

RFM DISCUSSION PAPER #5:

An examination of organic processes occurring in the agricultural production of RFF's cattle properties.

Forage crop with Carnarvon Gorge in background, Rewan, QLD, August 2016

ALL NATURE BREATHES

David Bryant, RFM Managing Director

'It is interesting to contemplate an entangled bank, clothed with many plants of many kinds, with birds singing on the bushes, with various insects flitting about, and with worms crawling through the damp earth, and to reflect that these elaborately constructed forms, so different from each other, and dependent upon each other in so complex a manner, have all been produced by laws acting around us.'¹

This was Darwin's last paragraph in *On the Origin of the Species*, published in 1859. It was almost certainly inspired by Alexander von Humboldt, who, after travelling through South America from 1799 to 1804, wrote:

*'How vivid is the impression produced by the calm of nature, at noon, in these burning climates! The beasts of the forest retire to the thickets; the birds hide themselves beneath the foliage of the trees, or in the crevices of the rocks. Yet, amid this apparent silence, when we lend an attentive ear to the most feeble sounds transmitted by the air, we hear a dull vibration, a continual murmur, a hum of insects, that fill, if we may use the expression, all the lower strata of the air. Nothing is better fitted to make man feel the extent and power of organic life. Myriads of insects creep upon the soil, and flutter round the plants parched by the ardour of the Sun. A confused noise issues from every bush, from the decayed trunks of trees, from the clefts of the rock, and from the ground undermined by the lizards, millipedes, and cecilians. There are so many voices proclaiming to us, that all nature breathes; and that, under a thousand different forms, life is diffused throughout the cracked and dusty soil, as well as in the bosom of the waters, and in the air that circulates around us.'*²

Alexander von Humboldt was one of the world's first scientists and naturalists to observe and posit the interconnections between living organisms throughout the world. His seven volume work, *Personal Narrative*, a book Charles Darwin said was one 'which I almost know by heart', inspired Darwin to sail on the HMS Beagle in 1831.³

This article examines organic processes occurring in the agricultural production of the cattle properties owned by the Rural Funds Group (RFF). While today these processes are well understood, thanks to the foundational work of Humboldt and Darwin, and the many agricultural scientists since, they highlight the deep and extended organic links that sustain the environment, agricultural production, profit making by farmers and ultimately the rents and dividends that RFF collects and distributes. These processes are fundamental to sustaining a balanced natural environment on RFF farms, equitable financial terms between RFF and its lessees, and ultimately secure and sustainable distributions for the providers of capital, such as RFF unitholders. Processes and relationships that, if properly balanced, can be sustained and enhanced for the benefit of nature and humankind.

Over the past year an important investment activity of RFF has been the acquisition of cattle properties in northern Australia, where sophisticated biological processes are occurring. The purpose of this discussion is not to dwell on the complexity and risks of agricultural enterprises, since those are concerns and contractual obligations of the lessee. Instead, the purpose here is to provide an explanation of the biological drivers of this business and the productivity gains that can be targeted, founded on science and understanding. This then, is an article concerned with money making, but focused on nature.

Calf and beef production can be optimised by recognising the hierarchy of factors that are required to maintain and grow these animals. These can be seen as the limiting factors of productivity, or needs that should be addressed in order of their importance. The highest limiting factors in their order are: water, energy, protein and dietary minerals.

1 As quoted in Wulf A., *The Invention of Nature, the adventures of Alexander von Humboldt, the lost hero of science*, John Murray London 2015, p234

2 *ibid*

3 *ibid* p168

Studies using GPS trackers attached to cattle have shown that on average cattle will stay within 1.2 km of a water source, and that up to 80% of grazing occurs within 2 km of that point.

Water

Water is the highest limiting factor to productivity because cattle must drink it to regulate numerous processes, such as body temperature, metabolism, and reproduction; while plants they eat require water to enable pasture growth. Cattle drink from 40 to 80 litres per day, depending on how hot it is – about 25 times higher than the recommended daily intake for adult humans – and without rainfall, grass does not grow.

Studies using GPS trackers attached to cattle have shown that on average cattle will stay within 1.2 km of a water source, and that up to 80% of grazing occurs within 2 km of that point. Where cattle have to walk greater than 2 km, they will use more megajoules of energy to find grass and over-graze those areas closer to the watering point. Interestingly, while the cow's objective is to stay close to water, the farmer's objective is to get them closer to unutilised grass. This is an important point, because over grazed pastures close to watering points will gradually decline in quality, so making it easy for cattle to get to fresh pasture is a key to managing these assets sustainably.

In July 2016, RFF acquired Mutton Hole and Oakland Park, two extensive cattle breeding properties in the south east of the Gulf of Carpentaria. In addition, it acquired Rewan, a grow-out property in central Queensland. The Gulf properties, totalling 225,800 ha, provide stock water through a mixture of farm dams and bores that supply water to troughs. RFF has identified that around 55,000 ha of these properties' pasture is underutilised, because the distance from a watering point is greater than 3 km. Twelve new watering points are being installed on these farms, which will improve carrying capacity and even out grazing pressure. These improvements will be included in the next round of property valuations with the aim of the improvements resulting in rental increases at the fifth year rent review.



Leucaena (a legume), Rewan, QLD, August 2016

Energy, protein and minerals

Once water has been adequately supplied, feed quality becomes the next limiting factor in driving productivity of calf and beef production. Feed in the form of pasture is highly variable across landforms and throughout the year. For example, tropical savannah environments, such as RFF's Mutton Hole property, will produce large quantities of fresh native grasses from the 900 mm average annual rainfall concentrated in the summer months. However, by winter rainfall is rare and pastures dry out and lose digestibility and nutritional value.

Before one can plan ways of improving nutrition to increase cattle productivity, it is important to gain an understanding of the digestive systems of ruminant animals. Humans, pigs and many other animals have a digestive system that uses one stomach, making them monogastric. Cattle and sheep however, utilise four chambers for digestion as a result of adaptation to the high fibre diets they consume when eating grass.

The largest of the four digestion chambers, the rumen, works as a 150 litre fermentation vessel, utilising micro-organisms feeding on the cellulosic plant materials. It is this ability to utilise microbes that gives ruminant animals the digestive edge over monogastrics and enables them to prosper across rangelands all over the world. Kangaroos in Australia, deer across the Northern Hemisphere, and wildebeest in Africa, are just a few examples of animals with ruminant digestive systems evolved to a diet of grasses.

Pasture or feed quality is the fulcrum of profitability in a cattle enterprise. While the ruminant digestive system is designed to process seasonably variable pastures, the difference between low and high quality pastures is exponential. This is because the next three limiting factors of production; energy, protein and minerals, beneficially compound upon each other providing they are present in the pasture or feed in suitable quantities.

Energy, the second limiting factor, is absorbed from grasses, primarily through the fermentation process occurring in the rumen. This process is maintained by microbes that reside there in incredible numbers and diversity. For each millilitre of rumen fluid there are around 10 billion bacterial cells of 200 differing species, plus protozoa, much larger but less numerous single cell organisms. This vast army of microbes, held in a solution



Cattle grazing on forage crops, Rewan, QLD, August 2016



Brahman cattle grazing near a watering point, Mutton Hole, QLD, August 2016

of saliva supplied at 125 litres per day, process plant cellulose into sugars and volatile fatty acids that create energy to sustain this process and enable animal growth or weight gain. This complex process is the consequence of a symbiosis between the host animal and the vast microbial population residing within it, and is an example of the diffusion and interconnection of life described by Humboldt and Darwin.

The third limiting factor is protein, which is largely a function of the amount of nitrogen present in the edible portions of the plant, making legume plants the star of protein production. Legumes enjoy a symbiotic relationship with the bacteria rhizobia that form nodules in legume plant roots. Rhizobia harvest atmospheric nitrogen, making it available to the plant whilst growing, and to the soil when the plant dies. In the digestion process, the micro-organisms in the rumen convert the nitrogen from legumes and grasses to ammonia, to fuel their own growth. These microbes are then washed from the rumen and then digested in the abomasum (similar to our stomach), or small intestine. Therefore, the process of protein accumulation in cattle is one occurring at a micro-organic level, with soil bacteria capturing nitrogen to feed microbes in the rumen, then absorbed as proteins for tissue growth, such as in the form of additional weight or new calves.

The fourth limiting factor is the 22 different minerals that cattle require for various specialised aspects of nutrition. For example, phosphorous and calcium are key components of bone formation, while potassium and sodium are required for the regulation of body fluids. Most of these elements are adequately supplied in Australian pastures, although phosphorous is deficient in soils, and therefore in most pastures in northern Australia. For this reason, supplementary feeds, called lick, are made available within paddocks so that cattle can self-regulate their intake of essential elements.

This complex system of production of energy and protein presents cattle farmers with great opportunities for increasing productivity by optimising these systems through improved pastures. RFF's Rewan property in Central Queensland will double the area of forage crops on that farm, planting annual crops of legumes for additional nitrogen, oats for additional starch-rich winter feed, and improving permanent pastures with fertiliser

application and additional perennial legumes. On RFF's northern Gulf of Carpentaria properties, 20,000 ha have been sown with a perennial legume called stylo. These improvements have well documented benefits that include higher carrying capacity and increased daily weight gain. Benefits that are a consequence of the compounding benefits of properly managing the symbiotic relationships between nitrogen fixing rhizobia, soil, pasture, and the armies of microbes within the digestive systems of cattle. Understanding and harnessing these systems enables profit maximisation by lessees, potentially higher rents for landowners and sustainable management of grasslands.

In conclusion, water distribution and pasture quality determines digestibility, energy content and protein production, and ultimately the profitability of each season.

The joy-filled prose of Humboldt and Darwin articulate their deep insight into the connections between all creatures and the resulting interdependency we all share. This article has explored just a small corner of the giant world that is our natural environment. It has attempted to explain some of the interconnections that, if harnessed, can improve land values and profits. These mercantile observations aside, it also reminds us of the treasure that is our environment. A treasure revealed through scientific knowledge that can ensure the assets owned by the 6,735 unitholders of the Rural Funds Group are managed sustainably for the almost infinite 'elaborately constructed forms, so different from each other, and dependent upon each other'.⁴

4 *ibid* p234