# Quality Graze: turning off beef while improving land condition in Central Australia

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## Abstract

Quality Graze is a grazing strategies trial on the Northern Territory Government's Old Man Plains Research Station (OMP), located south-west of Alice Springs. The project began in 2006. It tests six grazing strategies under a premium beef production system while improving and maintaining land condition in the variable and arid climate (median annual rainfall 237mm) of Central Australia. The strategies are all based on long-term, safe stocking rates (averaging 2.2AE/km$^2$) with a combination of set and variable stocking, with and without spelling (rest from grazing).

Early in the trial, there was a rapid improvement in land condition following a double La Niña event in 2009/10 and 2010/11. Satellite derived ground cover on OMP before the trial began was similar to surrounding pastoral land and an adjacent ungrazed (but previously grazed) conservation reserve. Since 2011, ground cover has been consistently higher than one surrounding commercial cattle station, but similar to the conservation reserve and another pastoral lease. Within OMP, there is little difference in ground cover between continuously grazed strategies and those with spelling. Abundance of palatable perennial grass increased across all treatments between 2011 and 2018. Combined, these indicators suggest the key to the improved ground cover on OMP has been an appropriate stocking rate. The one grazing strategy with a higher than recommended stocking rate developed lower levels of ground cover. Improvement in land condition has allowed sufficient pasture growth to occur, or carryover feed to be available in even the driest years. Liveweight gains, from weaning to abattoir (30 months of age), have consistently averaged 0.54kg/day across a range of years from sixth percentile rainfall (2019/20) to 97$^{th}$ percentile rainfall (2010/11).

Getting the stocking rate right is key to sustainable and profitable production. Recommended stocking rates allow land condition to be improved and maintained in the presence of grazing despite extreme climate variability in Central Australia.

## Keywords

Land Condition, Long-term Grazing Trial, Spelling, Seasonal Variability, Ground Cover

## Introduction

Quality Graze is a long-term grazing strategies trial designed to test and demonstrate recommended grazing management practices. We compared continuous set stocking rates with variable stocking rates and spelling. All strategies are based on the long-term safe stocking rate recommended by the EdgeNetwork® Grazing Land Management (GLM) methodology with the exception of the higher than recommended set stocking strategy. Our aim is to test and demonstrate strategies for improving and maintaining land condition, while sustaining a productive grazing herd.

The high climate variability in central Australia can make it difficult to forecast available feed. Our production goal was to produce consistent numbers of premium quality steers regardless of season. An important goal of the project was to find grazing strategies that would support a stable herd that reliably met production targets.

## Methods

*Location*

The Quality Graze trial is run on the Old Man Plains Research Station (OMP), 20km south west of Alice Springs in the Northern Territory (NT). The research facility is operated by the NT Department of Industry, Tourism and Trade. The production system relies on two main vegetation types that are representative of the region; calcareous shrubby grasslands and mulga woodlands on red earth and loamy sands, over native pastures dominated by arid short grasses and forbs, and scattered perennial grasses. Buffel grass, an introduced species, has established in the more productive areas associated with drainage lines and loamy sands. The predominantly Droughtmaster herd is representative of the district, with a trend in recent decades of introducing *Bos indicus* genetics into more traditional *B. taurus* herds, in order to meet both the specifications of southern markets and take opportunistic advantage of the live export trade. Cattle are nitrogen supplemented with urea once pastures have cured.

*Seasonal conditions*

A double La Niña event saw very high rainfall in the region across two consecutive summers (2009/10 and 2010/11). Over the next decade, the region experienced a run of more average years, followed by the driest three-year period on record (2018-2020) and an above average year in 2021 (Figure 1). This range of seasonal conditions has provided a unique opportunity to test the grazing strategies through a variety of seasons.

*Grazing strategies*

A set-stocked, four-paddock, rotational grazing strategy and a set-stocked, continuously grazed strategy started in 2006. In 2010, an additional six paddocks and three grazing strategies were added. All paddocks, with the exception of one continuously-grazed-set-stocked paddock, were stocked with breeders and 40 indicator steers. Finally, in 2015, a higher-than-recommended stocking rate strategy was added grazing steers only (Table 1).

**Table 1***. Grazing strategy and paddock grouping for analysis*

| Grazing strategy | Number & area of paddocks (Total Strategy Area) | 5km watered area | Stocking strategy (LTCC) | Annual stocking rate variability (Walsh *et. al.* 2014) | Rotation vs continuous |
|---|---|---|---|---|---|
| GLM.Cont.Set | 3 (152km$^2$) [26-73km$^2$] | 111km$^2$ | GLM-LTCC (236AE) [44-114AE] | Set LTCC (236AE) | Continuous |
| GLM.Rot4.Set | 4 (111km$^2$) [23-68km$^2$] | 170km$^2$ | GLM-LTCC (213AE) [35-75AE] | Set LTCC (213AE) | Rotation (3&6 month) |
| GLM.Rot2.Var | 2 (54km$^2$) [24-30km$^2$] | 48km$^2$ | GLM-LTCC (107AE) [49-58AE] | Variable (+30% to -50% LTCC) [107-139AE] | Rotation (12 month) |
| GLM.Con.Var | 1 (43km$^2$) | 38km$^2$ | GLM-LTCC (104AE) | Variable (+30% to -50% LTCC) [104-135AE] | Continuous |
| HS.Cont.Set | 1 (20km$^2$) | 15km$^2$ | 50% higher than GLM LTCC (20AE) | Set LTCC+50% (30AE) | Continuous |

*LTCC – Long-term carrying capacity; HS – Higher than recommended stocking rate*

*Data collection*

Ground cover for the whole of OMP and surrounding areas was downloaded from https://vegmachine.net/ and summarised Landsat derived ground cover (Scarth *et al.* 2015) for the entire area of each paddock was supplied by the Queensland Department of Environment and Science. On the ground, vegetation yield (minus the 'grey' carry-over yield), cover and species composition were monitored each autumn/winter using Botanal on two transects at 0.5, 1, 3 and 5km from water. Indicator steers distributed evenly between treatment paddocks were weighed three times a year and turned off at 30 months of age.

*Data Analysis*

All statistical tests used R 4.1.0 (R Core Team 2021). Models for assessing the effect of grazing treatments on cover and yield variables were fitted with linear mixed-effects models by REML for the fixed effect of grazing strategy (*lmerTest* package, Kuznetsova 2017, Bates et.al. 2015). Random intercept effects were fitted for paddock/transect interaction. Comparisons of estimated marginal means for grazing strategy were done with the *emmeans* and *multcomp* packages (Lenth 2021 and Hothorn *et.al.* 2008 respectively).

**Results and Discussion**

*Evidence of land condition improvement*

It can be difficult to know if changes on the ground are due to season or management. On-ground observations, fixed-point photographic data, and field data all indicated perennial grass establishment. Evidence for reduced run-off and dam filling events indicated that land condition was improving across the entire research station. However, were these changes due to seasonal influences or due to changed grazing management, or both? We have taken multiple strands of evidence, both quantitative and qualitative, to build a case that land condition improvement at OMP is due to the implementation of safe stocking rates, during and since the most recent La Niña event.

*Landsat cover trends on OMP compared to surrounding areas*

Beutel *et. al*. (2021) found ground cover estimates derived from multi-spectral satellite imagery were indicative of rangeland condition. We compared Landsat fractional ground cover trends through time on OMP with the neighbouring conservation reserve (ungrazed since 2003) and comparable, surrounding pastoral land. Prior to the trial, ground cover between 1988 and 2010 on OMP was similar to the surrounding pastoral land and the ungrazed adjacent conservation reserve (Figure 1). This time includes a 13-year period when OMP was part of a commercial cattle station (the Owen Springs Pastoral Lease), which was destocked in 2002. Since 2011, ground cover has been consistently higher on OMP than on one of the surrounding grazed areas, but similar to another grazed lease and the conservation reserve. The double La Niña event in 2009/10 and 2010/11 was critical in accelerating land condition change from predominantly C-condition to B-condition for much of OMP. Grazing intensity on OMP during this period varied between lower than, to equal to the long term carrying capacity (LTCC). Since 2011, the stocking rate has been aligned with the long-term safe stocking rate. Buffel grass contributed to cover and yield increases on OMP, especially in the drainage lines. So it is possible that buffel colonisation also influenced differences in cover changes through time between grazed areas.

*Did the grazing strategy influence land condition change?*

Within OMP there was little difference in satellite derived ground cover trends between continuously grazed strategies and those with spelling (Figure 2). In 2011, an uncontrolled fire within the paddock under a GLM.Cont.Var strategy (green line) reduced cover compared to the other treatment paddocks until 2014. On-ground transect data showed a similar significant decline in cover in this treatment (p=0.03), but by 2014 cover differences between treatments had returned to pre-fire levels (Figure 3). In 2015, an additional grazing strategy,

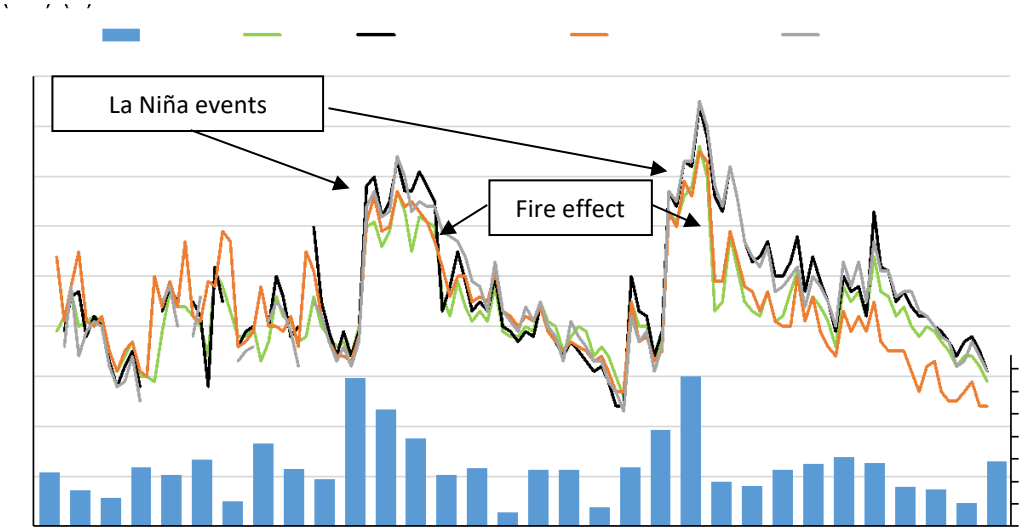


**Figure 1**. *Landsat ground cover for Old Man Plains Research Station, adjacent conservation reserve (Park) and two surrounding grazed pastoral leases. Alice Springs airport financial year rainfall.*

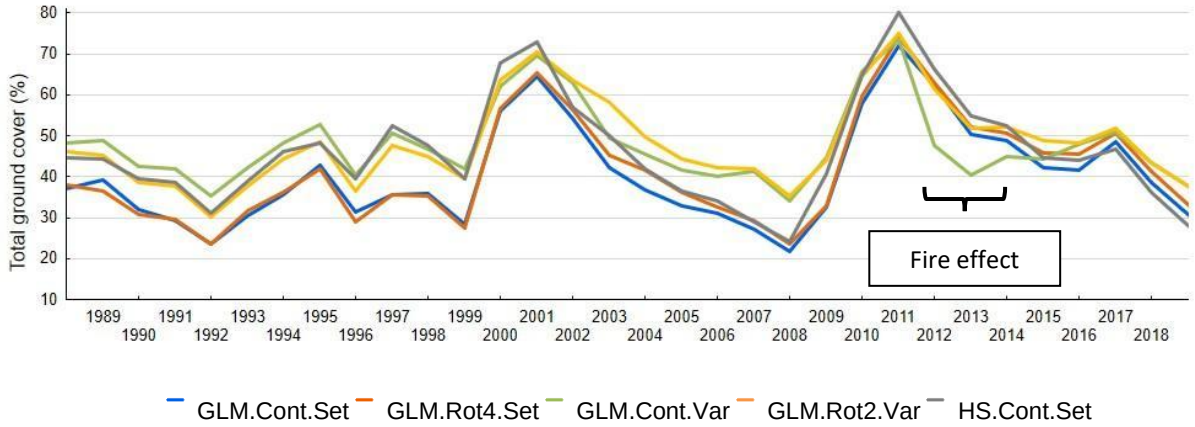


**Figure 2.** *Total Landsat average annual ground cover for the various grazing strategies implemented on Old Man Plains Research Station as part of the Quality Graze project.*

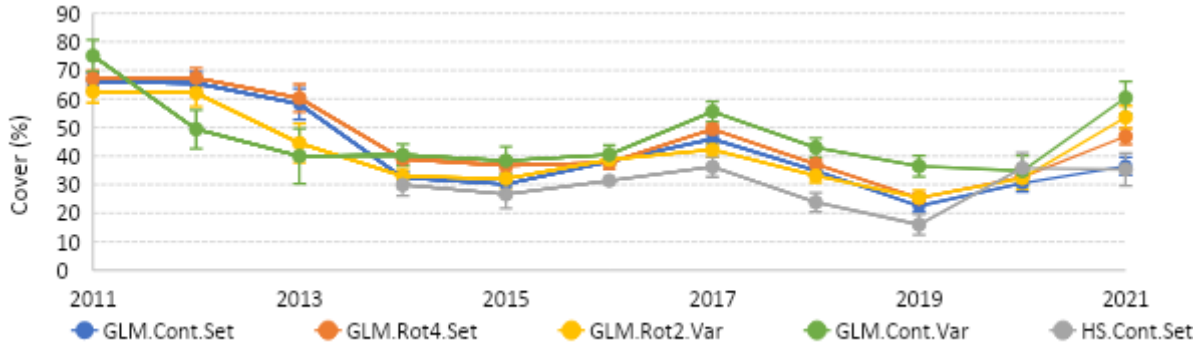


**Figure 3**. *Percent ground cover with model means +/- SE for each of the grazing strategy groups from transect data.*

with a higher-than-recommended stocking rate, was included in the trial; HS.Cont.Set (grey line). The ground cover in this paddock has declined over the six year period more than any other strategy and now has the lowest ground cover of all treatments. In 2017 after only two years, this paddock had significantly lower cover than the other treatments ($p<0.01$). In 2020, cover and yield in this strategy bounced back briefly (Figure 4), due to annual grass response to a localised storm (Figure 6). This highlights the value of on-ground monitoring data for interpreting satellite-based assessments.

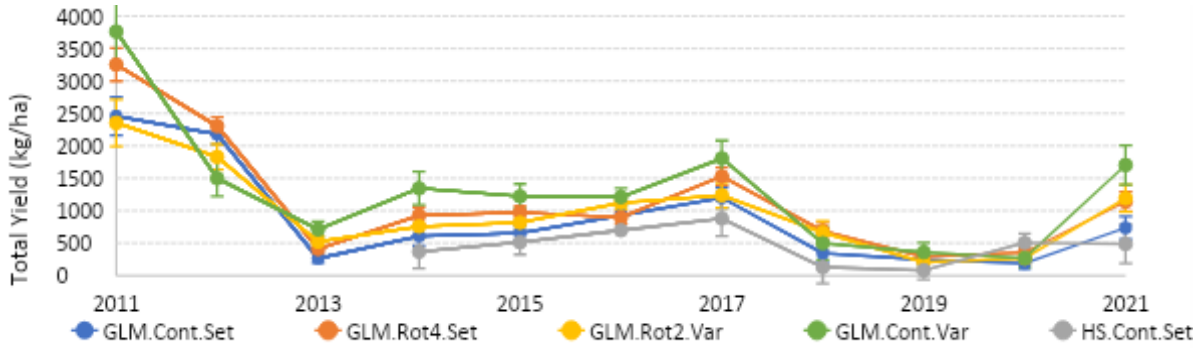


**Figure 4**. *Total yield with model means +/- SE for each of the grazing strategy group from transect data.*

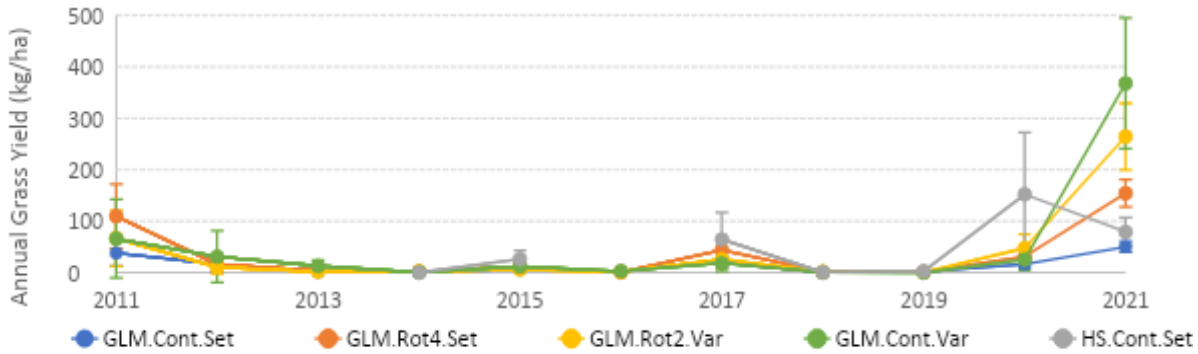


**Figure 5**. *Annual grass yield with model means +/- SE for each of the grazing strategy group from transect data.*

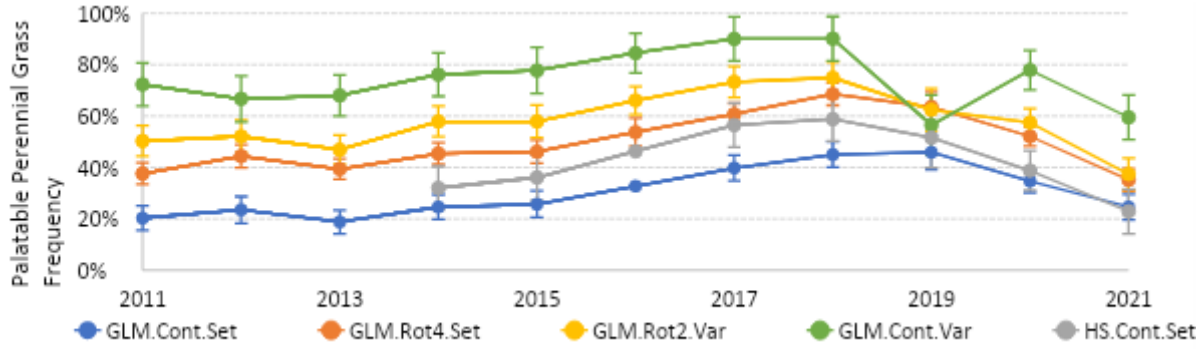


**Figure 6**. *Palatable perennial grass frequency with model means +/- SE for each of the grazing strategy groups from transect data.*

*Rainfall use efficiency*

An unexpected result of the land condition improvement has been a reduction in runoff and the reduced frequency of dam-filling. Since 2012 dams on OMP have rarely been considered full, with the exception of the dam in the higher-than-recommended stocking rate strategy. We suggest that land condition improvement, specifically an increase in ground cover and perennial grasses, has slowed surface water movement and increased infiltration into the soil. This has changed the relationship between rainfall and pasture growth. On more productive, calcareous shrubby grasslands (Figure 7), the pasture yield per millimetre of rain has doubled. This rainfall use efficiency gain at OMP quantifies an effect observed for many Central Australian land types, where improved land condition increases the capacity for pasture growth.

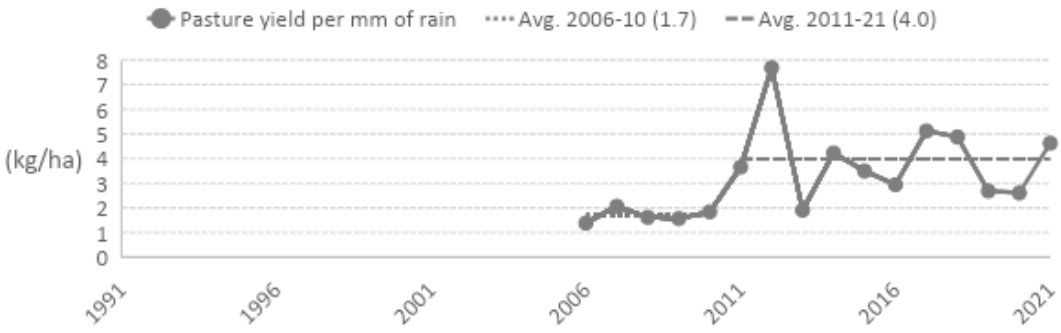


**Figure 7**: *Average rainfall use efficiency (TSDM / mm rain) of the calcareous shrubby grasslands on OMP.*

*Photography sites*

Figure 3, shows a photo-site located one km from the No.1 Dam. The site changed from bare ground in 2006 to early successional species button grass (*Dactylenium radulans*) in 2010; colonisation of perennial buffel grass (*Cenchrus ciliaris*) by 2014; and a decline in buffel grass during an extended dry period between 2019 to 2020 to a mixture of native grasses with some buffel grass in 2021.

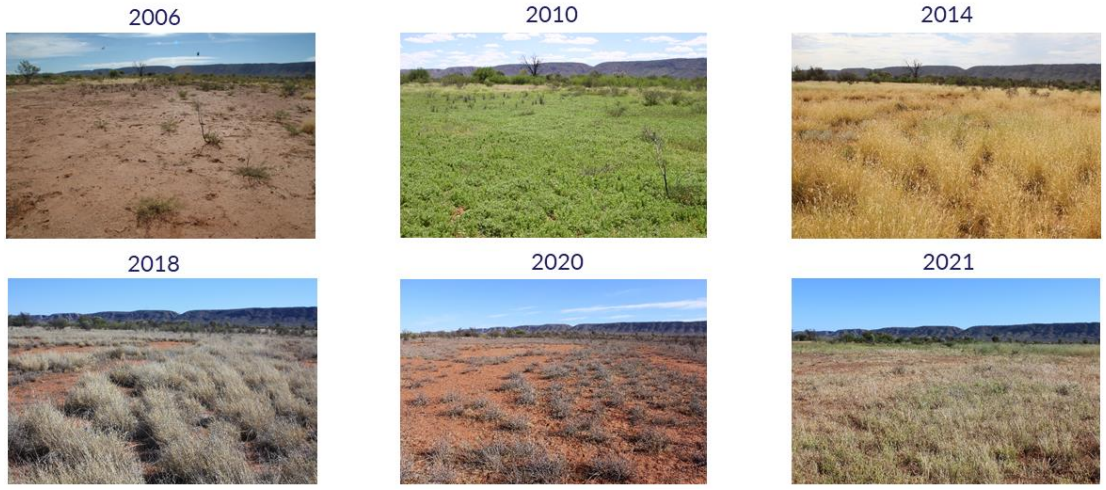


**Figure 6**. *Photo-point series located approximately 1km from No.1 Dam, Old Man Plains Research Station, 2006 to 2021.*

*Production benefits*

Stability in pasture production promotes steady animal production, able to withstand dry periods by ensuring access to reserved carryover feed. A valuable characteristic of Central Australian pastures is their ability to retain nutrient quality for up to two years once they have cured. Standing dry feed therefore provides effective carryover forage when there are long periods between growth events. The Quality Graze project has demonstrated production stability through the turnoff of a consistent number of premium steers, without additional production feeding, from the wettest year on record to the driest three-year period (2017-2020) experienced in Central Australia (Table 2).

**Table 2**. *Average number of steers, weights and MSA compliance achieved by steers from the Quality Graze project.*

| | |
|---|---|
| Avg. Number of steers | 139 (97-168) |
| Avg. Liveweight at 28-30 months (kg) | 564 (508-597) |
| MSA compliant (%) | 55 (21-84) |

## Conclusions

In the past 15 years since OMP was stocked with recommended stocking rates we have seen improved land condition, growth of desirable grass species not previously recorded on OMP, increased ground cover and improved rainfall use efficiency, regardless of grazing strategy employed. Cattle growth and beef production has been consistently high and we did not need adjust cattle numbers beyond the strategy guidelines, even through very dry years. Rangeland management is a numbers game, and the most important number is applying safe long term-stocking rate.

## Acknowledgements

Quality Graze has been running for more than 10 years. It is estimated that over 38,000 quadrats have been assessed in that time by many skilled people. In addition, the cattle herd has been superbly looked-after by the OMP manager, Bryan Gill, and all staff associated with OMP and the Arid Zone Research Institute Farm. Their dedication and hard work has been very much appreciated. Thanks to John Carter and Queensland Department of Environment and Science for supplying satellite derived ground cover for OMP paddocks.

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## Summary text for the Range Management Newsletter

Quality Graze is a long-term grazing trial being conducted in the semi-arid rangelands of Central Australia. The trial is investigating the potential of various grazing strategies to improve and maintain land condition while still allowing grazing and production of high-value steers for the premium beef market. After a decade of operation, including high rainfall years and extended drought, it looks as though getting the long-term stocking rate right is a key factor in achieving reliable, consistent production regardless of season.