Grazing systems – Recent Findings in Australia

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Abstract

McCosker (2000) described the paradigm shift which had occurred in grazing management since 1990 and presented some compelling results from adopting the practice. The purpose of this presentation is to review the uptake of grazing management in Project Pioneer.

Cell Grazing, a time control grazing system, is defined by RCS as following the principles which have evolved since 1990.

1. Plan, monitor and manage grazing.
2. Rest period is adjusted to suit the growth rates of the plant.
3. Stocking rate is adjusted to match carrying capacity.
4. Manage livestock effectively.
5. Apply maximum stock density for minimum time.
6. Use diversity of plants and animals to improve the ecosystem.

Time Control Grazing (TCG) has been described by McCosker (2000) and includes similar systems with different names such as Management Intensive Grazing (MIG), planned grazing, Adaptive Multi-Paddock grazing (AMP) and cell grazing. In the last 20 years, the industry has moved on with widespread adoption of grazing systems which incorporate a period of pasture rest, such as rotational resting and rotational grazing. Digital tools have begun to capture data that can be analysed to determine trends.

We used the data from a large project to explore the outcomes associated with the adoption of cell grazing principles. This presentation outlines the key findings of this review.

Background

Data for this paper comes from Project Pioneer (https://www.projectpioneer.com.au/), involving 94 grazing families from 2016 to 2021 from the inland coastal region of Queensland. It was funded by the Australian Governments Reef Trust and Great Barrier Reef Foundation, managed by RCS and supported by World Wildlife Fund, Central Queensland University and MAIAGrazing (https://www.maiagrazing.com). This large project provided the opportunity to look at many aspects of change on a significant scale. Additional data comes from the national database of MAIA, captured over a five year period. MAIA play an integral role in the successful management of TCG operations through the collection and aggregation of key data such as livestock class, mob size, paddock numbers and size, rainfall site and other enterprise levels of granularity (Davidson 2021).

Grazing families were supported with a Grazing for Profit School™, followed by a coaching and on ground advisory package, Executive Link™, benchmarking (https://www.rcsaustralia.com.au/) and MAIA software. The objective was to stop soil loss to the reef by increasing ground cover. The strategy addressed human and business needs first, and used grazing management to increase ground cover. Some high-level outcomes from Project Pioneer are shown in Table 1 below.

Outcomes

Table 1 indicates that TCG systems were adopted on a large scale with approximately $23M spent on water and fencing infrastructure. This investment and change of management systems resulted in increased carrying capacity and increased production per large stock unit (LSU). One of the most significant outcomes was in the way the training and tools were used to mitigate the effects of the drought - through timely destocking - which allowed land condition to improve.

Table 1. High level statistics from Project Pioneer.

Topic	Outcome
Project area	1.3 million ha
Capital expenditure	Exceeded $22.98 million on infrastructure
Carrying capacity	Increased by 14%
Animal production	kg produced per LSU increased by 13.9%
Land condition change	29,148ha improved 1 condition score in 2 years.

A subset of three properties in central Queensland had water quality and ground cover studies conducted in 2019 (year 1) - an extreme drought year - and again in 2020, together with neighbouring properties. This study was conducted by CQU and WWF staff (Chua et al 2021). The three properties had been managed for over three years under TCG. The neighboring properties were similar land type and experiencing the same conditions but were continuously grazed and used as a control.

The ground cover results are shown below in Table 2. The largest difference in ground cover between the properties was in the drought year, where TCG performed better than the continuous grazing control. Further, TCG was able to maintain similar ground cover in the good year as in the drought year. Cumulative rainfall for the 2 years across the 94 properties was 363mm (38%) below the long term average and that mostly occurred in 2019.

Table 2. Ground cover (%), Total Suspended Solids (TSS mg/L), Turbidity (NTU) from three properties under TCG and neighbouring continuous grazing control sites (Chua et al 2021).

	Baralaba		**Gogango**		**Thangool**	
Ground Cover	TCG	Control	TCG	Control	TCG	Control
Ground cover % - 2019	81	28	87	22	83	46
Ground Cover % - 2020	83	54	82	43	77	61
Water Quality						
Total Solids (mg/l) - 2019	421	12,898	48	3,192	721	2,756
Turbidity (NTU) - 2019	131	2,070	28	1,156	231	868
Total Solids (mg/l) - 2020	1,236	3,022	424	1,805	880	1,139
Turbidity (NTU) - 2020	630	2,002	294	1,266	5,880	4,720

NTU = Nephelometric Turbidity Units

The water quality data reflected the ground cover in that soil loss from the control group was far greater after the drought year. The difference between the two groups of properties persisted in the better year. The results were not statistically significant due to low replication, however the environmental effect is potentially significant. E.g. 10mm of runoff from a hectare would have lost 40kg of soil/ha under TCG, compared to 630kg/ha under the controls in 2019. Attempts to measure TSS in stream flow indicated there was less runoff from the TCG properties. These results show powerful evidence that TCG significantly improves water quality and reduces soil loss, especially in drought conditions, however further work is required to expand to a more robust dataset than just the three comparisons (Chua et al 2021).

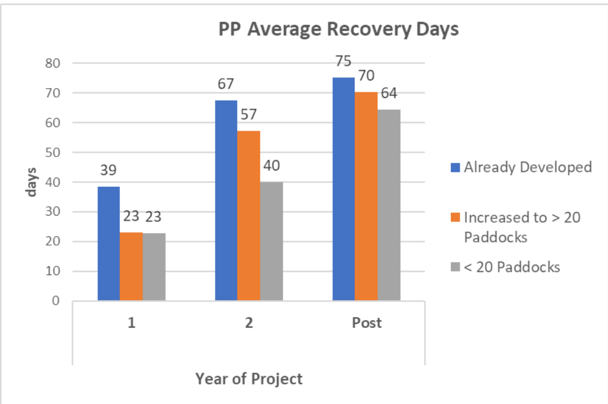
Davidson (2021) created a dataset in MAIA, comprising all paddocks that had been subdivided and had a recorded graze history both before and after subdivision. The results in Table 3, show that 66 paddocks were split, resulting in an increase in rest period and a reduction in graze period. A combination of increased density, increased rest and higher intensity management led to a 20% increase in carrying capacity on that 7,000ha which had prior grazing data.

Table 3. Project Pioneer grazing chart data from MAIA in paddocks with prior history.

	Pre Subdivision	Post Subdivision	% Change
Total paddocks split	66	145	120%
Av paddock area (ha)	106	36	-66%
Av Graze period (days)	14	7	-50%
% Total days not grazed	68%	86%	26%
Density (head/ha)	1	6.5	491%
Yield (SDH/100mm)	27.9	33.5	20%

Evidence of changes in pasture production was slow to emerge because it took most families up to two years to fully embrace the new software and grazing management practices. Developing clearer business insight, clarifying goals, improving communication within the business and family, understanding the grazing principles and gaining the confidence to invest in the property were all higher priorities initially, than on-ground change. However, once a confidence threshold was reached, investment in the requisite water and fencing infrastructure required to support the management changes in the paddock exceeded the funded investment in training and support by almost 8 to 1. The time to reach that confidence threshold varied depending on prior exposure to the RCS concepts, with prior exposure leading to faster change.

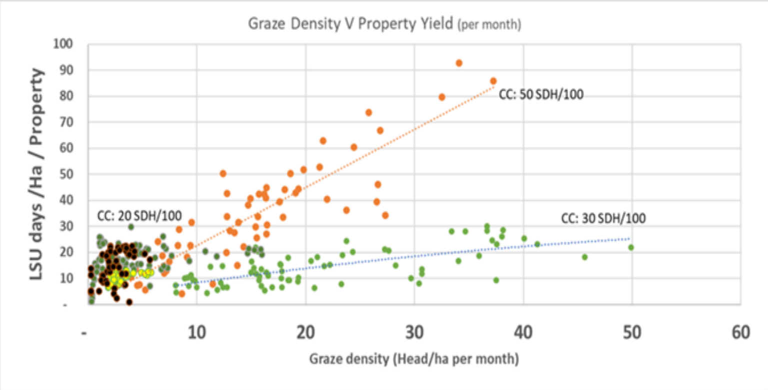
Figure 1. Average recovery days.



Data in Figure 1 is calculated from a total of 3,011 grazes (Davidson (2021) and illustrates increasing management intensity as time progressed and confidence built. In the final two years of the project (2019 and 2020), practice changes continued to increase, especially the extension of the average rest period. Number of paddocks refers to paddocks at a property scale.

Data in Figure 2 illustrates the effect of density (head per Ha at a point in time) on yield for all paddocks from several selected properties in different regions. There are 4 properties shown, 2 of which are managing at primarily low stock densities (less than 5 hd/Ha) and 2 of which are operating at a range of higher densities (greater than 5 hd/Ha). This data is external to Project Pioneer. For the low density properties, there is no correlation between density and yield.

Figure 2. Density versus yield on individual properties



For the higher density properties, there is a clear correlation between increasing density and increasing yield, but the extent of the response varies between properties. This is a function of carrying capacity where the higher the carrying capacity, the easier it is to achieve higher densities. This clearly demonstrates there is no effect of density on yield below 6hd/ha. However, it also shows the impact of density on yield as density moves between the bottom threshold of 6d/ha and the mid-range threshold of 20 to 25hd/ha and beyond.

Conclusions

Key findings;

- Run off and water quality can be improved through TCG, even in dry years.
- Stocking rate and animal production can be improved through TCG.
- The density thresholds apply only where the underlying carrying capacity allows.
- Changing land management practices requires a focus and investment in people first – where mindsets change, investment and practice change follows.
- Challenges remain in learning how to analyse very complex data sets

This study supports the growing body of knowledge about the outcomes of good land management, including maintaining high levels of ground cover, and improvement in water quality in catchment run-off (Koci et al. 2019, Sanjari et al. 2009) and a superior capacity of TCG to yield and maintain higher levels of ground cover compared to continuous grazing (Sanjari 2009, Hillenbrand et al. 2019). The TCG methods have also been shown to reverse ecosystem degradation and improve soil and ecosystem function (Earl and Jones, 1996; Jacobo et al., 2006; Ferguson et al., 2013; Teague et al., 2011, 2013).

We found that despite having large sets of grazing and economic data, it was not easy to find simple correlations. This is due to dealing with a very complex set of systems. These include the human impact on decision making from 94 different sets of circumstances; widely varying climate, soil, vegetation, and livestock enterprises; widely different business skills and constraints; a moving livestock and land market; and a host of lag times within all systems. Such data requires a much more sophisticated approach to analysis.

These conclusions shine a light on the reasons why simplistic grazing studies comparing different grazing systems in a reductionist paradigm, gain no traction within the grazing industry, and would do more harm than good if they did. Mosier et al (2021) in Canada confirmed conclusion where ranchers within the AMP group, demonstrated high variability in management practices among individual operators, highlighting the importance of using specific management metrics rather than generalized descriptors of "grazing system type" to interpret their influence.

References

Chua, E., Flint, N., Malan, J., Swain, D. and Thompson, M (2021) Project Pioneer comparative water quality survey. Final Report CQU.

Davidson, B (2021). Project Pioneer MAIA Grazing Report.

Earl, J. M., Jones, C.E., (1996) the need for a new approach to grazing management – is cell grazing the answer? *Rangelands Journal* 18: 327-350

Ferguson, B.G., Diemon, S.A.W., Alfaro-Arguello, R., Martin, J.F., Nahed-Toral, J., Alvarez-Solis, D., Pinto-Ruiz, R. (2013) Sustainability of holistic and conventional cattle ranching in the seasonally dry tropics of Chiapas, Mexico. *Agricultural Systems* 120:38-48

Hillenbrand, M. Thompson, R., Wang, F., Apfelbaum, S., Teague, R (2019) Impacts of holistic planned grazing with bison compared to continuous grazing with cattle in South Dakota short grass prairie. *Agriculture, Ecosystems and Environment* Volume 279, pp 156-168.https://doi.org/10.1016/j.agee.2019.02.005.

Jacobo, E.J., Rodriguez, R., Bartoloni, N., Deregibus, V.A., 2006. Rotational grazing effects on rangeland vegetation at a farm scale. *Rangeland Ecology and Management* 59: 249-257

Koci, J., Sidle, R. C., Kinsey-Henderson, A. E., Bartley, R., Wilkinson, S. N., Hawdon, A. A., Jarihania, B., Roth, C. H., Hogarth, L. (2019) Effect of reduced grazing pressure on sediment and nutrient yields in savannah rangeland streams draining to the Great Barrier Reef. *Journal of Hydrology* 582:14 https://doi.org/10.1016/j.jhydrol.2019.124520.

Mosier, S., Apfelbaum, S., Byck, P., Calderon, F., Teague, R., Thompson, R., Cotrufo, M.F. (2021) Adaptive multi-paddock grazing enhances soil carbon and nitrogen stocks and stabilization through mineral association in southeastern U.S. grazing lands *Journal of Environmental Management* Volume 288, 112409

McCosker, T.H. (2000) Cell Grazing – the first 10 years in Australia. Tropical Grasslands Conference Working papers p 50 - 57

Sanjari, G., Yu, B., Ghadiri, H., Ciesiolka, C. A. A., and Rose, C. W. (2009) Effects of time-Controlled grazing on run-off and sediment loss. *Australian Journal of Soil Research* 47(8) 796-808. https://doi.org/10.1071/SR09032.

Teague, W.R., Dowhower, S.L., Baker, S.A., Haile, N., DeLaune, P.B., Conover, D.M. (2011) Grazing management impacts on vegetation, soil biota, and soil chemical, physical and hydrological properties in tall grass prairie. *Agriculture, Ecosystems and Environment* 141:310-322

Teague, W.R., Provenza, F.D., Kreuter, U.P., Steffens, T., Barnes, M.K. (2013) Multipaddock grazing on rangelands: why the perpetual dichotomy between research results and rancher experience? *Journal of Environmental Management* 128:699-717