grain (barley, oats) or Lucerne hay has significantly increased intake and performance (Pearce et al 2002, Hopkins and Nicholson 1999). This is partly because the high percentage of NPN in saltbush can be utilised when a highly digestible energy supplement is available (Masters et al 2001). Rates of 250g/h/day fed in 2006 however appear insufficient to allow lambs to make full use of the saltbush high NPN levels and to attain satisfactory growth rates and production.

Hopkins and Nicholson (1999) in supplementing with Lucerne hay (ad lib) and oat grain (fed every 4th day) found that there was no significant difference between treatments for live weight but that there was a significant ($P<0.05$) treatment effect on hot carcase weight. Similar results have been found in both 2005 and 2006 (Tables 2, 4, 8 and 11 and in Figures 1, 3, 4 and 8) at the Grong Grong site although due to small lamb numbers and lack of treatment replicates present data has not been statistically analysed.

If not supplemented sheep fed on *Atriplex* species alone will merely maintain live weight (Atiq-Ur-Rehman et al 1994) and it is therefore recommended that *Atriplex spp* should not constitute more than 25-30% of the sheep's diet (Aganga et al 2003) if production is to be improved.

Meat quality

Hopkins and Nicholson (1999) reported that there was no effect of feeding *Atriplex* to lambs on tenderness or juiciness and that finishing lambs on saltbush and either supplemented with hay or grain did not present any apparent meat quality problems compared to Lucerne fed lambs. Muscle pH's for 2005 (Table 4) lambs were slightly higher in all treatments than those reported by the authors mentioned with all falling below 5.8 within 24 hours post chilling and electrical stimulation, a value considered indicative of tougher meat (Young et al, 1993)

Urine Specific Gravity

Dehydration in lambs prior to slaughter is attributed to a failure to drink in lairage (Pearce et al 2005) and is responsible, in part, for reduced carcase yields. Urine Specific Gravity is considered a useful indicator of the hydration status of lambs (Pethick et al 2003) with high USG values occurring when urine is concentrated, a physiological mechanism used by an animal to conserve water when dehydrated (Pearce et al 2005). Urine Specific Gravity varies on a scale between 1.000 to 1.060 with a 'normal' lamb expected to have values between 1.025 to 1.030. When USG exceeds 1.035 then effects of dehydration on the amount of water in muscle tissue can be expected (Jacob 2006)

Lambs grazing saltbush only plots had a lower USG in 2005 and 2006 than lambs that grazed supplemented saltbush or stubble plots (Tables 4 and 11). Similar findings by Pearce et al (2005) suggest that these lambs were excreting more water, keeping ingested salts diluted and

USG value low. This suggests greater water retention within the muscle and increased hydration reducing carcase shrinkage (Pearce et al 2005).

Vitamin E

Pearce and Jacob (2004) found that grazing hoggets on saltbush supplemented with barley boosted meat Vitamin E content and retained a fresh red colour for longer than meat from similar sheep grazing dry stubble with a barley supplement. Although no measurements were taken in relation to Vitamin E within lambs grazing saltbush stands this is an area of potential marketing advantage and should be further investigated.

Concluding Remarks

So where to from here? The current demonstration has one year to run. We are likely to incorporate energy supplements in the form of grain or quality roughage ad lib in 2007 within all saltbush plots to further investigate the potential for saltbush pasture use as a productive feed in southern NSW. Further genotype comparisons are also likely.

We would appreciate feedback and input from anyone dealing with producers interested in establishing or currently utilising saltbush based pastures to discuss additional areas of research required. The development of a set of management protocols for optimising saltbush use in terms of prime lamb production is necessary. Future validation of Grong Grong findings on-farm is also a core objective.

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