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Introduction of Dorper sheep into Australian rangelands: implications for production and natural resource management

Yohannes Alemseged[A,B] *and Ronald B. Hacker*[A]

[A]NSW Department of Primary Industries, PMB 19, Trangie, NSW 2823, Australia.
[B]Corresponding author. Email: yohannes.alemseged@dpi.nsw.gov.au

Abstract. The growing popularity of the Dorper breed of sheep potentially may have implications for the ecological sustainability of the semiarid and arid rangelands of southern Australia. The implications are heightened by forecasts of a warming and drying climate in these rangelands, which may in itself place native vegetation under increasing stress. While the Dorper breed of sheep offers important production advantages, little is known from research under Australian conditions about their grazing ecology and management requirements from a natural resource perspective. Key factors identified from this review of literature from other countries include a high fertility and fecundity, a generalist feeding strategy, a high growth rate and a capacity to survive and reproduce under low-rainfall conditions. The wider range of plant species selected by the Dorper compared with the traditional Merino breed of sheep potentially creates both opportunities and risks for rangeland condition. Less selective grazing may reduce pressure on some species but the capacity to harvest sufficient nutrients over a smaller area could concentrate grazing and promote resource degradation. High reproductive efficiency under a wide range of seasonal conditions may lead to more rapid onset of overgrazing and will require close attention to both natural resources and animal marketing if resource degradation is to be avoided.

Additional keywords: diet selection, Dorper sheep, grazing behaviour, reproduction rate.

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Introduction

The introduction of exotic herbivores, both domestic and non-domestic, into the semiarid and arid zones of Australia resulted in dramatic changes to the native vegetation (e.g. Noble and Tongway 1986; Friedel *et al*. 1990). Overgrazing and trampling reduced ground cover and changed species composition from dominance by perennial grasses and shrubs to dominance by annuals over extensive areas (e.g. Gunn 1986), or assisted the encroachment of woody species (Wilcox and Cunningham 1994).

Eight major episodes of rangeland degradation have been documented across the Australian rangelands commencing with an event in the Western Division of New South Wales (NSW) in the 1890s (McKeon *et al*. 2004). Seven of these episodes have resulted from the interaction of drought and high stocking rates of domestic livestock. The eighth episode resulted in large-scale woody weed encroachment in western NSW and was associated with high rainfall in the 1950s. Avoidance of the 'ninth episode' will require increasing sophistication of grazing management, particularly as the anticipated progression to a warmer and drier climate across southern Australia may place increasing stress on native vegetation. It is in this context that the recent introduction of new sheep breeds poses pertinent questions for the ecological sustainability of the region.

The new sheep breeds, especially the White Dorper, which has now established a position of some pre-eminence among recently introduced breeds, offer many production and economic advantages. Shedding 'hair' breeds, such as the Dorper, do not require shearing, crutching or mulesing, which minimises labour requirements in an environment in which skilled labour is increasingly in short supply. In addition, their reputation for hardiness (Knights 2010), high fertility (Budai *et al*. 2013) and capacity to produce superior meat carcasses (Snowder and Duckett 2003) make them apparently well suited to both the biological and economic environment of the pastoral industry of the southern Australian rangelands.

Little is known from Australian research to provide a basis for their sustainable management in these rangelands. This paper reviews aspects of the biology and grazing habits of the Dorper sheep, based mainly on literature from other countries, and identifies key features relevant to their management in Australia from the perspective of natural resource conservation. Relevant knowledge gaps are also identified.

Origin

The Dorper breed, also known as Dorsian in South Africa, is a composite breed developed at Grootfontein in the 1940s by the

Department of Agriculture and cooperating farmers (Wilson 1991). It was developed by combining the hardiness of the Black-headed Persian breed with the meat-producing capacity of the Dorset Horn breed (Campbell 1989; de Waal and Combrinck 2000; Milne 2000) to produce a breed suitable for meat production under extensive grazing conditions. Body conformation, growth rate and fat distribution were among the characteristics emphasised in the development of the breed (de Waal and Combrinck 2000). Although developed originally for the more arid areas, the breed today is widespread throughout South Africa (Marais and Schoeman 2011). The Dorper breed has also performed well in Namibia, and have been exported to many other countries including Zimbabwe, Zambia, Kenya, Mauritius, Malawi, Burundi, Israel, Saudi Arabia, Australia, the United States and several European countries (Brand 2000; de Waal and Combrinck 2000; Milne 2000; Budai *et al*. 2013).

Due to its productivity, hardiness and other useful traits the Dorper breed has become the second most numerous sheep breed in South Africa and accounts for 65% of the commercial flock in Namibia (DAGRIS 2011). In Australia, the success of the Dorper breed has resulted mainly from its reputation as an adaptable animal that can produce marketable lambs under less than ideal pasture conditions (Knights 2010).

The word, Dorper, is often loosely used to describe both black-headed and white-headed (White Dorper) variants. Although the White Dorper variant has assumed dominance in the rangelands of southern Australia, this review does not differentiate between them.

Biological characteristics

Reproduction

The Dorper breed is an early-maturing breed. Maiden ewes have been reported to exhibit their first oestrus at 213 days of age, at a liveweight of 28 kg (Greeff *et al*. 1988; cited in Cloete *et al*. 2000) although considerable variation in age and liveweight at first oestrus and lambing has been reported (Cloete *et al*. 2000). The reported length of gestation of ewes also varies but averages 146 days (Elias *et al*. 1985; Cloete *et al*. 2000). Ram lambs have been observed to be sexually active as young as 3 months of age in Western Australia (Butler *et al*. 2001) and have successfully fertilised females before weaning.

The Dorper breed survives and reproduces very successfully under harsh conditions (Cloete *et al*. 2000). In South Africa, lambing percentage (lambs born/ewes lambing) may be as high as 180% and ewes can produce 2.25 lambs on an annual basis under an accelerated lambing system (Schoeman and Burger 1992). Cloete *et al*. (2000), in a review of the reproductive performance of Dorper sheep, found that ewe fertility (i.e. ewes lambed/ewe mated) ranged from 0.75 to 0.97 among 12 studies conducted under different pasture and management conditions, and was commonly ~0.90. Across nutritional conditions including natural pasture, irrigated pasture and complete diet, the variation in reproductive performance was small. However, reproductive management had an appreciable impact with reproductive performance tending to be higher under accelerated lambing compared with annual lambing although results were variable. The number of lambs weaned per ewe mated varied from 0.99 to 1.40 among several studies while exceeding 1.40 under accelerated lambing (Cloete *et al*. 2000).

In a later study, Snyman and Olivier (2002) reported that 84% of Dorper ewes mated produced lambs, resulting in a lambing percentage (lambs born/ewes mated) of 126%, a ewe fecundity of 150%, and a weaning percentage (lambs weaned/ewes mated) of 114%. Survival rate from birth to weaning was 90%. Young and Kilminster (2004) reported a lambing percentage of 138% for Merino ewes joined to Dorper rams in a study in Western Australia.

Ewes of the Dorper breed (F_1 and F_2 backcrosses) in western NSW have been reported by producers to achieve lamb marking rates (lambs marked/ewes joined) of 130%, with some ewes producing three lambs in 2 years under drought conditions in which Merinos failed to breed (T. Atkinson, pers. comm. 2010). Anecdotal evidence from western NSW also suggests that accelerated lambing (in which ewes are mated more than once annually) may suit Dorper enterprises in that region. Such systems have been discussed widely in the South African scientific literature. Schoeman (1990) (cited in Schoeman 2000) found Dorper ewes in an accelerated lambing system produced 1.46 lambs per ewe joined per year. Cloete *et al*. (2000), in a review of literature, reported Dorpers producing 1.48 lambs weaned per ewe mated per annum under accelerated lambing. However, some other studies reviewed (Schoeman *et al*. 1993, 1995) could not demonstrate conclusively that reproductive performance under an accelerated joining program was superior to annual joining for ewes grazed on natural pasture.

Liveweights (DAGRIS 2011) reported an average birthweight of 3.5 kg for males, and 3.4 kg for females. Adult liveweight averaged 74 kg for males and 44 kg for females (DAD-IS 2011). An average pre-weaning daily liveweight gain of 243 g ensures a high quality carcass of ~16 kg at 3–4 months of age and reflects the inherent growth potential of the Dorper lamb. The ability to graze at an early age, and the ability of Dorper ewes to produce large quantities of milk, contribute to the high growth potential of the lambs (DAD-IS 2011). In more marginal areas of Kenya's Machakos District, a study involving 15 years of production data (King'oku *et al*. 1975) showed that Dorper ewes produced lambs with an average birthweight of 3.6 kg and average pre-weaning daily liveweight gain of 178 g. Slightly higher pre-weaning daily growth rates (183 g), and an average weaning liveweight of 23.8 kg at 109 days, were recorded in the Naivasha district in Kenya (De Haas *et al*. 1973). Schoeman (2000) reported an average weaning liveweight (at 100 days) and average daily liveweight gain to slaughter to be 37 and 44% higher, respectively, than a range of wool breeds and crossbreds. A well grown Dorper lamb has good conformation and fat distribution, which generally qualify the carcass for a superior grading. Dressing percentages can reach 52% (Cloete *et al*. 2000).

Several studies have evaluated the suitability of Dorpers as terminal sires in lamb production systems. Snowder and Duckett (2003) found that weaning liveweight at 118 days and average daily liveweight gain did not differ among sire groups in a comparison of F_1 Dorper-Columbia, F_1 Suffolk-Columbia and pure-bred Columbia lambs. They concluded that Dorper rams can be used as terminal meat sires to produce lambs whose growth rate to weaning, post-weaning growth rate, feed efficiency and carcass characteristics are similar to Suffolk cross-bred lambs and

pure-bred Columbia lambs, but with a slight improvement in tenderness. Similarly, Burke *et al*. (2003) found that pre-weaning liveweight gain was similar for Dorper-sired and Katahdin lambs, but that liveweight gain from weaning to slaughter was greater for Dorper-sired compared with St Croix-sired and Katahdin lambs. They concluded that Dorper rams increased carcass weight and muscling and that they appeared to be excellent sires to produce carcasses that would appeal to traditional lamb markets in the United States.

Cloete *et al*. (2000) reported average pre-weaning daily liveweight gains varying from 210 to 290 g among nine studies based on either natural pasture, supplemented natural pasture, cultivated pasture or a complete diet. Among studies reporting the relevant data, pre-weaning liveweight gain was not correlated with either weaning liveweight or weaning age although weaning liveweight and weaning age were highly correlated ($R^2 = 0.99$). Malhado *et al*. (2009) reported that lambs from Dorper rams mated to ewes of three Brazilian breeds had different pre-weaning liveweight gains. The differences were not sustained after weaning as they were mainly dependent on the milk production of the ewes.

In a study comparing the growth performance of Merino, South African Mutton Merino and Dorper lambs, van der Westhuizen (2010) reported higher feed conversion ratio and average daily liveweight gain for Dorper compared with Merino lambs under feedlot conditions. Dorper lambs also had higher dressing percentage than either Merino or the South African Meat Merino breeds. Similarly Snyman and Herselman (2005), in comparing the productive and reproductive efficiency of Afrino, Dorper and Merino sheep, reported that Dorper lambs had a higher liveweight at weaning. However, the financial returns per hectare were higher for Afrino and Merino breeds than for the Dorper breed due mainly to the higher lamb weaning rate of the Afrino breed and the higher wool production from the Merino breed. Zishiri *et al*. (2013) found growth traits in Dorper sheep to be moderately heritable and genetic improvement through selection is feasible.

Nutrition and diet selection

Although the Dorper breed was developed for arid and semiarid environments, it has performed favourably under a variety of climatic and grazing conditions including intensive feeding systems (de Waal and Combrinck 2000; Schoeman 2000). This characteristic enables them to fit well in different management systems where they can be used to convert feed resources which are underutilised, or not utilised, by other livestock (Brand 2000).

Usually the Dorper breed is regarded as being less selective than Merino-type breeds (Brand 2000), utilising shrubs and bushes to a greater extent and grasses to a lesser extent (Roux 1992). Although du Toit and Blom (1995) reported only slight dietary differences between the Merino and Dorper breeds, du Toit (1998) reported that the Dorper breed utilised 90% of the plant species present compared with 60–65% for the Merino breed. This reduced selectivity apparently enables the Dorper breed to walk less to select food, or a suitable spot to graze, with a consequent reduction in grazing time and fewer separate grazing periods (Roux 1992). Brand (2000) considered the non-selective grazing trait of Dorpers to have positive implications for pasture species that are normally overgrazed by livestock.

Engels *et al*. (1974) reported organic mater intake per unit liveweight to be higher for the Merino than for the Dorper breed but the difference was not significant on a 'per-sheep' basis due to the higher liveweight of the Dorper breed. Similarly De Waal and Biel (1989) showed that Dorper ewes consumed less herbage per unit metabolic liveweight than Merino ewes.

Schoeman (2000) and Mwenya *et al*. (2003) reported, respectively, that sheep of the Dorper breed displayed higher dry matter digestibility compared with sheep of a range of wool breeds and crossbreds, and longer total mean retention times in the digestive tract compared with indigenous fat-tailed sheep. These findings suggest that the Dorper breed is well adapted to the utilisation of low-quality roughage diets.

Flock management

The scientific literature has few detailed management practices for Dorper sheep or for enterprises upgrading from a base Merino flock. Generally, in the latter case, the challenge is to ensure that sheep remain hardy, adaptable and fertile, have high liveweight gains and produce a carcass of acceptable quality.

If upgrading from the Merino breed, management should aim to produce a flock that readily sheds wool, reduces the incidence of fly strike and eliminates expensive and time-consuming management requirements such as shearing and mulesing (Fourie and Horak 2000). Using rams with a full-shedding coat in the crossbreeding phase with woolly White Dorper cross ewes usually helps to produce a flock with a high proportion of ewes with a full-shedding coat according to commercial breeders in Australia (A. Mosely, pers. comm. 2010). Generally, first- and second-cross lambs must be shorn and their wool labelled with an 'R' suffix (S. Ware, pers. comm. 2011). This wool is usually sold privately rather than through the auction system and attracts a relatively low price, which may not cover the cost of shearing.

Despite the importance of joining date in the sheep-production calendar, the general lack of information on this subject makes it difficult to formulate a breeding plan on any objective basis (Cloete *et al*. 2000). In Australia, best practice is to mate Dorper ewes (1 ram per 100 ewes) at 9 months of age to have their first lamb at 14 months under reasonable feed conditions (A. Mosely, pers. comm. 2010). Ram lambs under average feed conditions must be weaned no later than 14 weeks to avoid mating with their dams. By 6 months of age, rams can be used for breeding but must be rested to allow growth through a shorter joining period and a higher numbers of rams per 100 ewes, or combination of the two (A. Mosely, pers. comm. 2010).

Managing a Dorper flock requires fences with a bottom wire close to the ground to ensure animals cannot push underneath. It is important to prevent sheep from roaming, from the perspectives of both flock management and interaction with neighbours who do not have the Dorper breed and for whom fibre contamination is a serious issue. The fleece of the Dorper breed, especially from black-headed animals, can contain coloured fibre and may have a high content of medullated fibre.

The possible resistance of Dorpers to gastro-intestinal worms and lice has created interest among producers but there is no clear evidence that this is the case (Butler *et al*. 2001) and drenching for

internal parasites and dipping for external parasites may still be required (Vanimisetti *et al*. 2004). Fourie and Horak (2000) reported that, although Dorper sheep may be infested with scab mite and louse, production losses were small. However, they reported infestation with the larvae of the nasal bot fly and the caliphorid fly, along with ticks, which may affect liveweight gain.

The potential of the Dorper breed to achieve reasonable lambing percentages even in dry years provides an advantage compared with the traditional Merino breed. It will also increase the availability of more replacement ewes to maintain flock structure and the capacity to apply increased selection pressure to achieve genetic improvement.

Implications for natural resource management

From the information reviewed, the salient features of the biology of the Dorper breed relevant to their management in the semiarid and arid rangelands 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 the traditional Merino breed;
- feed intake per sheep about equivalent to that of the Merino breed but 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 low-rainfall conditions, probably resulting in part from the traits outlined above but possibly determined also by other traits not covered in the literature reviewed here.

Together, these traits imply:

- a high population growth rate, which can be maintained over a wide range of climatic conditions;
- liveweight gains, which should allow lambs to reach a marketable liveweight under a wide range of seasonal conditions; and
- potential for reduced selection pressure on individual plant species compared with the Merino breed if forage is relatively abundant, but also potential for increased grazing pressure if grazing distribution is reduced and/or hardiness allows sheep to be kept for longer under limited forage conditions.

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 systems of livestock production, the capacity of the Dorper breed to survive and reproduce under a wide range of seasonal conditions makes this problem potentially more serious than for systems based on the traditional Merino breed, and likely to manifest itself more quickly in the absence of astute management.

It is, therefore, important that managers have well planned strategies to ensure that the risk of any such imbalance is reduced and the potential for critical situations identified early so that corrective action can be initiated. These strategies might include:

- stocking at a lower rate than would be practised with the Merino breed, despite the apparent equivalence of the breeds in terms of feed intake;
- use of seasonal risk management tools, such as trigger points (Hacker *et al*. 2006*a*) or forward projections based on a[1] DDH 100 mm^{-1} benchmark and rolling annual rainfall totals (Hacker and Smith 2007), to prompt action or identify potential mismatches between stocking rate and forage availability (a form of fodder budgeting);
- establishment of on-property feed lots, or development of alliances with off-property finishers, to ensure that turn-off can be maintained under all seasonal conditions; and
- restricted joining of ewes or heavier culling of older age groups under low-rainfall conditions.

Since the Dorper breed appears able to survive, and presumably maintain body condition over a wider range of seasonal conditions than the Merino breed, it is essential that managers pay close attention to the state of the pasture, and not just the sheep, in making grazing management decisions. Implementation of a range-monitoring system with close attention to ground cover and utilisation of key species, including shrubs, should be part of all grazing operations in the rangelands but should be particularly encouraged with the introduction of the Dorper breed.

The wider range of plant species selected by the Dorper breed potentially carries both opportunities and risks for rangeland condition. Less selective grazing may reduce pressure on key species but the capacity to harvest sufficient nutrients over a smaller area could potentially concentrate grazing on a reduced area. The net result of these potentially counter-balancing influences is currently unknown for the southern rangelands of Australia.

Knowledge gaps

From a resource management perspective, major issues highlighted by the above discussion relate to:

- the Dry Sheep Equivalent rating of the Dorper breed; and
- uniformity of grazing – temporally, spatially and among plant species.

Establishing the DSE rating of Dorper classes based on age, sex and reproductive status is fundamental to providing a basis for replacement of sheep of the Merino breed with those of the Dorper breed. While this can be achieved relatively easily in terms of field metabolic rate and water turn-over (e.g. Munn *et al*. 2009), adjustments to accommodate differential diet selection patterns will be more difficult and would require more intensive field studies over a longer period. A study, similar to that of Muya *et al*. (2013), based on the application of range condition assessment to determine the type and number of animals to be carried in a given area, would also be instructive.

More generally, the further understanding of the response of key plant species to the interaction of grazing and drought is an ongoing issue for the development of grazing management strategies. While some understanding is available in relation to

[1]DDH 100 mm^{-1} – dry sheep equivalent days per ha per 100 mm of annual rainfall.

grasses (e.g. Hodgkinson and Muller 2005; Hacker *et al*. 2006*b*), no comparable studies have been reported for the important shrub species in the southern rangelands of Australia.

Conclusions

Given their physiological and behavioural traits, the Dorper breed may pose a greater threat than the traditional Merino breed to natural resource condition in the arid and semiarid rangelands unless management is of a high standard. These traits include high fertility and survival under widely varying seasonal conditions. Forage demand may, therefore, more rapidly exceed forage supply in dry periods, with adverse consequences for resource condition indicators such as ground cover.

Practices such as use of seasonal risk management tools, fodder budgeting and pasture monitoring (particularly for ground cover and utilisation of key species) should be part of any grazing management system, but they are particularly indicated for systems with the Dorper breed because forage imbalances may develop faster than for systems using the traditional Merino breed.

In addition, it seems particularly important to manage flock numbers in order to minimise the likelihood of serious imbalance between the population growth rate and the turn-off rate, the proximate cause of excessive grazing pressure. Reduced stocking rate of females and establishment of facilities or cooperative arrangements to ensure that lambs can be finished and turned off under poor seasonal conditions thus seem important adjuncts to grazing management in these new production systems. They would have the additional advantage of facilitating industry development through more consistent supply of products meeting market specifications. Tactical responses to seasonal conditions, such as heavier culling of older age classes or restricted joining, could also have a role in managing the forage demand-forage supply balance.

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