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Determination of Dorper DSE rating for stocking decisions

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Abstract

The Dry Sheep Equivalent (DSE) is a standard unit used to compare the feed requirements of different classes of livestock or to assess the carrying capacity and potential productivity of a given paddock. Field Metabolic Rates and Water Turnover Rates of Dorper sheep were assessed under the semi-arid condition of western NSW to establish their DSE rating. Results showed no significant difference between Dorpers and Merinos in either Field Metabolic Rate or Water Turnover Rate. However there was significant difference in Body Water Content of the two breeds. It is concluded that DSE rating of individual animal cannot be criterion to determine the safe stocking rate of Dorper sheep.

Background

Dorper sheep have recently been introduced into Australia, particularly in lower rainfall environments and have created considerable interest in the region in view of their reputed ‘easy care’ characteristics, potential to allow organic meat production and hardiness in the semi-arid environments.

The DSE, as a standard unit used to compare the feed requirements of different classes of stock or to describe the carrying capacity, is a vital tool in determining stocking rate. The feed requirement and therefore stocking rate of Dorper sheep needs to be studied. Such studies are urgently required in order to support the management decisions of Dorpers, which may be quite different to those of traditional Merinos. This information will enable an improved assessment of the potential for differential impacts on rangeland resources.

Recent works on feral goats and kangaroo (Munn *et al*.2009; Mann et al. 2012) have shown Field Metabolic Rate (FMR), Water Turnover Rate (WTR) and (Basal Metabolic Rate) could be used to generate DSE to predict potential grazing pressure.

Data from this project will be available to support the development of sustainable management strategies for Dorper sheep, which pose both opportunities and potential threats to the economic and ecological sustainability of the rangelands pastoral industry.

Project Objective

To determine the field metabolic rate, water turnover rate and feed intake of Dorpers compared with Merinos

To describe the DSE of Dorper sheep and compared with Merinos

Provide a draft copy of the output that will be incorporated into the NSW DPI publication on Dorper Grazing Management booklet

Methodology

1.1 Study site and climatic conditions

The study was conducted at Fowlers Gap (31_050S, 141_430E), the Arid Zone Research Station of the University of New South Wales, Australia. The station covers approximately 39,200 ha and operates as a commercial sheep station. Vegetation is dominated by woody shrubs (< 1 m), chiefly of the family Chenopodiaceae. Rainfall is

variable, with a yearly average of 236.7 mm. The study was conducted during a mild austral winter between late June and early July 2014.

1.2 Study animals

Mature Dorper (n=6) and Merino (n=5) sheep were mustered using motorbikes from their home paddock and moved to an onsite shearing facility for processing. Average initial body mass of Dorper and Merino was 43.18kg and 38.08kg respectively.

1.3 Field metabolic rates (FMR), body water content and water turnover rates (WTR)

Blood samples (ca. 4 mL) were obtained from the jugular vein for measurement of the background levels of isotopes ^{18}O and deuterium (^{2}H). The animals were then injected intraperitoneally with solutions enriched with ^{18}O (98 % enriched) and ^{2}H (95 % enriched) from separate syringes in the same location (isotope solutions were supplied by Rotem Industries, Israel). All animals were injected with 0.2 g kg^{-1} ^{18}O and 0.1 g kg^{-1} ^{2}H. For both breeds, the isotopes were allowed to equilibrate with body water for 8 h before a second blood sample (ca. 4 mL) was obtained from the jugular vein. After treatment, the sheep were released to a holding paddock for 5 days after which the sheep were mustered for final blood collection and body masses measurement. The holding paddock consisted of abundant natural vegetation to support the animals for the duration.

Background, equilibration and final blood samples were analysed for ^{18}O and ^{2}H by isotope ratio mass spectrometry (Metabolic Solutions, Nashua, NH, USA) after vacuum distillation to obtain pure water (Speakman 1997). Pool sizes for isotopes (NH or NO) were calculated following methods summarised in ‘‘Methods for isotope pool sizes and doubly-labelled water (DLW) calculations of field metabolic rate (FMR) and water turnover rate (WTR) (Lifson and McClintock 1966; Speakman 1997). Initial dilution space ratios (N_H/N_O) were not significantly different between the sheep breeds and mean group dilution space ratio was used to calculate WTR and FMR. Total body water (TBW; % initial live mass) was estimated from the dilution space (N) for ^{18}O. WTR and carbon dioxide production were calculated using equations summarised in ‘‘Methods for isotope pool sizes and DLW calculations of FMR and WTR’’ (Speakman 1997; Lifson and McClintock 1966; and see Munn et al. 2012). Carbon dioxide production was converted to FMR (kJ day^{-1}) assuming energy equivalents of 21.7 kJ L^{-1} CO_2 (Nagy et al. 1999).

Result and discussion

1.4 Body mass

On average, the initial body mass (live mass) of the two sheep breeds was not significantly different. There was no significant breed difference in the average change in body mass during the experimental period and for each breed the average body mass change over the experimental period was not significantly different from zero.

1.5 Field Metabolic Rate, Water Turnover Rate and Body water content

Enrichments for ^{18}O after equilibration were 153.15 and 138.02 ppm above the background level for Merino and Dorper, respectively and for ^{2}H were 1032.96 and 895.50 ppm for Dorper and Merino, respectively. Final isotope enrichments for ^{18}O were 18.30 and 25.55 ppm above background for Dorper and Merino, respectively while for ^{2}H were 143.64 and 190.32 ppm above background for Merino and Dorper,

respectively. There was no significant difference between breeds for isotope dilution space ratio and isotope kinetics were within acceptable ranges to reliably estimate WTRs and FMRs for Dorper and Merino

The apparent body water content of Dorper (70.9 %) was significantly higher than that of Merino (62.1 %), but this likely reflects the contribution of wool to the live mass of the merinos. These merinos had approximately 5 months wool growth, which would typically contribute approx. 3kg body mass based on the extensive wool growth records for this herd at Fowlers Gap (see Edwards 1996). Once an estimated wool mass is considered the merino body water content would be comparable to that of the Dorpers.

The average FMR (kJ kg $^{0.75}$d^{-1}) of Merino was 434.0 while that of Dorper was 433.8 and differences were not significant. WTR (units) were also not different between the breeds (439.1 for Merino and 401.8 for Dorper).

The differences in ^{18}O and ^{2}H between the equilibrium and final blood samples measure the sum of the water and CO_2 losses and measures metabolic rates. FMR is the total energy cost an animal pays during a course of a day. FMR includes cost of basal metabolism (metabolism cost when an animal is in complete rest), reproduction, growth, thermoregulation, locomotion, feeding, digestion and other associated costs. The variation in FMR for a given body mass indicates differences in feed requirements of different classes of livestock. The lack of difference in FMR between Merinos and Dorpers indicate they have the same feed requirement per body weight and therefore no difference in their DSE rating.

Table 1. Live mass, BWC, WTR and FMR of individual animals. WTR and FMR values were scaled using scaling exponents of 0.8 and 0.75 respectively to account body mass differences.

Animal ID	***Breed***	***Live mass (kg)***	***Body water content (%)***	***WTR (L d-1)***	***WTR (mL kg-0.8)***	***FMR (kJ d-1)***	***FMR (kJ kg-0.75 d-1)***
M220	Merino	41	57.7	7.4	380.9	5115	315.7
M1191	Merino	36	61.4	7.3	417.5	8112	552.0
M2327	Merino	41	60.8	9.1	468.5	7103	438.4
M69	Merino	40.5	64.1	9.1	470.5	6874	428.2
M1448	Merino	31.9	66.7	7.3	458.0	5848	435.7
D1179	Dorper	45.6	74.2	8.6	405.8	8629	491.8
D2029	Dorper	52.7	72.9	11.4	477.2	7524	384.7
D1778	Dorper	48.4	71.0	6.9	308.7	9685	527.8
D2472	Dorper	33.8	69.2	6.6	395.3	3625	258.6
D1746	Dorper	45.6	69.9	8.7	410.2	9409	536.2
D2479	Dorper	33	68.3	6.8	413.4	5559	403.7

Table 2 Summary of Merino and Dorper FMR, BWC and WTR analysis.

FMR (KJ KG-0.75 D-1)			
	Means	SD	SE
Merino	434.0	83.6	37.4
Dorper	433.8	106.5	43.5
Body water content (%)			
	Means	SD	SE
Merino	62.1	3.4	1.5
Dorper	70.9	2.3	0.9
WTR (mL kg-0.8)			
	Means	SD	SE
Merino	439.1	39.0	17.4
Dorper	401.8	54.1	22.1

1.6 Draft copy - NSW DPI publication on Dorper Grazing Management

The project output has been incorporated in the NSW DPI publication on Dorper Grazing Management booklet. See Appendix 1.

Success in achieving objectives

The project achieved the objective of determining the comparative field metabolic rate and water turnover rate of Dorpers compared with Merinos. The two breeds had basically the same FMRs and WTRs and therefore the same DSE rating.

The results will be incorporated into the booklet being prepared by NSW DPI to guide the grazing management of Dorpers in the semi-arid regions.

Impact on meat and livestock industry

Changing from Merinos to Dorpers involves decisions about their DSE ratings as well as considerations about the type of country available. This trial has shown that Dorpers should be rated equal to Merinos based on body weight. However, FMR and WTR may not account for differences in diet selection patterns or the mixture of vegetation types available in specific situations. At a practical level it is common to find more Dorper ewes rearing twins while at the same time carrying twins which is rare in Merinos. In such situations the DSE rating of Dorpers would be much higher. Therefore, a strategic reduction in stocking rate of Dorper ewes in relative to Merinos is appropriate because the potential for high lambing percentages even under poor seasonal conditions can easily lead to a feed shortage.

On the other hand, under scrubby country, Dorper enterprises could run the same number of Dorpers as Merinos because of the greater selective range of the Dorper and/or the ability to sell Dorpers at a young age offers greater flexibility for varying stocking rate in relation to seasonal conditions compared to Merino enterprises provided close monitoring of pasture resources is put in place.

Conclusions and recommendations

There was no difference in either FMR or WTR between Merinos and Dorpers indicating they have the same feed requirement per body weight and therefore no difference in their DSE rating. However the two breeds differ in reproduction rate and diet selection and therefore stocking rate decisions should take into account these differences.

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Appendix 1.

MANAGING DORPER SHEEP
IN THE WESTERN DIVISION OF NEW SOUTH WALES

Yohannes Alemseged

Introduction

The pastoral industry in the Western Division of NSW is undergoing a substantial transformation with the establishment in recent years of new sheep breeds, especially Dorper. These changes from the traditional Merino grazing enterprise have been stimulated by the perceived advantages of the new breeds or species in terms of reduced intensity of management, fitness for the rangeland environment including the capacity to utilise forage resources not exploited by Merinos, and overall potential for profitable production. At the same time, however, their reputed hardiness and fertility have raised concerns about their potential impact on land condition, particularly the maintenance of ground cover in line with regional targets.
This publication presents the results of recent investigations into the biology and current management of Dorpers and summarises the key points relevant to their incorporation into sustainable livestock enterprises in the Western Division.

the study

The study summarised in this publication was conducted over five years, from January 2009 to October 2014. It included:

- A review of literature, mostly from overseas sources, to identify key features of the biology of the species relevant to their sustainable management, and to reveal knowledge gaps;
- Collation of local knowledge through producer discussion groups across the Western Division which sought opinion on a number of fixed questions as well as more general comment;
- Field, animal house and laboratory studies to assess differences in grazing behaviour, diet selection and feed utilisation characteristics compared to Merinos. Field studies included observations of ground cover, botanical composition, total biomass on offer, and shrub cover in adjacent paddocks grazed by Merinos and Dorpers. Paddock sets were selected at eight locations across the Western Division (a total of 24 paddocks). In the animal house experiment, the feed utilisation characteristics of Dorpers and Merinos were measured when fed diets of either Lucerne chaff (high quality) or wheaten chaff (low quality). The laboratory studies involved the use of DNA fingerprinting to identify plant species present in faecal samples of the three species collected in the field.
- Dry Sheep Equivalent determination, Field Metabolic Rates and Water Turnover Rates of Dorper sheep were assessed under the semi-arid condition of western NSW to establish their DSE rating.

biological background

1.6.1 The Dorper[1]

The Dorper, also known as Dorsian in South Africa, is a composite breed developed at Grootfontein (South Africa) in the 1940's by combining the hardiness of the Black-headed Persian with the meat producing capacity of the Dorset Horn. Due to its productivity, hardiness, and other useful traits the Dorper has become common and widespread in southern Africa. In Australia, the success of the breed has resulted mainly from its reputation as an adaptable animal that can produce marketable lambs under less than ideal pasture conditions. The White Dorper has gained greater popularity with producers in the Western Division that the black-headed strain.

1.6.2 Reproduction

The Dorper is an early-maturing breed. Maiden Dorper ewes have been reported to exhibit their first oestrus at 213 days of age, at a weight of 28 kg, although considerable variation in age and weight at first oestrus and lambing has been reported. Ram lambs have been observed to be sexually active as young as three months of age in Western Australia and have successfully fertilized females prior to weaning.

Dorpers survive and reproduce very successfully under harsh conditions. Over a range of pasture and management conditions ewe fertility (i.e. ewes lambed per lambing opportunity) has been reported to range from 0.75 to 0.97, and to be commonly around 0.90. The number of lambs weaned per ewe mated varied from 0.99-1.40. Producers running F1 and F2 (back crossed) Dorper ewes in western NSW have reported lamb marking rates of 130 percent and ewes producing three lambs in two years under drought conditions in which Merinos failed to breed. Anecdotal evidence from western NSW also suggests that accelerated lambing (in which ewes are mated more than once annually) may suit Dorper enterprises in the region. Accelerated lambing has been discussed widely in South African literature and figures of 1.46 lambs per ewe joined per year and 1.48 lambs weaned per ewe mated per annum have been reported. However, some studies could not demonstrate conclusively that reproductive performance under an accelerated joining program was superior to annual joining for ewes grazed on natural pasture.

1.6.3 Growth

Average birth weights for Dorper males and females, respectively, reported from South Africa, are 3.48 kg and 3.36 kg with corresponding adult weights of 74 kg and 44 kg. Average weaning weight (at 100 days) and average daily gain to slaughter have been reported to be 37% and 44% higher, respectively, than a range of wool breeds and crossbreds. The high growth rate of Dorpers may be attributed to their inherent growth potential, ability to graze at an early age, and the maternal ability of Dorper ewes.

1.6.4 Digestive efficiency

In the animal house experiment conducted at Wagga Wagga with Dorper and Merino wether weaners, sourced from the same vicinity, animals were fed rations of either lucerne chaff (high quality; 15 per cent crude protein) or wheaten chaff (low quality, 6.1 per cent crude protein). On the lucerne diet differences in digestibility between Dorpers and Merinos were small (Table 1) but on the wheaten diet Dorpers displayed

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[1] More detailed information and relevant references can be found in: Alemseged Y and Hacker RB (2014). Introduction of Dorper sheep into Australian rangelands: implications for production and natural resource management. *The Rangeland Journal* **36**:85-90.

consistently higher levels of digestibility than Merinos although the difference was statistically significant only for Acid Detergent Fibre. Higher digestibility of dietary components by Dorper x Damara cross animals compared with Merinos has also been found in other studies at Wagga Wagga.[2]
These findings are consistent with literature reports which indicate that Dorpers are capable of digesting more of the forage consumed than a range of other breeds and that they are well suited to use of low quality forages.
Although Dorpers have been shown to have lower food intake per unit of body weight than Merinos, the difference on a 'per sheep' basis is small due to the higher body weight of the Dorper.

1.6.5 diet selection

Though bred for arid and semi-arid environments, the Dorper breed has performed well under a variety of climatic and grazing conditions, including intensive feeding systems.
Usually Dorpers are regarded as less selective grazers than Merinos, utilising shrubs and bushes to a greater extent and grasses to a lesser extent.
The identification of species present in the faeces by DNA fingerprinting confirmed the greater selective range of Dorpers compared to either Merinos (Tables 2 and 3). Dorpers consumed a total of 28 species of which 16 were found only in Dorper faeces. The corresponding figures for Merinos were 17 and 8. Analysis at the Family level, where identification by the method used is more certain than at the species level, produced a similar picture of the greater selective range of Dorpers. Those species that were uniquely selected by Dorpers, however, were mostly herbaceous with no indication in the data of any preference for shrubs under the good seasonal conditions that prevailed during the study.
However, observations in the paddock sets did indicate a tendency for Dorpers to graze shrubs more that Merinos. Most shrub species found in the Dorper paddocks were moderately grazed, including *Dodonea attenuata* (narrow-leaf hopbush), *Acacia victoriae* (prickly wattle) and *Casuarina cristata* (belah).
The capacity of Dorpers to utilise a wider range of species on offer may enable them to walk less during grazing, reduce grazing time or the number of separate grazing periods, and could reduce grazing pressure on some species that could be readily overgrazed by Merinos.

1.6.6 DSE rating

Changing from Merinos to Dorpers involves decisions about their DSE ratings as well as considerations about the type of country available. This trial has shown that Dorpers should be rated equal to Merinos based on body weight. However, FMR and WTR may not account for differences in diet selection patterns or the mixture of vegetation types available in specific situations. At a practical level it is common to find more Dorper ewes rearing twins while at the same time carrying twins which is rare in Merinos. In such situations the DSE rating of Dorpers would be much higher. Therefore, a strategic reduction in stocking rate of Dorper ewes in relative to Merinos is appropriate because the potential for high lambing percentages even under poor seasonal conditions can easily lead to a feed shortage.
On the other hand, under scrubby country, Dorper enterprises could run the same number of Dorpers as Merinos because of the greater selective range of the Dorper and/or the ability to sell Dorpers at a young age offers greater flexibility for varying stocking rate in relation to seasonal conditions compared to Merino enterprises provided close monitoring of pasture resources is put in place.

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[2] G. Krebs, unpublished data.

1.6.7 Overview of biological characteristics

This brief overview of the biology of Dorpers suggests that the key features relevant to their incorporation into sustainable enterprises in the Western Division are,

- High fertility and fecundity especially if managed within an accelerated lambing system;
- Generalist feeding strategy, and high digestive efficiency, resulting in the capacity to utilise low-quality diets and plant species, particularly browse, less utilised by Merinos;
- Feed intake per animal about equivalent to Merinos but probably acquired with less grazing time and reduced walking distance due to less selective grazing habits;
- High pre-weaning and post-weaning growth rates, due respectively to the maternal ability of the ewe and the capacity to utilise low-quality diets efficiently; and
- Hardiness or capacity to survive and reproduce under poor seasonal conditions.
- Maintenance of a high population growth rate over a wide range of seasonal conditions;
- Potential for reduced selection pressure on individual plant species, compared to Merinos, if forage is relatively abundant, but also potential for increased grazing pressure if grazing distribution is reduced (e.g. due to less selective feeding habits) and/or hardiness allows animals to be kept for longer under deteriorating seasonal conditions.
- Potential for animals to achieve marketable weights under a range of seasonal conditions although some sensitivity must still be expected.

These features justify an optimistic view of the future role of Dorper in pastoral businesses. However, adverse consequences for rangeland condition can be expected if seasonal or market conditions result in an imbalance between population growth and off-take, leading to a high grazing pressure. While this is true of all livestock production systems, the capacity of Dorpers to survive and reproduce under a wide range of seasonal conditions makes this problem potentially more serious than for traditional Merino enterprises, and likely to manifest itself more quickly in the absence of astute management.

management of dorpers

The biological background above and the experience of the producers summarised in Appendix 1 indicate that Dorpers present some challenges for management compared to traditional Merino operations. These issues need to be considered no matter what form of grazing management is applied or where the business lies on the spectrum of trader-set stocker operations.

1.6.8 THe feed base

The different diet selection patterns of Merinos and Dorpers mean that the available feed in any paddock at any time will vary between the species. Dorpers will select a wider variety of species, including browse species, than Merinos and this difference may allow a short term increase in stocking rate, or for the current rate to be maintained longer into a dry period. Current recommendations for estimation of the

amount of forage available for grazing assume that only about 20 per cent of the total standing dry matter (excluding browse) should be considered as available forage.[3] No guidelines are available to suggest how this figure should be altered, if at all, to allow for the potentially wider selection of Dorpers among ground storey species. Of greater importance is to take account of the amount of browse available. No practical method has yet been developed for estimating browse availability for management purposes in Australian rangelands. However, some basic considerations in assessing browse availability will include the shrub species present, their density, and the grazing reach of the animals. Shrub density will determine the total amount of browse available but will also influence its accessibility. Studies in Africa[4] have shown that browsers can seldom utilise more than 10% of the browse material available and it is therefore important not to overestimate this component of the feed base. The species identified by DNA barcoding in the present study are listed in Table 4, together with the breed/species by which they were consumed. Acceptability of some common browse species to Dorpers is shown in Table 5. While these tables may assist producers assess how forage availability for Dorpers may differ from Merinos, great care should be exercised not to overestimate the stocking rate that can be supported.

Plant poisoning has not been a major issue for Dorpers in the Western Division. Nevertheless, some producers who contributed to focus group discussions suspected that instances of plant poisoning of Dorpers may have occurred with salvation jane (*Echium plantagineum*), capeweed (*Arctotheca calendula*), pig weed (*Portulaca* spp.) and Heliotrope (*Heliotropium* spp.) named as possible causes.

1.6.9 exchanging Merinos for dorpers

Changing from Merinos to Dorpers involves decisions about the dry sheep equivalence (DSE) ratings of the new animals as well as considerations about the type of country available and the degree of dietary overlap with Merinos.

Most producers in the focus group discussions believed that Dorpers should be rated equal to Merinos but some considered that their rating should be higher (i.e. fewer should be carried on the same area of land) because of their faster growth rate. At a practical level, producer opinion varied on the question “If a paddock was meant to be stocked with 500 Merino ewes, how many Dorper ewes would you stock it with?” Some considered that if a mixture of open and scrubby country was available then the same number could be run, or even more, because of the greater selective range of the Dorper and/or the ability to sell Dorpers at a young age offered greater flexibility for varying stocking rate in relation to seasonal conditions compared to Merino enterprises. However, some producers believed that fewer Dorper ewes should be run because of the higher lambing percentages that can be expected, especially under poor seasonal conditions, and the potential for numbers to increase rapidly.

Changing from Merinos to Dorpers involves decisions about their DSE ratings as well as considerations about the type of country available. This trial has shown that Dorpers should be rated equal to Merinos based on body weight. However, FMR and

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[3] Campbell T. and Hacker R. (2000) The Glove Box Guide to Tactical Grazing Management for the Semi-Arid Woodlands. ISBN 0 7347 1195 6. NSW Agriculture. 69 pp.

[4] Muya, S. M.,Kamweya,A. M., Muigai, A.W.T., Kariuki, A., and Ngen, S.M. (2013). Using range condition assessment to optimize wildlife stocking in Tindress Wildlife Sanctuary, Nakuru District, Kenya. Rangeland Ecology and Management

WTR may not account for differences in diet selection patterns or the mixture of vegetation types available in specific situations. At a practical level it is common to find more Dorper ewes rearing twins while at the same time carrying twins which is rare in Merinos. In such situations the DSE rating of Dorpers would be much higher. Therefore, a strategic reduction in stocking rate of Dorper ewes in relative to Merinos is appropriate because the potential for high lambing percentages even under poor seasonal conditions can easily lead to a feed shortage.
On the other hand, under scrubby country, Dorper enterprises could run the same number of Dorpers as Merinos because of the greater selective range of the Dorper and/or the ability to sell Dorpers at a young age offers greater flexibility for varying stocking rate in relation to seasonal conditions compared to Merino enterprises provided close monitoring of pasture resources is put in place.

1.6.10

1.6.11 Stocking rate decisions

All livestock enterprises, regardless of the form of grazing management applied, must ultimately adjust the number of animals to match the feed supply currently available or expected over the planning horizon. A number of approaches can be applied.

Fodder budgeting

In its simplest form this involves estimating the amount of feed available (assuming that only 20 per cent of the total dry matter present should be consumed) and determining how long it will last given the number of stock on hand or, alternatively, the number of stock that can be carried for a given period. When only ground feed is involved this process is straight forward and can be based on the use of available photo-standards to estimate the amount of dry matter present[5].

For Dorpers an estimate of the browse available is also desirable but as noted above there is currently no robust practical method of estimating this in the field. In open country where the amount of browse is small it can safely be ignored and treated as a reserve that will provide some protection against over-estimation of the stocking level based on ground feed alone. Where browse is expected to be a major part of the feed on offer, and until a better alternative is available, producers may develop a capacity to adjust the grazing capacity determined from ground feed alone by noting the impact of the stocking rate applied on ground cover and shrub utilisation. If ground cover is maintained at a reasonable level and shrubs are not heavily browsed or damaged then the difference between the actual stocking rate and the rate calculated from ground feed alone could be taken as an estimate of the browse contribution for future reference. A discounted estimate would be appropriate if ground cover or shrub utilisation is higher than desired.

Stocking rate estimation

The approach to fodder budgeting outlined above does not account for the forage that can be expected to grow over the planning period. A method of calculating short term stocking rate for Western Division properties that does attempt to account for future seasonal expectations, and other factors, has been developed[6] but not widely trialled to date. This method is based on simple rating scales for three factors – (1) forage availability relative to the same time last year, (2) expected growing conditions over the coming year (divided into two 6-monthly periods) relative to those which produced the current level of forage and (3) the condition of the paddock relative to the targets that have been set for natural resource management. These factors are applied to the average number of dry sheep equivalents, including non-domestic herbivores, that has been carried in the paddock over the last 12 months. This final 'total grazing pressure' factor ideally requires regular monitoring of non-domestic herbivore numbers using the technique described in the Glove Box Guide[7] but less formal estimates of the non-domestic component could be made. This method

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[5] Photo-standards and procedures are given in Campbell T and Hacker R (2000) *The Glove Box Guide to Tactical Grazing Management for the Semi-Arid Woodlands*. NSW Agriculture. pp 21-26.

[6] 'Determining Stocking Rate' in Campbell T and Hacker R (2000) *The Glove Box Guide to Tactical Grazing Management for the Semi-Arid Woodlands*. NSW Agriculture. pp 61-63.

[7] 'Total Grazing pressure' in Campbell T and Hacker R (2000) *The Glove Box Guide to Tactical Grazing Management for the Semi-Arid Woodlands*. NSW Agriculture. pp 41-46.

requires ongoing monitoring of livestock numbers, non-domestic herbivore numbers, and natural resource condition indicators but the calculations involved and the ratings required are simple. In addition to future seasonal expectations the method also specifically accounts for the presence of a substantial component of non-domestic grazing. The method can be applied at any time of year but is particularly useful for adjusting stocking rates at the end of the summer and winter growing seasons.

DDH/100mm of rainfall

Another method of incorporating future seasonal expectations into stocking rate decisions is the use of the DDH/100 mm (DSE days per hectare per 100 mm of annual rainfall) carrying capacity benchmark (BM)[8]. At any time of the year, the expected rainfall for the 12 month period to the end of the planning horizon (e.g. for the last nine months and the next 3 months) can be determined based on the actual rainfall record and assumptions regarding the expected rainfall for the coming planning period. The rainfall expected in the planning period can be set at any level of acceptable seasonal risk based on personal preference[9] or seasonal climate forecasts[10]. Application of the expected 12-monthly rainfall figure to the carrying capacity benchmark will produce an estimate of the number of DSE days per hectare that the property can be expected to support over the entire 12-month period, as shown below:

DDH = BM x expected 12-monthly rainfall (mm)/100

where DDH is the expected carrying capacity for the 12 month period in DSE days per ha. Comparison of the expected carrying capacity with the actual stocking rate planned for the 12 month period (i.e. the actual stocking rate to date combined with any anticipated changes during the planning period) will indicate if the current stocking policy can be maintained or should be changed.

Central to this approach is a realistic estimate of the carrying capacity benchmark. If the property is in good condition then a reasonable estimate, for the historical grazing enterprises, can be obtained from the long term stocking rate and the long term average annual rainfall. However, any figure derived from long term records would need to be discounted if the condition of the property is below what management seeks to achieve. In addition, a benchmark based on historical records may not be appropriate for a new enterprise based on new types of livestock. Nevertheless an approximation based on historical records would serve as a useful starting point. Maintenance of good stocking and rainfall records, for example through use of a grazing chart, combined with monitoring of the impact of grazing on land condition will allow individuals to progressively refine their estimate of the BM figure appropriate for their property, or for individual paddocks, under the new grazing regime.

Trigger points

If formal approaches to stocking rate assessment such as those described above are not applied producers should at least consider establishing ‘trigger points’ for their

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[8] Hacker RB and Smith WJ (2007) An evaluation of the DDH/100mm stocking rate index and an alternative approach to stocking rate estimation. *The Rangeland Journal* **29** 139-148.

[9] Probabilities of monthly rainfall for locations throughout the Western Division are given in: Hacker RB, Alemseged Y, Carberry PM, Browne RH and Smith WJ (2006) *Betting on Rain. Managing seasonal risk in western NSW*. NSW Department of Primary Industries. pp 25-33.

[10] Seasonal climate forecasts for NSW can be obtained from www.LongPaddock.qld.gov.au

property –calendar dates beyond which decisions to buy or sell livestock should not be delayed. These dates can be determined from pasture growth profiles that show, for each fortnightly starting point throughout the year, the potential for pasture growth over the next three months, and the variability in 3-monthly growth from year to year. Dates at which future growth potential reaches a minimum (generally in autumn) or a maximum (generally in spring) are logical 'trigger points' beyond which decisions to buy or sell stock should not be delayed. 'Primer' dates can also be established so that preparations can be made for decisions that should not be delayed beyond the trigger point.

Establishment of trigger points can complement the use of seasonal climate forecasts. Spring trigger points, for example, are usually associated with high variability in growth from year to year but at this time seasonal climate forecasts based on the Southern Oscillation Index[11] are reasonably reliable and can be used to assist decision in particular years. Pasture growth profiles for 27 locations throughout the Western Division have been published[12] and can assist producers in establishing trigger points for their properties.

Strategic stocking rate reduction

As noted above, some producers in the Western Division consider that a strategic reduction in stocking rate relative to Merinos is appropriate for Dorper ewes because the potential for high lambing percentages even under poor seasonal conditions can easily lead to a feed shortage. This approach need not preclude some variation in stocking rate to take advantage of better seasons. Feed not utilised in high rainfall years can provide carryover feed and improve ground cover. Pasture regeneration in the Western Division has been shown to improve when the ground cover during the previous year is higher[13].

1.6.12 grazing management

The biological characteristics of Dorpers and producer experience in the Western Division, indicate that some aspects of their grazing management will differ from that of traditional Merinos. A characteristic noted for Dorper is a tendency to walk shorter distances from water. This may be due to the greater selective range that Dorper display relative to Merinos, including the greater use of browse. Their shorter legs compared to Merinos have also been suggested as a possible reason for this trait. Dorper sheep have also been noted to be relatively sedentary in their grazing as they have also been observed to feed in the one location longer than would be expected of Merinos. .

Thus while the greater selective range available to both Dorpers has potential to reduce grazing pressure on some species, these behavioural characteristics may negate this benefit even under good seasonal conditions. Under poor seasonal conditions the hardiness of Dorper will enable them to 'hang on' longer, and exert greater grazing pressure than Merinos unless corrective management action is taken.

These characteristics suggest that management of Dorpers would benefit from smaller paddocks and/or more frequent waters than traditionally used for Merinos in

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[11] Available from www.LongPaddock.qld.gov.au

[12] Hacker RB, Alemseged Y, Carberry PM, Browne RH and Smith WJ (2006) Betting on Rain. Managing seasonal risk in western NSW. NSW Department of Primary Industries. pp 65-79.

[13] Alemseged Y, Hacker RB, Smith WJ and Melville GJ (2011). Temporary cropping in semi-arid shrublands increases native perennial grasses. *The Rangeland Journal* **33**, 67-87.

order to allow more efficient use of the landscape and to provide the flexibility to implement non-continuous grazing practices. In addition, while the operation of simple paddock monitoring systems should be part of any livestock enterprise, the careful observation of levels of ground cover and utilisation of key species should be integral to Dorper enterprises as the reproductive potential and hardiness of the species can lead to rapid increases in grazing pressure under deteriorating seasonal conditions.
Research in the Western Division has shown that summer is the time when most deaths of desirable grass species occur and that, in general terms, the more heavily grazed the plant and the drier the summer the greater is the likelihood that individual plants will succumb[14]. Producers need to pay particular attention to the level of utilisation of desirable species going into summer and plan sales to reduce grazing pressure at this time either routinely or in specific circumstances.

1.6.13 population dynamics

Given the capacity of Dorpers to maintain high lambing rates, the maintenance or improvement of natural resource condition requires that turnoff be maintained at correspondingly high levels, or that management action be taken to reduce the reproductive rate, under poor seasonal conditions. Management of Dorper flocks is generally of a sufficient standard to allow control of the reproductive process, if necessary, in order to limit reproduction under poor seasonal conditions (e.g. by joining only a portion of the available ewes). However, the marketability of young Dorpers would probably mean that this option is not usually adopted.

1.6.14 infrastructure

Infrastructure that has been established for traditional Merino enterprises may not be adequate for Dorpers as they are well known for their propensity to test fences and boundary fencing, in particular, may thus need to be upgraded. A wire or cable close to ground level may be required to prevent animals pushing under fences.
Given the grazing habits of Dorpers, discussed above, smaller paddocks and/or more closely spaced waters may be desirable to promote uniform utilisation of the landscape and provide flexibility in grazing management. However, they don't appear to have a greater water requirement *per se* than Merinos.

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[14] Hacker RB, Hodgkinson KC, Melville GJ, Bean J and Clipperton SP (2006) Death model for tussock perennial grasses: thresholds for grazing-induced mortality of mulga Mitchell grass (*Thyridolepis mitchelliana*) *The Rangeland Journal* **28**:105-114