final report

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Lake Nash Breeder Herd Efficiency Project

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Abstract

This study involved monitoring both breeder cow performance and pasture quality on the Barkly Tableland. It was designed to provide producers in the region with practical strategies to evaluate both livestock and pasture performance over a wide range of seasonal conditions. The study was able to highlight the losses that may be occurring annually between pregnancy diagnosis and weaning (approx 17%), and the pasture sampling techniques employed (NIRS) will be of great benefit to producers who wish to target their supplementation programs. The significance of the more common reproductive diseases in the regions has been documented and the beef industry will be confident in the management and expenditure on control programmes for these diseases – especially on the Barkly Tableland. The fortuitous run of good seasons during the course of the trial has allowed the manifestation of the insect borne viral diseases to occur but unfortunately prevented any meaningful recommendations on the amount and level of supplementation. Attempts were made to implement a Breeder Cow Efficiency Index for breeding herds in northern Australia that may serve as a benchmark for all breeding properties. The need to develop a useable index and to further explore the reasons for calf wastage are two important outcomes of the project.

Executive Summary

This document reports on an observational study conducted on the commercial cattle operation, Lake Nash Station in the Barkly tableland of Northern Territory. At initiation of the project, it was intended that the study would be conducted for three seasons (2000 to 2002) following a set-up year in 1999. The project was concluded at the beginning of 2002, one season early, due to unforeseeable weather and personnel circumstances. While these circumstances prevented the anticipated outcomes for the study, results from the data collected are presented and considered to be of some value.

The main objectives of the trial were:

- To measure and report on the effect of dry and wet season supplementation on breeder herd efficiency (kg of calf weaned per 100 kg of cow mated) for three successive years at Lake Nash Station.

- To measure and report on supplement intake, pasture crude protein, phosphorus and *in vitro* digestibility, faecal phosphorus and crude protein levels and cow body condition monthly for three years and analyse the relationships between each for three breeding herds.

The presence of diseases known to affect the reproductive performance in bulls and /or cows for three successive years was also reported.

A demonstration was established on Lake Nash Station in three separate paddocks using Santa Gertrudis breeders and three different supplementation regimes i.e. nil supplement, wet season supplement and wet and dry season supplement. No replication of treatment groups was established.

A subset of maiden heifers were selected at the start of the trial and these females were monitored for reproductive disease.

Animal production data for the Barkly Tableland region was collected over a three year period from 1999 to 2001 and the results were analysed. Unfortunately due to the gaps in the data collected accurate and detailed analyses were unable to be produced. However estimates of conception rates, weaning rates and even an attempt at producing a Breeder Cow Efficiency Index for each of the mobs involved in the trial were produced. These indices will form a valuable bench mark for any further work that is undertaken in this region. Weaner weights varied between the groups from 196 kg to 222 kg. It would appear that the use of Charolais bulls may have had an impact on increasing weaning weights by increasing hybrid vigour.

Valuable pasture monitoring occurred for the duration of the project and seasonal variations of protein, biomass, dry matter digestibility and phosphorus have been recorded. NIRS technology was implemented and the results should be very useful for producers wishing to implement supplementation strategies over the dry season.

Diseases affecting reproductive performance in the herd were studied. While positive serological findings were detected for viral diseases such as Bluetongue, Bovine Ephemeral Fever and

Infectious Bovine Rhinotracheitis and for the bacterial disease Leptospirosis, it would appear that none of these diseases are causing significant reproductive losses in the region. Akabane infection was also detected and this may have caused some reproductive loss. Trichomoniasis was prevalent in the bulls but its impact was unable to be quantified - 12 bulls were culture positive for *Tritrichomonas foetus*. No *Campylobacter fetus* was cultured from the trial bulls but five of fifteen cows sampled with vaginal swabs were positive to the Vibrio IgA ELISA.

Losses of around 17.1% between pregnancy tested and weaning were identified. This will prove to be useful data for further research in the area of calf wastage,

This study never attempted to be an "on farm" replicated trial as the budget was small and beyond the scope of funds allocated. While the findings relating to supplementation were not significant, the methodology and sampling techniques developed for the project have enabled producers in the region to commence data collection and establishment of their own benchmarks for their breeder herds in the Barkly Tableland.

This project recommends that further work in calf wastage be undertaken in northern Australia and that NIRS technology be supported to increase producer awareness as to when to supplement. More work needs to be undertaken to develop a practical Breeder Cow Efficiency Index which can be applied to all herds in northern Australia.

Contents

1 Background

The Barkly Tableland is one of Northern Australia's most productive cattle areas. It has 144,000 km^2 under 33 pastoral leases, carrying approximately 530,000 head of cattle. It is characterised by treeless black soil plains.

Breeder herd efficiency can be defined as the kg of calf weaned/100kg cow mated (Baker and Carter 1976). Improved breeder nutrition (weaning/paddock management/supplementation) is the key to improving breeder herd efficiency. Investigation of practical management strategies to improve beef breeding herd efficiency on the Barkly Tableland was conducted.

Factors determined to be of relevance to breeder herd management included reproductive disease, soil types, rangeland and seasonal conditions, supplements, and objective measurement of herd performance. The study documented reproductive performance of 626 individually identified breeders in three separate herds (Georgina Bullock, Stokes/Costello & Desert Paddocks) of Santa Gertrudis origin on Lake Nash Station in the Northern Territory's Barkly region.

The results gathered were analysed to ascertain if any relationships or correlations occurred between these factors. Management variations between the consecutive years of the trial and the three trial paddocks, as well as seasonal constrictions, made it difficult in some areas to achieve an accurate comparison due to lack of consistency in data presented.

Reproductive diseases have also been identified as possible causes of wastage in breeding herds in northern Australia. There are many causes of abortion and calf loss recognised in the Australian cattle herd. Hungerford (1990) describes 31 known causes of abortion in Australia comprising various micro organisms, genetic and reproductive abnormalities. Many of these are sporadic in nature. One of the most serious causes of abortion and calf loss internationally, Bovine Brucellosis, was eradicated from Australia by 1989.

There remains concern across the northern Australian cattle industry with foetal/calf losses from pregnancy diagnosis to branding averaging 10-13%. Specific observations are described in the following reports:

- 12.3% Brown (1998), property on Barkly Tableland
- 18% Brown *et al*. (1994), property in the Gulf of NT
- 6-28% Holroyd (1979) North Western Queensland
- 11% Holroyd (1981) North Western Queensland
- 13.5% Holroyd (1987) Swan's Lagoon, North Queensland
- 15% Andrews (1972) NT various including Barkly Tableland
- 6% MacDonald *et al.* (1997), Mt Sanford, NT
- 23% Sullivan & O'Rourke (1997) Victoria River Research Station

Cattle stations are developing improved management strategies as described by Braithwaite & De Witte (1999) to maximise branding rates. These include techniques such as early weaning, controlled mating systems and reproductive segregation. Commonly, breeding cattle segregated without bulls after positive pregnancy testing are exhibiting 10-13% loss of foetus/calves. (Jephcott and Braithwaite *pers. comm.*) A Barkly heifer group segregated after being diagnosed pregnant recently exhibited a 23% loss of foetus/calves during the 1999-2000 season prior to branding.

Efforts to identify specific factors important in these calf losses are hampered by the large paddock and herd sizes, high costs of mustering and remoteness from laboratory facilities.

The only published attempts in recent times to identify causes of abortion, perinatal loss and postnatal loss in pastoral herds in Australia has been by Holroyd (1987) based on 11 years of accumulated data on Swan's Lagoon Research Station near Townsville. Serum collected from those cows that aborted was only tested for leptospirosis and brucellosis. Both *Leptospira interrogans* var *hardjo* and *pomono* were found but considered of minor importance. Arboviruses were not considered. Infectious Bovine Rhinotracheitis was also found to be present but was not considered to influence conception rates or foetal survival (Allan et al. 1975). Holroyd (1987) quoted results of 13.5% loss from pregnancy diagnosis to weaning which was divided into the following observations: 3.5% abortions, 4.4% perinatal loss, 5.6% postnatal loss.

Brown (1998) observed 6% abortions, 6.3% abortions/perinatal loss and 2% postnatal loss on a herd study on the Barkly Tableland, NT. Identification of specific causes of loss in that study were largely unfruitful.

Arboviruses such as Bluetongue virus, Bovine Ephemeral Fever and Akabane virus are recognised as causes of abortion and calf loss in northern herds (Beveridge 1981). Bovine Viral Diarrhoea (BVD) virus and Infectious Bovine Rhinotracheitis (IBR) virus are widespread in Australian herds and infections are capable of causing abortions or calf loss (Beveridge 1981). *C. fetus* sub *venerealis* and *T. foetus* are venereal organisms carried by bulls capable of causing significant reproductive loss in northern herds. Various serovars of *L. interrogans* are recognised as endemic in the northern cattle herd causing disease syndromes characterised by mastitis, abortion and perinatal and postnatal calf loss. These serovars are primarily *hardjo, pomono* and to a lesser extent *tarassovi* (Beveridge 1983).

A study was designed to assess serological evidence of infection in breeding cows on the Barkly Tableland and to measure the association between periods of seroconversion of common endemic diseases with abortion, delayed conception and calf loss. This study was part of the larger Lake Nash Supplementation Trial which assessed the value of supplementation strategies and production parameters of a large Barkly breeding herd from 1999 until 2002.

2 Project Objectives

The objectives of a Breeder Herd Efficiency project for the Northern Territory were to identify current levels of breeding herd efficiency and to evaluate and document cost effective production systems capable of providing a 10% increase in the efficiency index in the NT breeding herd by 2003. The objectives of this trial held in the Barkly region were to measure and report on breeding herd efficiency in three paddocks for three successive years at Lake Nash station.

The project objectives were met by the following processes:

- Measuring and reporting on the effect of dry season and wet season supplementation on breeding herd efficiency (kg of calf weaned per 100 kg cow mated) for the duration of the project at Lake Nash Station, Barkly Tableland.
- Measuring and reporting on supplement intake, pasture crude protein, phosphorus and in-vitro digestibility, faecal phosphorus and crude protein levels and cow body condition monthly for the duration of the project and analysing the relationship between each
- Sampling three breeding herds and reporting the presence of disease known to affect reproductive performance in bulls and/or cows for the duration of the project
- Assessing and reporting on rangeland condition, the nutritional value of herbage samples and the pattern and amount of rainfall in three paddocks grazed by breeding cattle

3 Methodology

3.1 Location

The project area is situated approximately 500km due east of Tennant Creek (20^{o}25'S, 137^{o}33'E) in the Barkly Tableland region of the Northern Territory (Figure 2.1). The three project paddocks are primarily treeless black soil downs supporting a native pasture community of *Astrebla* spp. and *Iseilema* spp. Each paddock also has some watercourse frontage and undulating hills supporting a dominance of *Aristida* spp. and other annual pasture species.

3.2 Land Systems:

Christian *et. al* (1947-48 CSIRO Land Systems mapping) identify three different black soil systems across the four trial paddocks (Table 3.1). Although these systems are all black soil, distinct differences in Mitchell grass pasture were noted during ground observations. The dominant "Barkly" Land System of Stokes and Desert paddocks appeared to contain a heavier clay soil and produced larger and denser Mitchell grass tussocks. The "Wonardo" land system that dominated Costello and Bullock paddocks appeared to be a lighter "browner" black soil that produced stunted, smaller Mitchell grass tussocks.

Table 3.1: Total land system area for each trial paddock

Land System	**Description**	**Stokes**	**Desert**	**Costello**	**Bullock**
		(km^2)			
Barkly (B1)	Black soil plain – Mitchell grassland	359 (54%)	101 (20%)	17 (5%)	
Camil (Cl)	Red sandy plain – spinifex grassland	295 (44%)	375 (74%)	5. (1%)	
Kallala (Kl)	Black soil plain – Mitchell grassland & *Acacia georginae* woodland		27 (5%)		91 (31%)
Tobermory (T)	Low limestone hills - *Acacia georginae/Senna* sp. shrubland			29 (8%)	62 (21%)
Wonardo (Wd)	Black soil plain – Mitchell grassland	14 (2%)	1 (0%)	301 (86%)	137 (47%)
TOTAL AREA		668	504	352	290

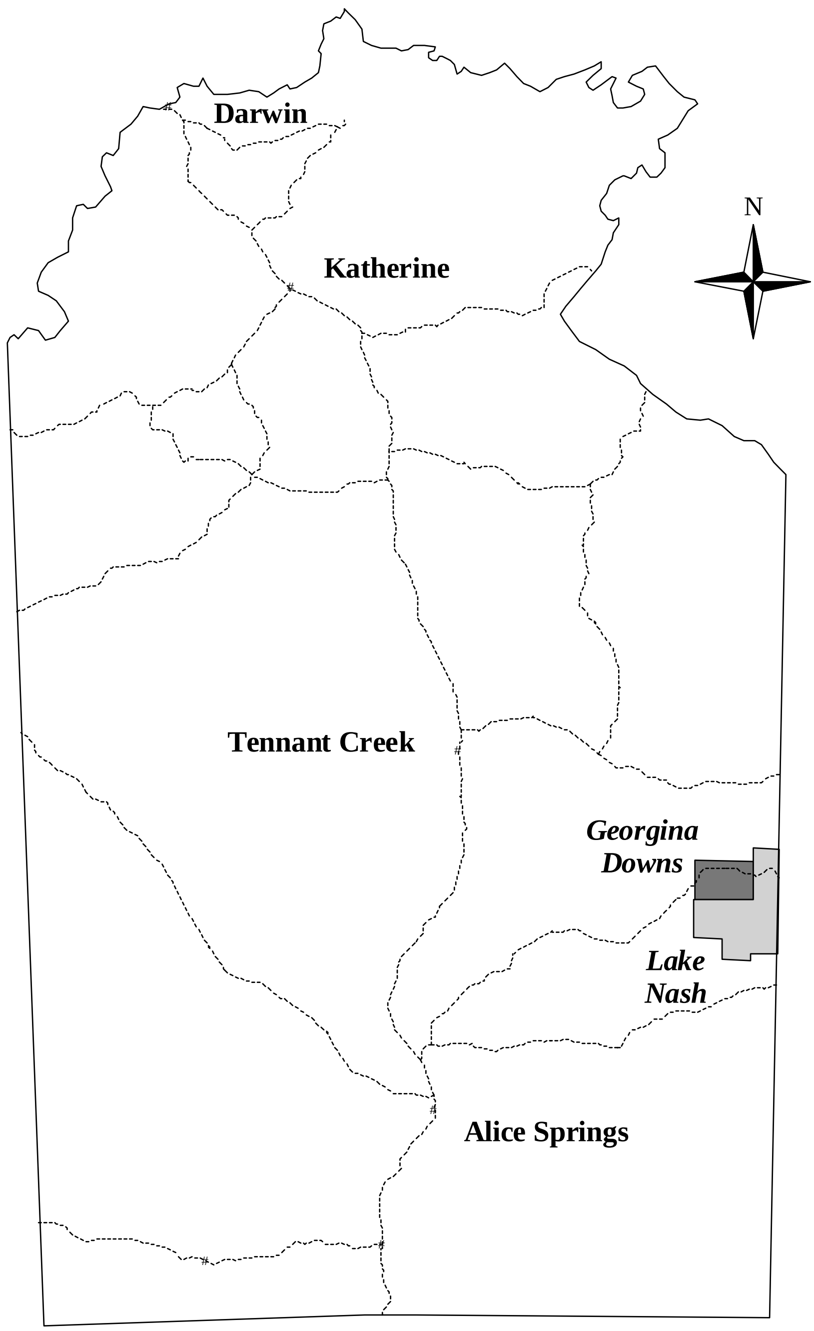


Figure 3.1: NT Map depicting locality of study sites

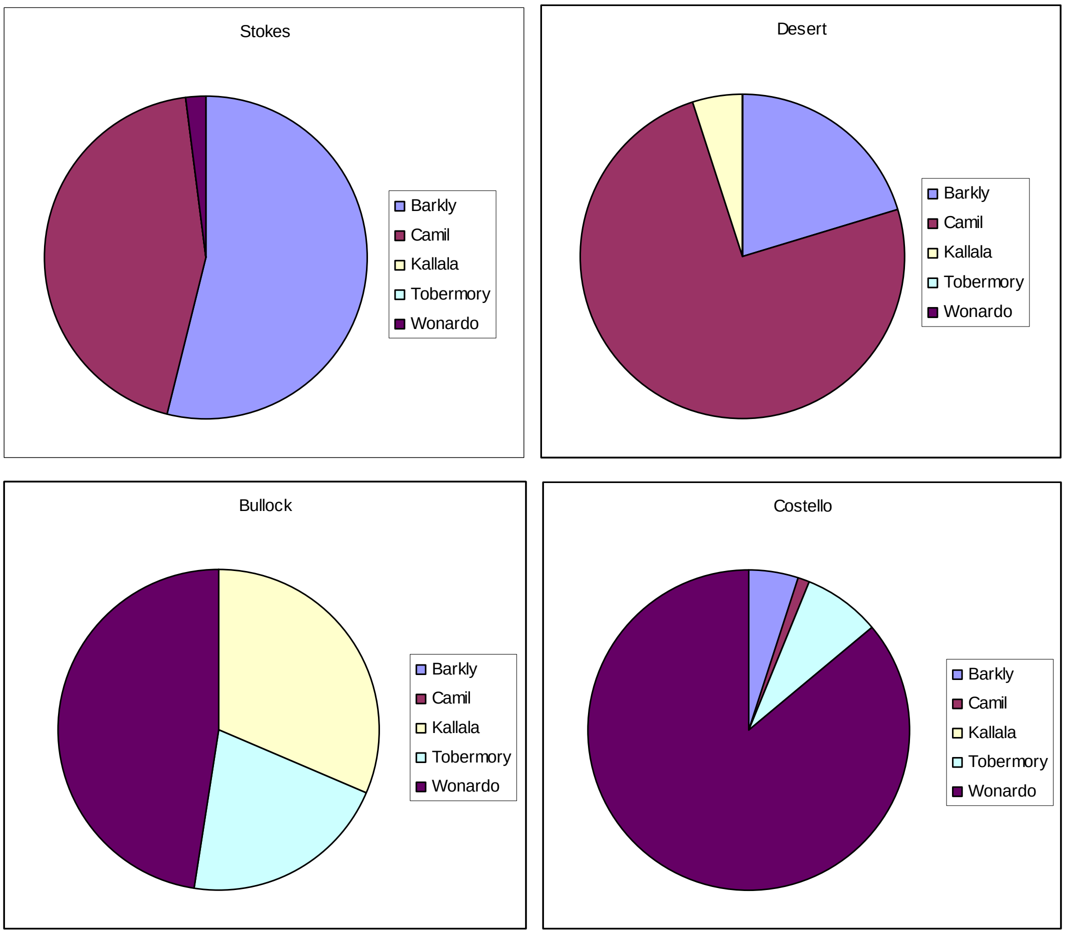


Figure 3.2 – Graphical representation of land types in each of the study paddocks.

"Tobermory" Land System is made up of low limestone hills with *Acacia georginae* and *Senna* spp. over *Enneapogon* spp. grassland, covering a significant area in both Costello and Bullock paddocks, but absent in Stokes and Desert paddocks. The red sandy plains "Camil" Land System covers a significant area of the northern two paddocks (Stokes and Desert) but is absent from the southern two (Costello and Bullock). (Figure 3.2)

3.3 Major Landforms and Water Courses

A major watercourse flows north-east from Costello paddock through Desert paddock and is considered an important pasture unit. Due to the location of dams (watering points) and the associated desirable annual grass feed production this land unit is preferred by cattle. It was noted that the cattle stayed in this land unit well into the dry season, moving out onto the Mitchell grassland only when the majority of the feed in this unit had been utilised.

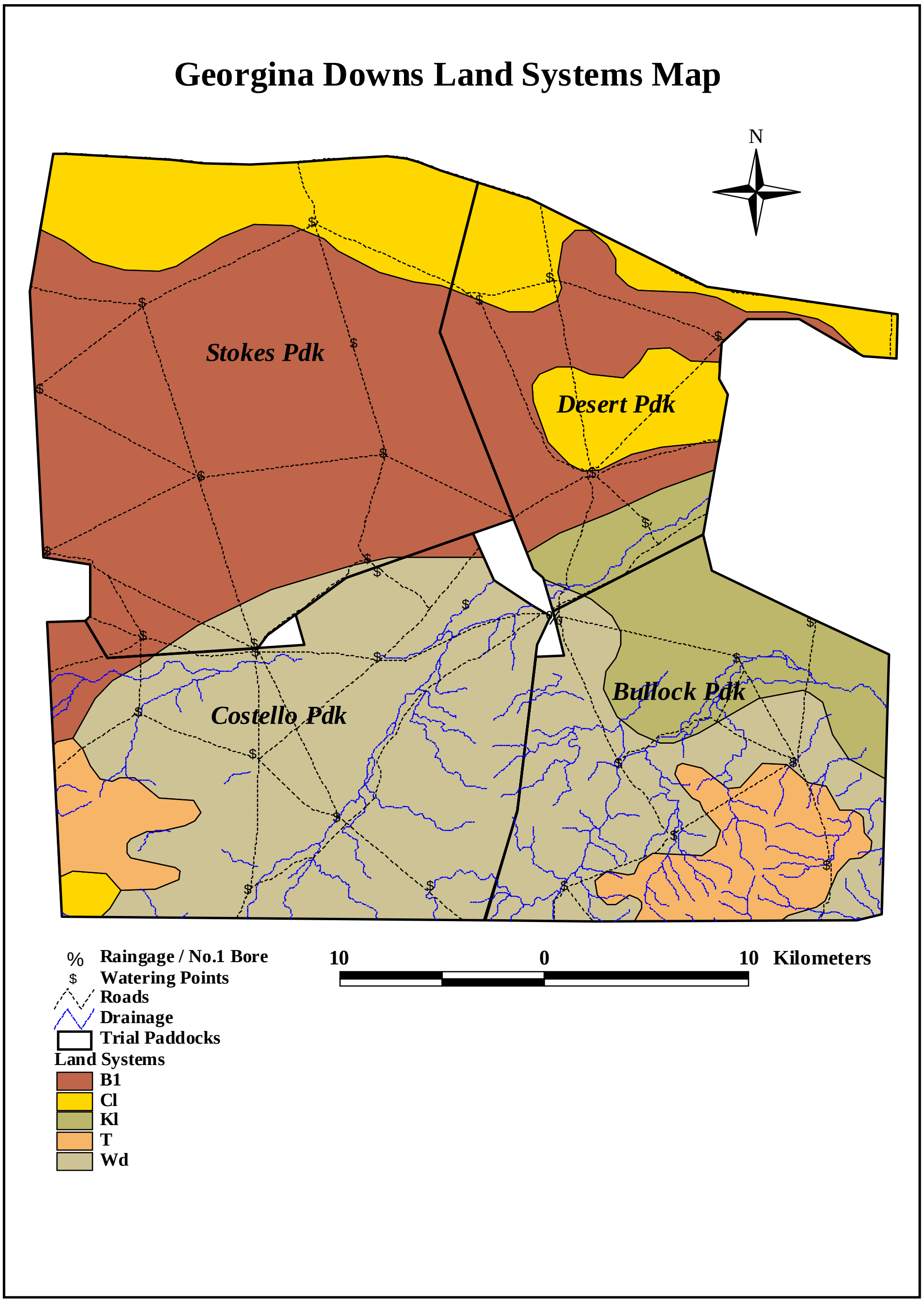


Figure 3.3: Land system map of the trial paddocks

The northern two paddocks (Stokes and Desert paddocks) are relatively flat with minimal watercourses, however the southern two paddocks (Costello and Bullock paddocks) show significant undulating relief, forming a network of minor and major watercourses. This localised difference would significantly affect the quality and quantity of pasture production and the associated cattle grazing behaviour.

Costello paddock also differs from the other paddocks by containing extensive stands of *Acacia georginae* woodlands requiring unique cattle management due to the poisonous nature of that plant species.

3.4 Paddock Details

The paddocks, Georgina Bullock, Costello, Stokes and Desert are 290 km^2, 352 km^2, 668 km^2 and 504 km^2 in size respectively and are situated in the Georgina Downs area of Lake Nash Station (Table 3.1).

Costello: Pasture and soil communities change from water frontage annual grasses and forbs to open downs (Mitchell and Flinders) to red country spinifex species. The cows were moved from Costello to Stokes paddock in the first round each year due to gidyea (*Acacia georginae*) poisoning in Costello.

Georgina Bullock: Pasture and soil communities change from water frontage annual grasses and forbs to open downs (Mitchell and Flinders) to red country Spinifex. Bullock paddock has a smaller percentage of red country than Desert.

Desert: Pasture and soil communities change from water frontage annual grasses and forbs to open downs (Mitchell and Flinders) to red country spinifex species. Desert paddock has a larger percentage of red country than the other paddocks. (Figure 3.3)

3.5 Project Design

The production system of the three project paddocks was typical of a large breeding herd (21,000 breeders) in Northwest Australia. Each of the three study paddocks were subject to different nutritional regimes (Figure 3.4). The project animals on Lake Nash Station comprised purebred Santa Gertrudis breeding cows and bulls. Some Charolais bulls were used later in the project. When convenient and appropriate, two “rounds” of mustering, branding and weaning were conducted each year. The first round was conducted between April and August, during which approximately 70% of the annual weaning was performed. The remaining weaning was conducted later in the year, at the second round, between September and October.

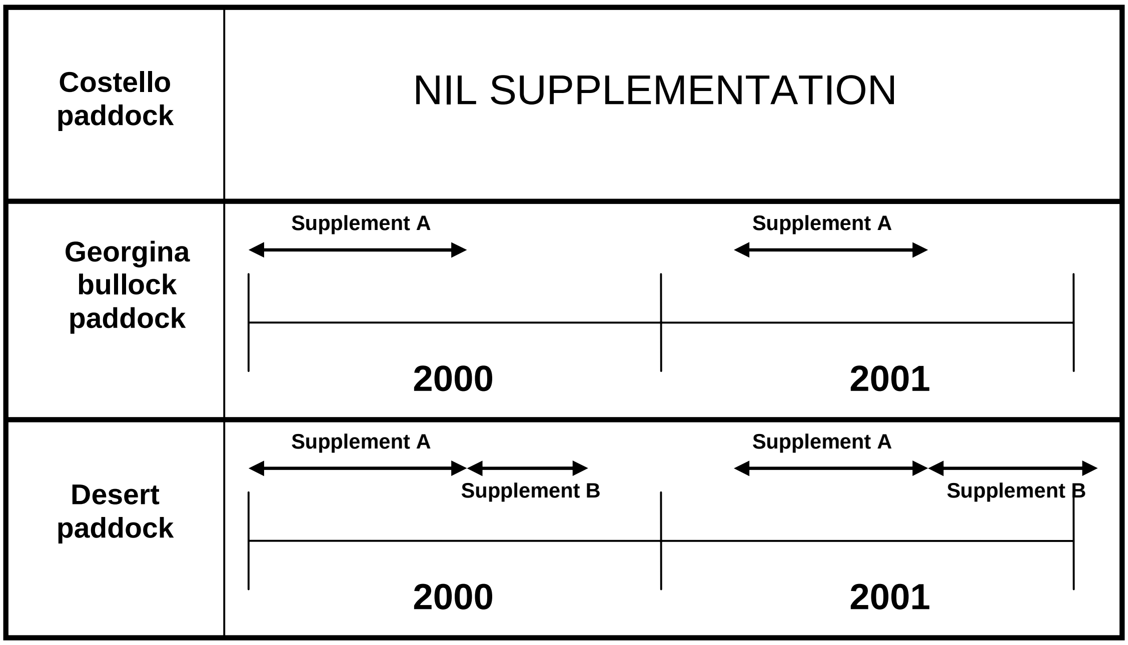


Figure 3.4: Schematic diagram of nutritional regimes for the three trial herds.

During both rounds, all calves were tagged with ear tags colour coded for the year of birth and numbered with an approximated month of birth. Calves between 40kg and 150kg were branded, earmarked, and steers castrated and implanted with a hormonal growth promotant (HGP), de-horned, eartagged and returned to their mothers. Older cleanskin calves at weights over 130 to 150kg received the same treatment but were weaned also. Some previously branded calves were also weaned according to the above weight ranges. Calves under 40kg were eartagged and returned to their mothers. Bulls received an annual vaccination for Botulism C & D and Vibriosis. Mustering was conducted with the use of plane, motorbike and horse.

After mustering the study cows and calves were drafted from the main breeding mob and handled as a separate mob. All individually identified study cows were pregnancy tested, with body condition score and lactation status recorded. Pregnancy diagnosis was performed by rectal palpation with month of gestation (1 to 9) recorded after confirmation of test accuracy based on previous breeding performance records. The calves and the weaner progeny of these cows were weighed and their month of birth and sex recorded. They were then treated as described above.

The non-study breeders were drafted wet (lactating with calf at foot) and dry (non-lactating). Dry cows were pregnancy tested and culled according to their pregnancy status and udder/teat conformation. Wet cows were returned to their paddock of origin. No replacement breeders were introduced to the trial group however paddocks were maintained at an appropriate stocking rate. All breeders, trial or otherwise, received a Botulism C&D vaccine.

Vaccinations Vibrovax and Botulism C&D were supplied by CSL. The Hormonal Growth Promotants (HGPs) used were Compudose 400 for first round and Compudose 200 for second round. Ridley Agriproducts generously supplied feed supplements for use throughout the period of the trial (Table 3.2).

This was not an experiment as there was no replication and animals were not allocated in a random form. There were three paddocks from which the data was collected. Animals running in Bullock paddock received wet season nutrient supplement, Costello/Stokes Paddock received nil supplement and Desert paddock was supplemented during both the dry season and wet season (Figure 2.3).

Table 3.2: Nutrient composition of supplements used in the trial.

Constituents	Supplement A*	Supplement B**
Total Crude Protein (%)	32.0	98.0
Equivalent Crude Protein (%)	30.0	90.5
True Protein (%)	2.0	7.5
Urea (%)	10.5	25
Molasses (%)	40.0	N/A
Salt (%)	10.0	18-25
Calcium (%)	6.0	3.5-5.0
Phosphorus (%)	5.0	3.5-4.6
Sulphur (%)	0.5	4.5
Copper (mg/kg)	300	300
Cobalt (mg/kg)	30	30
Iodine (mg/kg)	30	30
Zinc (mg/kg)	500	500
Selenium (mg/kg)	2.5	2.5

* Supplement A delivered in a compressed block form.

** Supplement B delivered in a loose lick form.

3.6 Rainfall

Rainfall was measured using a tipping bucket rain gauge and recorded using a data logger measuring the timing, intensity and duration of rainfall.
Figure 3.5 shows that for the three years of the trial rainfall was higher than in 70% of years.

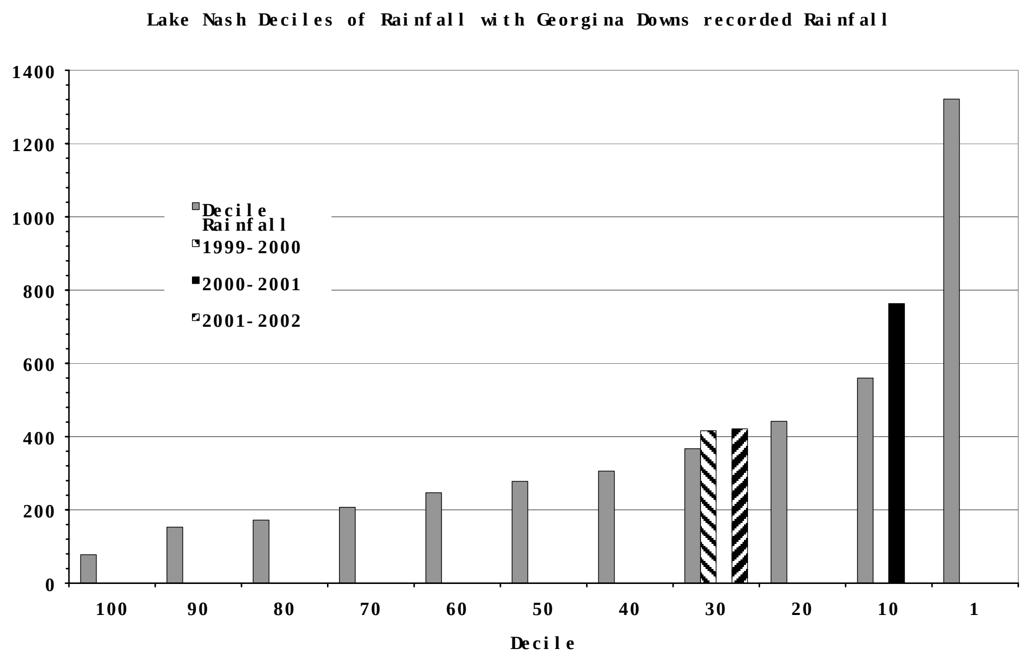


Figure 3.5: Comparison of three years of rainfall with deciles for the area

3.7 Rangeland Measurements

Pasture assessments were undertaken annually to estimate biomass, species composition and cover. The “grab sample” technique (Ash and McIvor 1995) was used for nitrogen and phosphorus concentration analysis.

3.8 Pasture Composition

Within the four trial paddocks on Georgina Downs two main pasture types were identified:

- Mitchell / Flinders Grasslands
- Short Arid Grasslands

The pasture species recorded in each pasture type have been grouped into five categories: annual grasses, palatable perennial grasses, unpalatable perennial grasses, palatable herbs/forbs and unpalatable herbs/forbs.

In both pasture types, and in all paddocks, there appeared to be a substantial increase in the perennial component of the pasture through out the assessment period. This increase appears to be due to the Georgina/Lake Nash area being in a period of above average rainfall (5 year moving average - Rainman).

The April 2002 assessments measured a distinct reduction in the annual plant component of all pasture types in all paddocks, and again can be explained by the weather. The 2001-2002 daily rainfall reveals a period of 4½ weeks from the middle of January until the middle of February of no useful rain. This dry period may explain the reduction in the annual plant component during the April 2002 pasture assessments. Above average rainfall from October to January (except for December) would have stimulated the germination of the annual grasses and forbs over the 2001-2002 wet season, however they appear to not have been able to survive the 4½ week dry period. By the time the above average rain fell in mid February 2002 the majority or the annual pasture component would have died with additional rain causing the deterioration of any associated annual hay that was produced. Germinating annual plants with the February 2002 rain would have then experienced only a very short growing season resulting in only sparse small stunted annual plants.

3.9 Pasture and Faecal Sampling

Pasture sampling and faecal sampling was undertaken monthly using the “grab sample” technique (Ash and McIvor 1995) and analysed for nitrogen and phosphorus concentration. Faecal sampling was conducted by collecting approximately 20 fresh samples and combining them to form one sample for each paddock. Faecal samples were analysed by the traditional wet chemistry method and using Near Infra-Red Reflectance Spectroscopy (NIRS) technology (Lyons and Stuth 1992).

3.10 Livestock Measurements

Measurements recorded included apparent supplement intake, cow and weaner liveweight, weaner sex and month of birth, cow pregnancy diagnosis by rectal palpation, lactation status and cow body condition using the nine point scale (Herd and Sprott 1996) (Appendix 1).

3.11 Measuring the impact of reproductive diseases

100 breeding heifers & cows were sampled for evidence of known diseases which could cause reproductive loss. Blood samples were collected from as many tagged cows as were presented at muster twice yearly from October 1999 until April 2002. Serological testing occurred for Bluetongue, BVD (Bovine Viral Diarrhoea), Akabane virus, BEF (Bovine Ephemeral Fever), Leptospirosis (three serovars) and IBR (Infectious Bovine Rhinotracheitis). These diseases were selected as known causes of abortion and calf mortality in cattle herds (see introduction). *Leptospira interrogans* var *hardjo* and *pomono* are recognised abortive agents in cattle herds (Beveridge 1983), but in recent years var *tarrasovi* has generated interest. Black (2001) found 13.9% seroprevalence of *L. interrogans* var *tarassovi* in central Queensland cattle herds.

Testing was conducted by the Berrimah Veterinary Laboratory using the following tests:

- Bluetongue - ELISA
- BVD – Agar Gel Immunodiffusion Test
- Akabane virus - Serum Neutralisation Test

- BEF – Serum Neutralisation Test
- Leptospirosis – Macroscopic Agglutination Test
- IBR – Virus Neutralisation Test

Bulls were preputial sampled for venereal diseases Vibrio (*Campylobacter fetus* sub *venerealis*) and Trich (*Tritrichomonas foetus*) in October 1999. Mucous samples were inoculated into transport media (Landers TEM and In-pouch System® respectively) and conveyed to the laboratory within 24 hours for incubation and culture. 15 vaginal samples were taken from cows for testing by Vibrio IgA ELISA (Hum 1994).

At least twice a year, the breeding cows were mustered and recorded for lactation status and pregnancy tested to record foetal age. From sequential records, a reproductive incident was identified (Table 4.12, Table 4.13) whereby:

1) The cow had aborted her foetus (abortion)
2) The cow had either aborted or the calf had died at birth or soon after (Aborted or Calf Loss)
3) The cow had failed to conceive during the intervening period (Conception Failure).

The Aborted or Calf Loss category was determined by the cow being not detectably pregnant and not lactating when she should have calved during the intervening period. Conception Failure incidents would include anoestrus, returns to service and early embryonic or foetal loss.

Relative Risk or Odds Ratios were used to assess the increased risk of reproductive incidents occurring upon exposure to an infective agent (seroconversion). 95% Confidence Intervals for the ratio were calculated and Chi square or Fishers Exact test was used to assess the probability that these reproductive incidents could have occurred in a manner unrelated to seroconversions

4 Results

4.1 Seasonal Conditions

In the 1999-2000 wet season, Georgina Downs (416mm) recorded a higher rainfall between November 1999 to April 2000 than the yearly average rainfall of Lake Nash (320mm - based on 109 years of records).

The majority of the 1999-2000 season rain fell in the month of February, with only January and March receiving lower than the Lake Nash average monthly rainfall for both stations during the November to April period (Figure 4.1).

The 2000-2001 wet season saw Georgina Downs receive a total rainfall of 763 mm, 159 mm more than the 604 mm rainfall received at the Lake Nash Homestead. The rain received by Georgina Downs was 2.6 times the Lake Nash mean rainfall of 293mm based on 110 years of records.

Figure 4.2 shows that Georgina Downs had an above average start to its 2000-2001 wet season to January, followed by average monthly rainfall until April. Over forty percent of 2000-2001 wet season rainfall at Georgina Downs was received in December with rain being recorded approximately every second day during that month.

During the 2000-2001 wet season Georgina Downs (67 rain days) recorded rainfall on approximately three times as many days as the mean number of rain days for Lake Nash (22 rain days). On average, Georgina Downs recorded approximately 11mm of rain per rain day, which indicates lower average rainfall intensity than the mean average rainfall of 13mm per rain day for Lake Nash.

The 2000-2001 growing season for Georgina Downs was above average due to 2.6 times more rainfall than average, lower rainfall intensity and an even rainfall spread over the entire 2000-2001 wet season.

During the 2001-2002 wet season Georgina Downs received a total rainfall of 421.4mm recorded at No.1 Bore, 84.4mm more than the rainfall recorded at the Lake Nash homestead and 128.4mm more than the Lake Nash mean rainfall of 293mm based on 110 years of records.

Approximately 50% of Georgina Downs 2001-2002 Wet Season rainfall was received in the last two weeks of February with rain recorded on 10 out of the 11 days during those weeks. No further rain was recorded after February. Figure 4.3 shows a dry period was experienced prior to the February rain and extended from the middle of January for approximately 4½ weeks. This dry period may explain the noted reduction in the annual plant component during the April 2002 pasture assessments. The above average 2001-2002 wet season recorded at No.1 Bore ensured the Lake Nash/Georgina Downs area remained in an above average rainfall period.

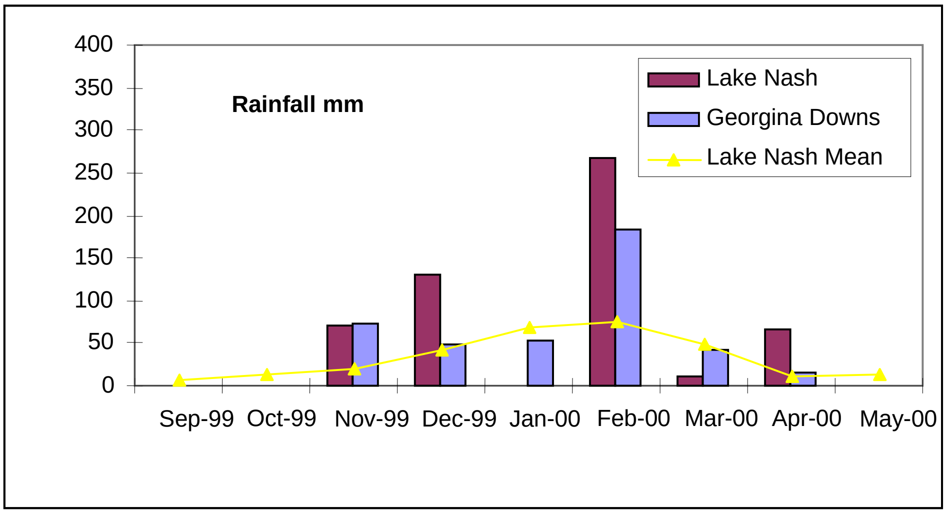


Figure 4.1: Georgina Downs & Lake Nash av. monthly rainfall 1999/2000 wet season

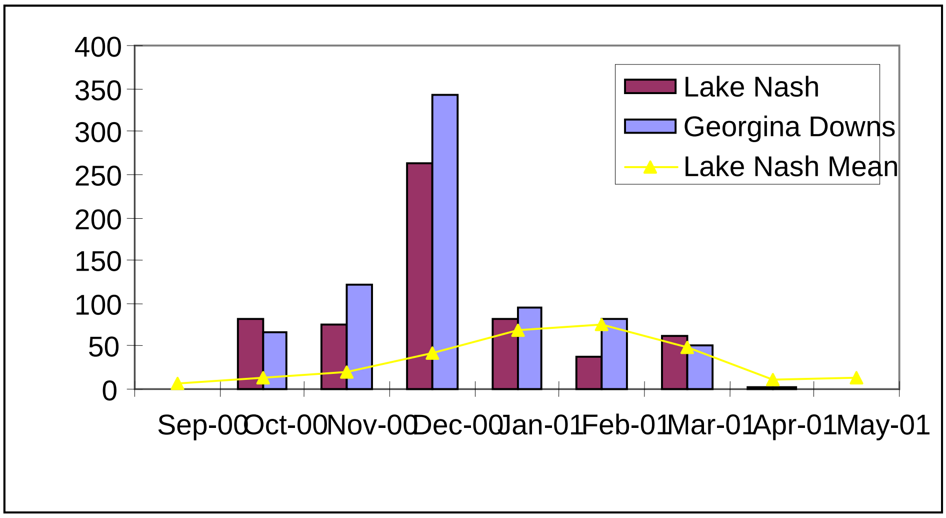


Figure 4.2: Georgina Downs & Lake Nash av. monthly rainfall 2000/2001 wet season

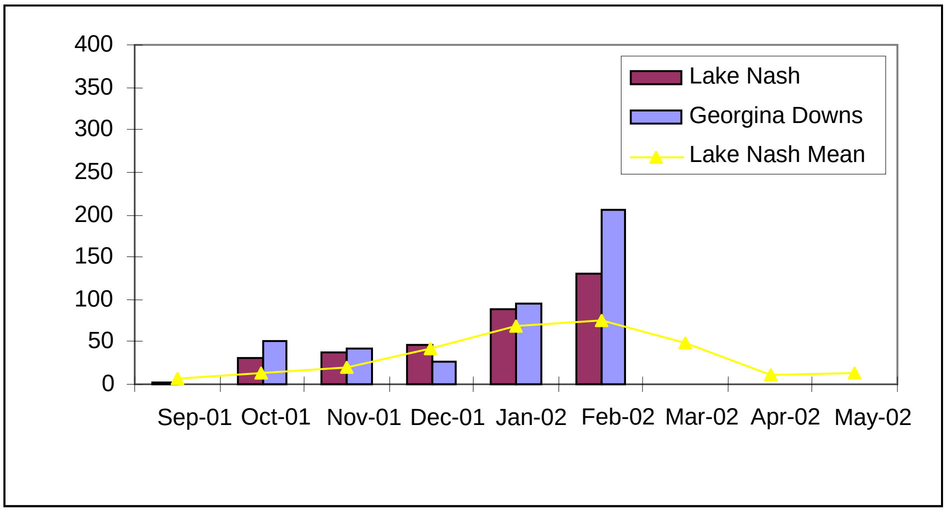


Figure 4.3: Georgina Downs & Lake Nash av. monthly rainfall 2001/2002 wet season

4.2 Pasture Yield

Pasture yield is based on the mean estimated dry standing biomass of three sampling sites per pasture type for each paddock, and is expressed in kilograms per hectare. Table 4.1 shows the total pasture biomass estimated during the assessments on Georgina Downs. A distinct increase in pasture biomass was observed between 2000 and 2001 but falling slightly between 2001 and 2002. This variation in paddock biomass over time appears to be dominated by total rainfall and the way that it fell. Figure 4.6 shows the Georgina Downs rainfall recorded at No.1 Bore against the total average paddock yield which supports this theory.

Biomass in all paddocks except Bullock paddock remained high over the 2001-2002 growing season (similar to the biomass produced over the 2000-2001growing season) despite the lower, but still above average total rainfall, and probably reflects the result of a series of above average rainfall years. Figure 4.5 shows that there was a significant drop in the Bullock paddocks yield between May and October during 2001, however unlike the other paddocks yield remained low after the 2001-2002 growing season. Stokes paddock also declined in yield over the 2001-2002 growing season, due to a decline in the Short-arid grassland biomass over this time (Figure 4.5).

Costello paddock appears to be the consistently highest yielding paddock of the four, however this is attributed to a larger unpalatable perennial grasses component, mainly *Aristida latifolia*.

All the components of the pasture, except the desirable palatable perennial grass component, decreased as expected between May and October. It was interesting to note that in Stokes and Desert Paddocks, Georgina Downs most northerly paddocks, both recorded an increase in palatable perennial grass biomass during this period. This increase may have been due to the extended 2000-2001 wet season enabling the perennial grasses in these paddocks to continue growing well into the 2001 dry season.

2001 saw a marked increase in total pasture biomass in all trial paddocks which may have been due to the Georgina Downs and Lake Nash area being in a period of above average rainfall. Two consecutive above average wet seasons during the trial period and a short dry season would have resulted in the condition of pastures remaining high at the end of 2000, allowing the pasture to build upon this biomass during the 2000-2001 wet season.

Table 4.1: Estimated yield and mean total blacksoil biomass for each trial paddock (kg/ha)

Paddock	*Pasture Type*	*Aug 2000*	*May 2001*	*Oct 2001*	*April 2002*
Desert	Mitchell Grassland	1637	4553	3798	4468
Desert	Short Arid Grassland	840	2585	1702	2579
Desert	**Mean Total Yield**	**1239**	**3569**	**2750**	**3523**
Bullock	Mitchell Grassland	2852	4617	3609	3449
Bullock	Short Arid Grassland	1033	2260	1058	1307
Bullock	**Mean Total Yield**	**1942**	**3439**	**2333**	**2378**
Costello	Mitchell Grassland	2600	5339	4808	4664
Costello	Short Arid Grassland	792	2435	2231	2974
Costello	**Mean Total Yield**	**1696**	**3887**	**3519**	**3819**
Stokes	Mitchell Grassland	1686	4396	4071	4351
Stokes	Short Arid Grassland	280	2584	3544	1993
Stokes	**Mean Total Yield**	**983**	**3490**	**3807**	**3172**

Dry Matter Estimates of Mitchell Grass in the three study paddocks.

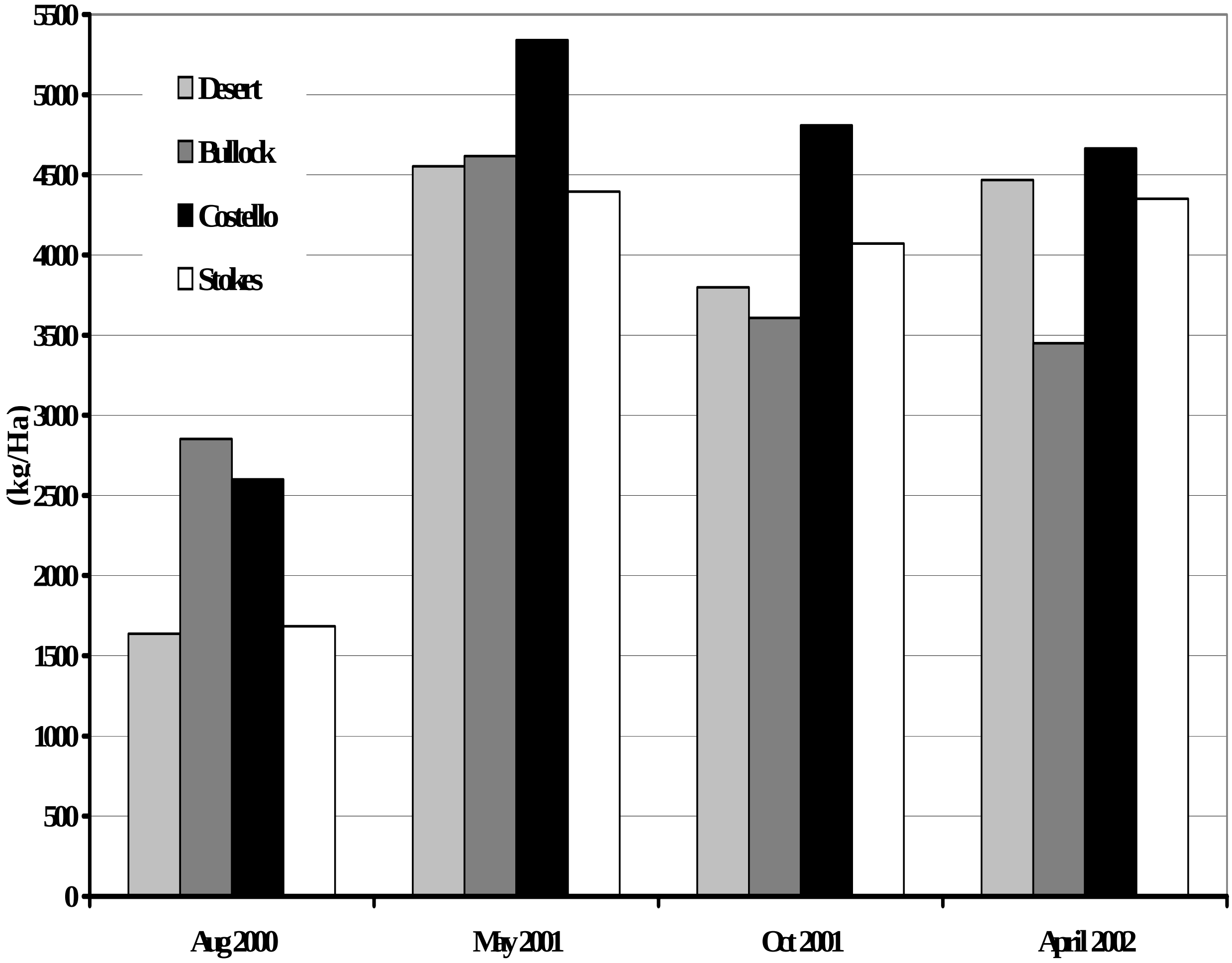


Figure 4.4: Estimation of Mitchell Grass in study paddocks from 2000 to 2002.

Dry Matter Estimation of Short Arid Grasses in each study paddock.

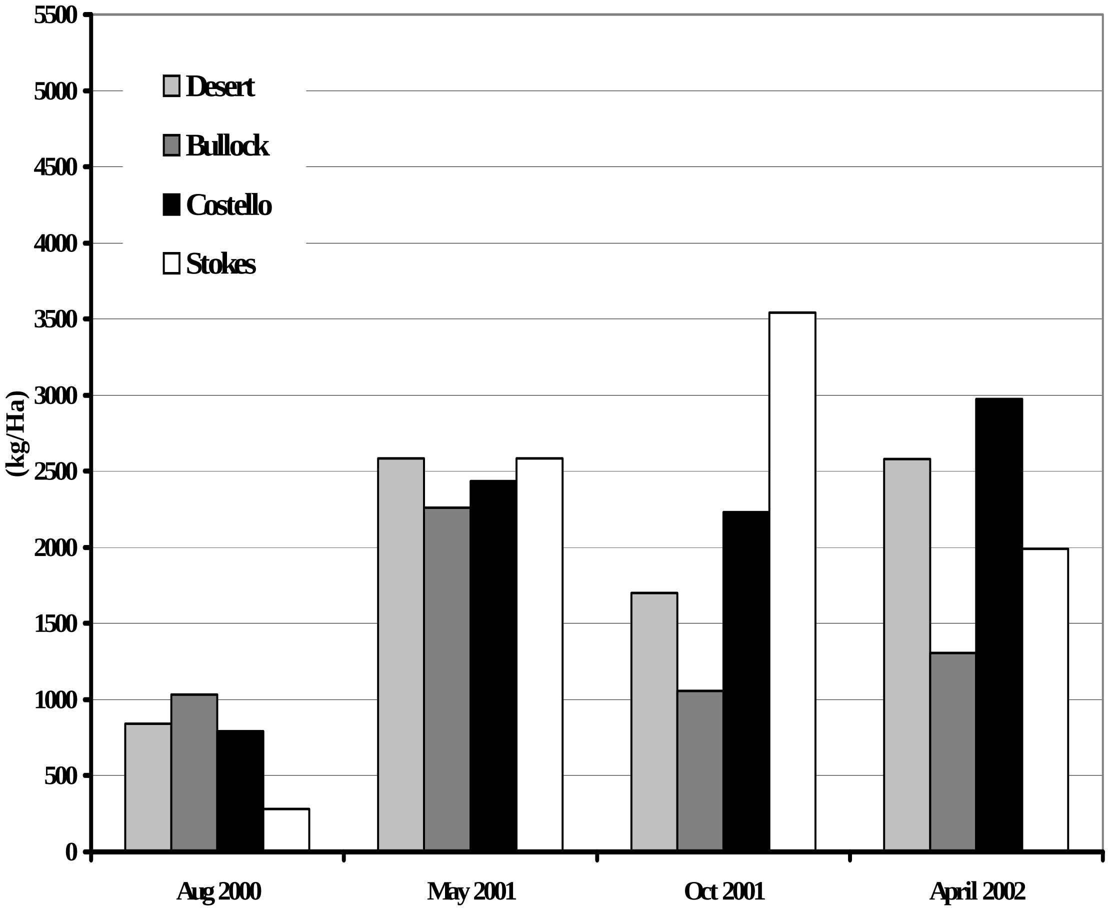


Figure 4.5: Estimation of Pasture Dry Matter in 4 paddocks over 4 years.

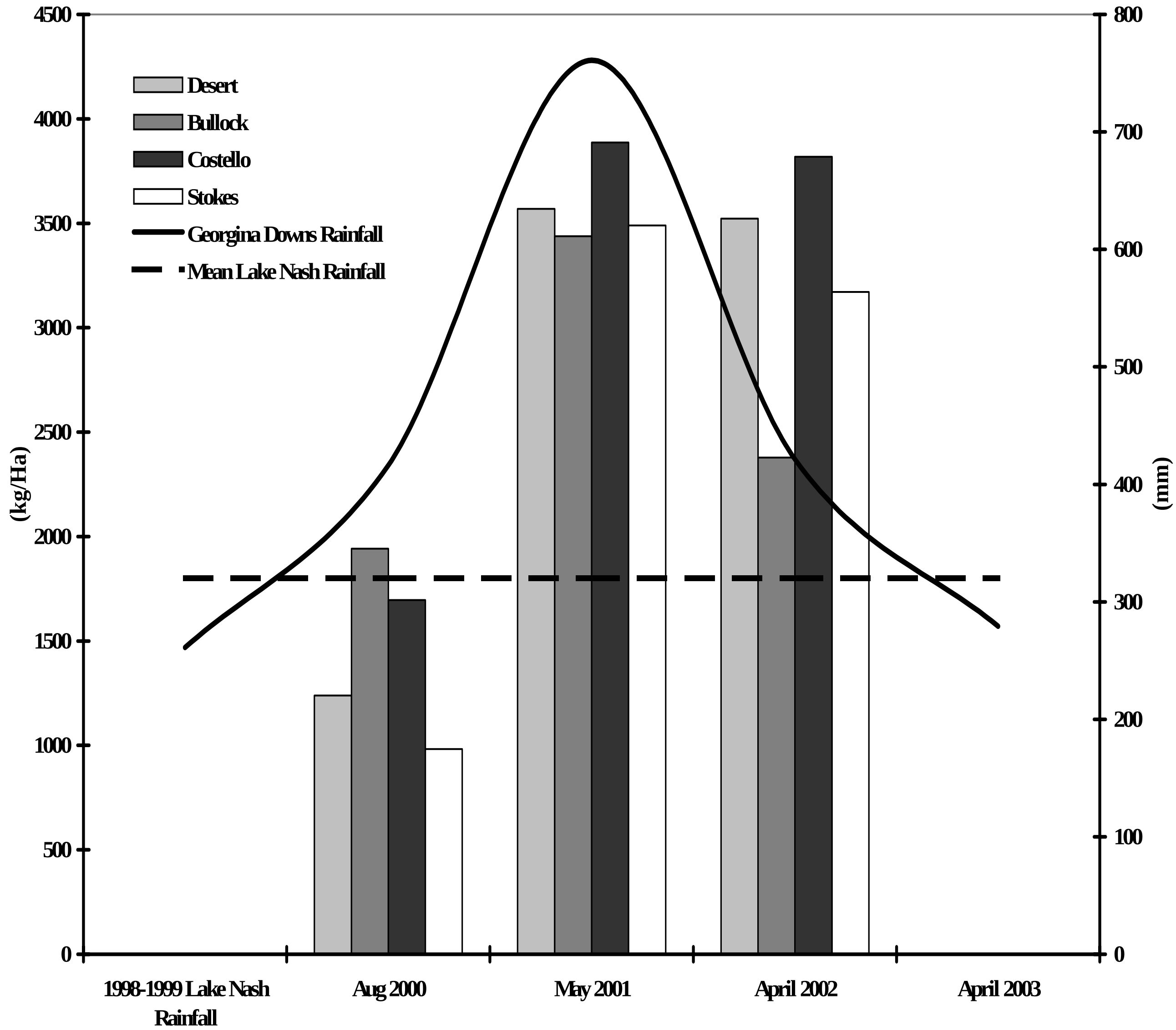


Figure 4.6: Total mean paddock biomass plotted against the rainfall recorded at number 1 bore.

4.3 Pasture and Faecal Sampling

Throughout the duration of this project, the area enjoyed above average rainfall conditions (Figures 4.1, 4.2 & 4.3). As such, pasture quality appeared to have a much greater bearing on animal performance than pasture quantity. Pasture protein and phosphorus concentration responded to timing of rainfall with pasture quality at its best in 1999/2000 (Figure 4.7). Interestingly, while the duration of good (>4% protein) pasture quality was longer in 2001, higher peaks of plant protein concentration were measured in the 1999-2000 wet season. This is thought to be a result of the excessive pasture biomass available at the end of the 2000 season, creating a 'dilution effect' on pasture nutrient concentrations.

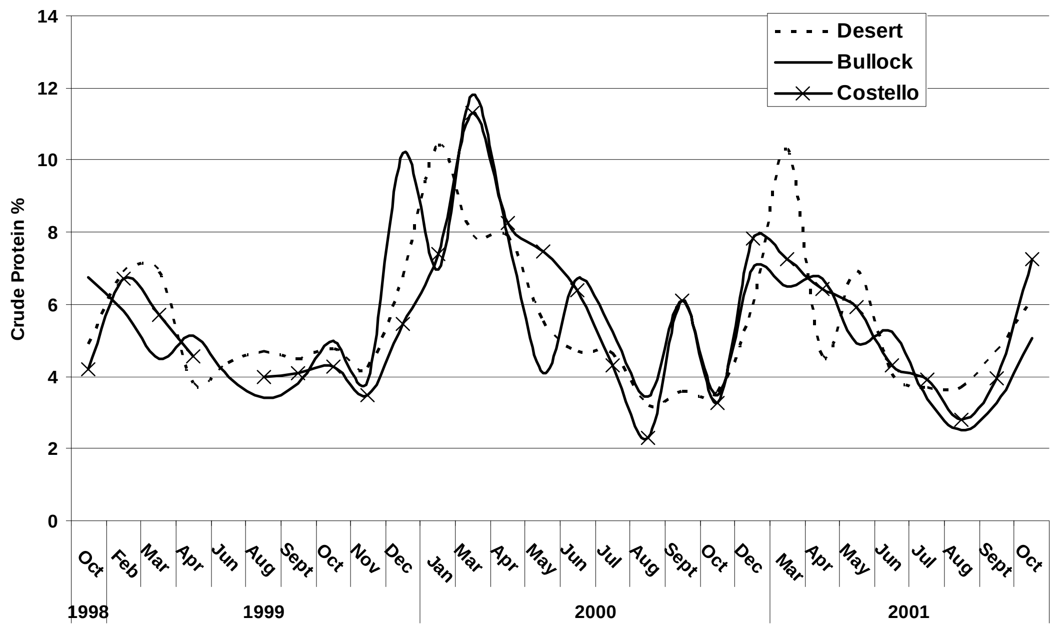


Figure 4.7: Mitchell Grass (*Astrebla pectinata*) protein content trends as measured by monthly sampling of grab samples.

Pasture quality and pasture yield followed a similar trend in all three paddocks, with Bullock paddock displaying higher faecal and pasture phosphorus levels. This paddock difference is also reflected in the pasture composition assessments, showing a higher presence (as % of pasture composition) of palatable perennial grasses in Bullock paddock than Desert and Costello paddocks.

In all three recorded seasons, pasture quality dropped to a 'base' level of below 4% protein and 0.05% phosphorus during the dry season. The duration at which pasture quality is at this level seems to be driven by timing of rainfall and may have the greatest influence on animal performance.

Faecal and pasture phosphorus levels were higher in Bullock than the other two paddocks in 1999 and 2000. Results from 2001 analysis showed a similar trend with the exception of the Flinders grass samples. Faecal and Mitchell grass phosphorus levels were generally higher for Bullock paddock as seen in previous years, but Desert and Costello paddocks retained a more consistent P level throughout the year, while Bullock dropped off in the dry season. This is possibly due to the dry season supplementation provided to Desert Paddock.

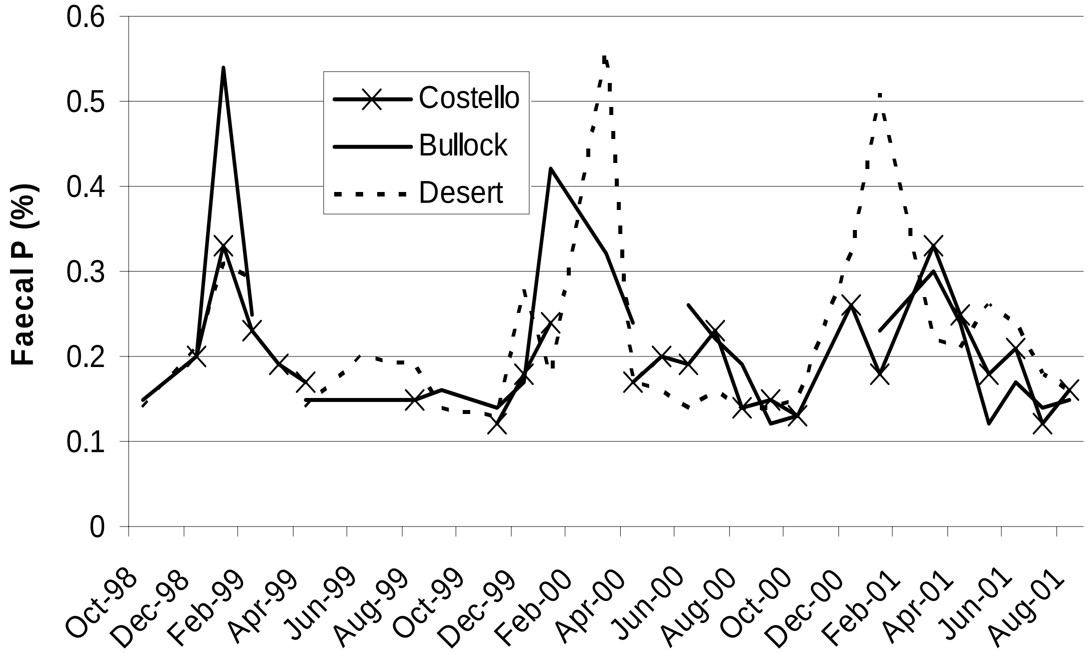


Figure 4.8: Monthly faecal phosphorus concentrations (Faecal P) for fresh samples taken from breeders in the three trial paddocks.

A similar pattern of faecal phosphorus levels and rainfall was observed in all three paddocks for 2001. As in 1999 and 2000, the lowest levels of P (0.01%) were witnessed in Oct/Nov as the storms began and consequently the highest P levels (0.3 to 0.7%) were noted in the January to March quarter after effective rainfall.

Monthly faecal nitrogen concentration appeared to be higher for Bullock paddock than Desert and Costello paddocks, however all three paddocks showed a very similar trend (Figure 4.9). The most apparent difference between 1999, 2000 and 2001 sample results is the duration of time at which faecal nitrogen concentration is below 1.3%, the level where a response to supplementation can be expected (Winks *et al.* 1976). The period of time below 1.3% faecal nitrogen concentration ranges from 6 months in 1999 to 1 month in 2001. This highlights the above-average rainfall patterns for the duration of the study and the exceptionally high rainfall for the 2001 season.

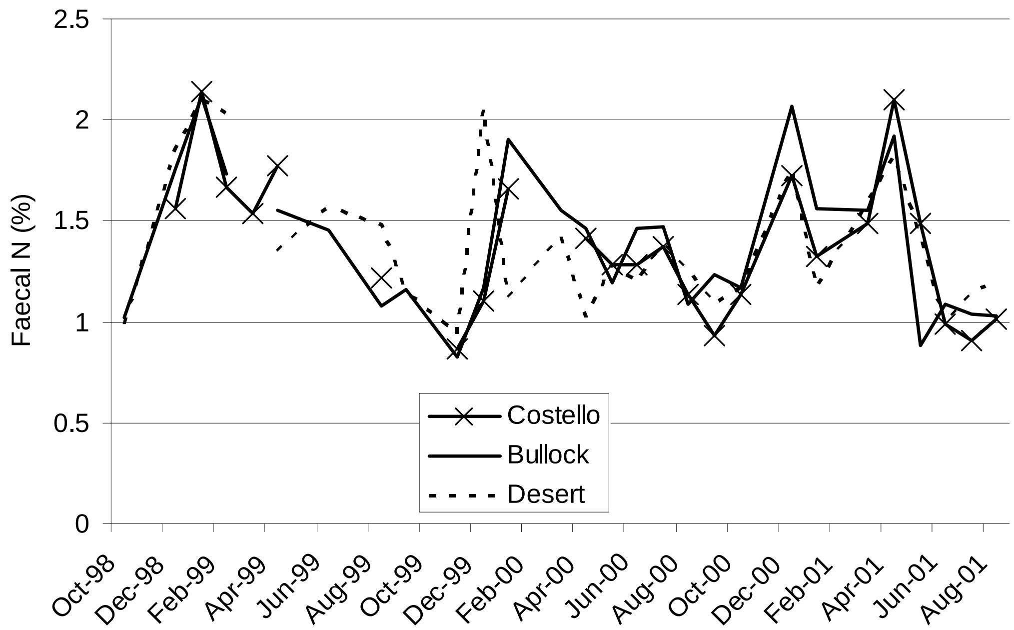


Figure 4.9 : Monthly faecal nitrogen concentrations (Faecal N) for fresh samples taken from breeders in the three trial paddocks.

Using NIRS technology, fresh dung samples were analysed to allow prediction of diet crude protein content (Figure 4.10). The trend for diet crude protein content changes is similar across the three trial paddocks although different to the pattern observed for faecal nitrogen concentration (Figure 4.9). The 'rule-of-thumb' value of diet crude protein content for cow maintenance is 6%. Figure 4.10 indicates that for approximately 6 months in 2000 and 7 months in 2001, predicted diet crude protein content was below the recommended 6%. This finding is inconsistent with the patterns observed in Figure 4.7. Prediction equations for NIRS are still in the development stage for the Barkly Tableland region and these results suggest that improvements in the accuracy diet quality predictions may be possible.

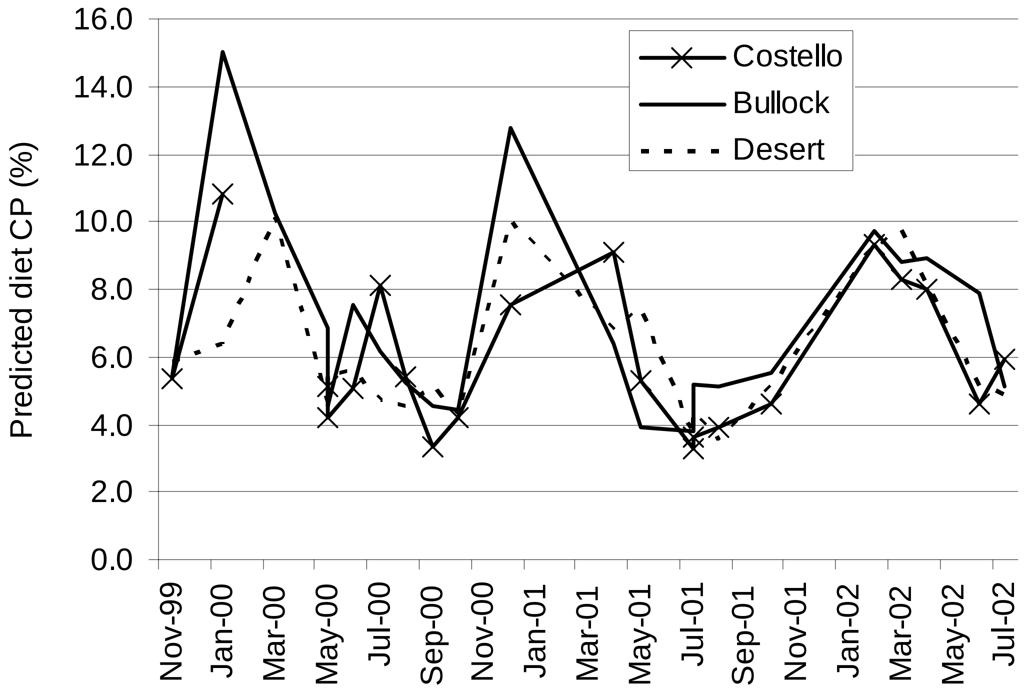


Figure 4.10 : Predicted diet crude protein content (CP) from NIRS analysis of fresh faecal samples taken from breeders in the three trial paddocks.

4.4 Livestock Measurements

4.4.1 Cow Body Condition

Costello Paddock

	13/10/98	15/5/99	24/6/00	18/9/00	20/7/01
Av. BCS of wet cows	N/A	4.8	4.6	4.9	4.7
Av. BCS of dry cows	5	5.9	6.6	5.7	7

Georgina Paddock

	15/4/1999	22/10/1999	24/5/2000	4/5/2001	5/10/2001
Ave. BCS of Wet Cows	6	4.8	4.6	4.9	4.7
Ave. BCS of Dry Cows	5	5.9	6.6	5.7	7

Desert Paddock

	15/4/99	19/10/99	21/3/00	15/8/00	4/12/00	1/5/01	7/10/01	04/05/02
Ave. BCS of Wet Cows	4.8	4.3	4.7	5.1	5.2	5.1	6.1	5.7
Ave. BCS of Dry Cows	5.9	5.9	5.7	7.1	5.6	6.6	6.6	6.6

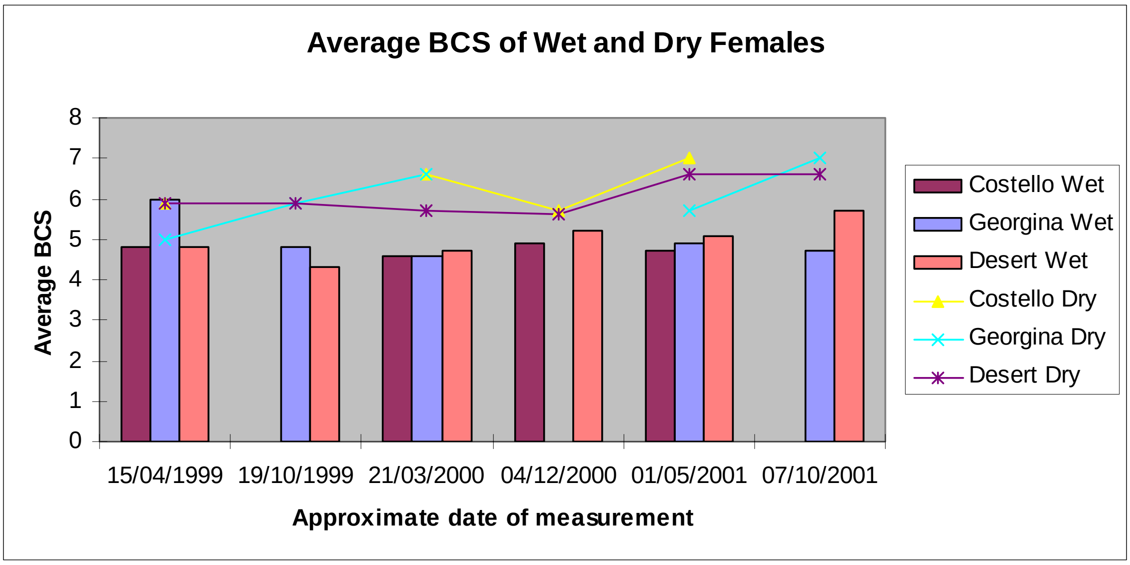


Figure 4.11: Average body condition scores of wet and dry cows for the duration of the trial

The graph depicts the changes in the condition score of the breeder groups for the duration of the trial. The differences between the groups at the start of the trial has not been able to be incorporated in the analyses.

Table 4.2: Paddock number breakdowns for 2000 to 2001 - Costello / Stokes Paddock.

Date	Paddock	Breeders	Bulls	Calves	Weaners
25/1/00	Costello	1988	76 (3.8%)	1194	139
23/6/00	Stokes	1210	0	83	1220
16/7/00	Stokes	1809	0	98	0
19/9/00	Stokes	1093	0	31	176
13/11/00	Costello	1088	27	142	0
29/07/01	Costello	1198	25	20	912
29/07/01	Stokes	1080	11	12	0
23/12/01	Costello	1080	31	12	0

The efficiency values from the breeder herd in Stokes/Costello paddocks were attempted and are shown below in table 4.3. Full details and calculations for all efficiency values are shown in App 4.

Table 4.3: Costello/Stokes efficiency values (Kgs calf weaned /100 Kgs of cow mated)

	2000	**2001**	**2002**	**Average**
Costello/Sokes	27	39	36	34

The following table (Table 4.4) is a summary of the data collection carried out in Costello Paddock since the commencement of the trial and ending in 2001. The changes in pregnancy rate correlate with lactation status and condition scores. Inter-conception intervals were calculated for individual study cows within this paddock to give an average of 380 days with 366 days being the most frequent interval across the herd. These calculations did not include those cows that had not reconceived at the last pregnancy test unless a previous result could be substituted. Therefore the result is based on the selected best breeders and is an over estimate of the real situation.

Table 4.4: Summary of data from Costello Paddock since trial commencement**.**

	13/10/98	15/5/99	24/6/00	18/9/00	20/7/01
Total Number Pregnancy Tested	215	202	169	141	142
Total Pregnancy rate	100%	57.20%	61.50%	77%	77.46%
Av. BCS	5.03	4.97	5.52	5.55	5.48
Cows lactating	0	171	87	36	95
Cows lactating & pregnant	0	101	44	15	68
Av. BCS of wet cows	N/A	4.8	4.6	4.9	4.7
Av. BCS of dry cows	5	5.9	6.6	5.7	7
Av. age at weaning (days)		150	189	184	227

4.5 Georgina Bullock paddock

A rough estimate of the efficiency values from the breeder herd in Georgina Bullock paddock are shown below in table 4.5.

Table 4.5: Efficiency values for Georgina bullock paddock (Kgs of calf weaned / 100Kgs of cow mated)

	2000	2001	2002	Average
Bullock	56	42	25	41

The following table (Table 4.6) is a summary of the data collection carried out in Bullock Paddock since the beginning of the trial. It should be noted here that at the beginning of the trial period in 1999, Bullock paddock opened with only 26 trial cows (as seen in Table 4.6). The remaining trial cattle were selected in October 1999 to give a total number of trial cattle of 228. The high lactation and pregnancy rates in May 2000 indicate that 70% of cows conceived before weaning. May 2001 figures show a lower number of cows lactating and pregnant giving a 58% pre-weaning conception.

Inter-conception intervals were calculated for individual cows, although this did not account for animals that had not reconceived or were missing at the final pregnancy test unless a previous pregnancy diagnosis could be used to calculate an appropriate interval. Therefore those selected for this calculation were actually the best in terms of reliable conception and hence the result is the optimal interval that could be achieved. The paddock average for the Bullock breeders was 397 days with 366 days being the most frequent individual interval observed.

Table 4.6: Summary of data from Georgina Bullock Paddock since trial commencement

	15/4/1999	22/10/1999	24/5/2000	4/5/2001	5/10/2001
Total Number Pregnancy Tested	26	228	207	179	150
Total Pregnancy rate	100%	15.80%	86.50%	72%	69.30%
Average BCS	6.08	4.63	5.24	5.40	6.22
No. of cows lactating	2	181	171	143	55
No. of cows lactating & pregnant	2	1	146	105	12
Ave. BCS of Wet Cows	6	4.8	4.6	4.9	4.7
Ave. BCS of Dry Cows	5	5.9	6.6	5.7	7
Ave. age at weaning (days)		229	248	222	263

Recording of weaners did not take place first round 1999.

4.6 Desert Paddock

In December 1999 there were 20 (3%) bulls and 652 cows in Desert paddock. This was reduced to 629 cows in March 2000; increased to 829 cows in July; decreased to 817 cows in August; and finally finished 2000 with 824 cows and 22 bulls. Bulls were removed from the herd on the 16 August 2000 and 22 Charolais bulls (2.7%) were returned to the herd on the 4 December 2000. The impact of Charolias infusion and the subsequent hybrid vigour on weaner weights has not been able to be quantified but would have impacted on the average weaning weights obtained.

An approximate estimate of efficiency values from the breeder herd in desert paddock are shown below in table 4.7.

Table 4.7: Efficiency values for desert paddock over trial duration (Kgs of calf weaned/ 100 Kgs of cow mated)

	2000	2001	2002	Average
Desert	12.4	40.4	23.7	26

The following table is a summary of the data collection carried out in Desert Paddock since the commencement of the trial. The changes in pregnancy rate correlate with lactation status and condition scores. The only unexplained variable is the one point increase in average BCS between the March and August 2000 musters. This is again reflected in 2001 with a one point increase in BCS however this may be due to the supplement intake of these cattle being greater than the recommended rate and a decreased number of lactating cows. Inter-conception intervals were calculated for individual animals to give an average of 377 days with most cows displaying an interval of 366 days between conceptions. As with previous paddocks this did not account for cows that still had not reconceived at the last pregnancy test unless a previous conception date could be substituted and again was based on the best breeders in the herd.

Table 4.8: Summary of data from Desert Paddock since trial commencement.

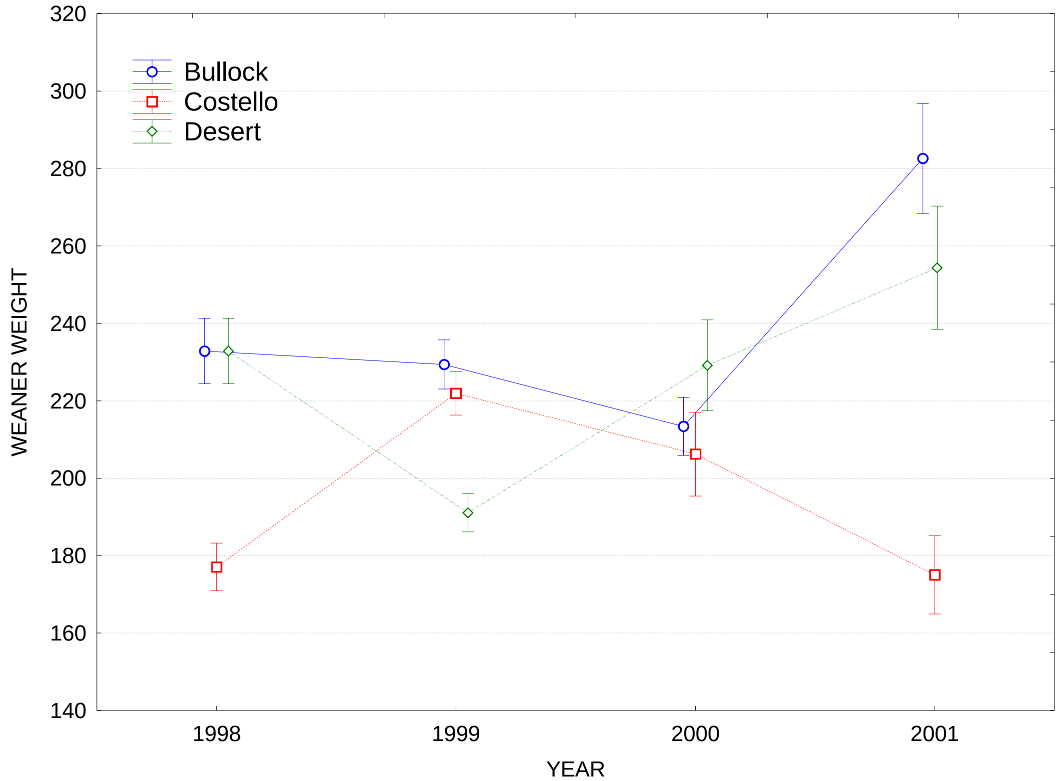
	15/4/99	19/10/99	21/3/00	15/8/00	4/12/00	1/5/01	7/10/01	04/05/02
Total Number Pregnancy Tested	101	214	197	193	172	170	128	104
Total Pregnancy rate	32.67	36.92	62.44	78.24	31.98	65.29	79.69	30.8%
Average BCS	4.91	4.56	5.41	6.45	5.33	5.39	6.54	5.8
No. of cows lactating	90	180	59	65	110	140	27	84
No. of cows lactating & pregnant	22	57	12	36	7	91	10	23
Ave. BCS of Wet Cows	4.8	4.3	4.7	5.1	5.2	5.1	6.1	5.7
Ave. BCS of Dry Cows	5.9	5.9	5.7	7.1	5.6	6.6	6.6	6.6
Ave. age at weaning (days)*				234		228	251	

*Missing values are due to no information collected relevant to these dates.

4.7 Summary of Performance Measures across all paddocks.

Table 4.9: Summary of trial paddocks descriptions and performance

	Costello/Stokes Paddock			Georgina Bullock Paddock			Desert Paddock		
	1999	**2000**	**2001**	**1999**	**2000**	**2001**	**1999**	**2000**	**2001**
Acreage (km^2)	500	500	500	290	290	290	504	504	504
Closing Cattle Numbers.	1919 (+4.4% bulls)	1088 (+2.7% bulls)	1080 (+2.8 % bulls)	933 (+3.6% bulls)	998 (+3% bulls)	702 (+3.9 % bulls)	652 (+3% bulls)	824 (+2.7% bulls)	430 (+3.2% bulls)
Stocking Rate (cow/km^2)	3.8	2.2	2.2	3.2	3.4	2.4	1.3	1.6	0.9
Class of Cattle	1st round 1999 preg weaner mums. Bulls not vacc. for vibrio or semen tested.	Bulls were remove d between June and Nov. vacc. for vibrio.		1st round heavy preg dry cows (should have calved by Dec 99)	Bulls were removed between May and Dec.		1st round 1999 cows & calves (weaned 2nd rd). Bulls removed May to Dec.	Bulls were removed August to Dec.	
Feeding Regime	No Supplement			Wet season supplement			Wet & dry season.		
Number of Times trial Cows have Been Recorded.	2 (Oct 98 & May 99)	2 (June and Sept)	1 (July)	2 (April & Oct 99)	1 (May)	2 (May & Oct)	2(April & Oct 99)	3 (March, August and Dec)	2 (May &Oct)
Closing Number of Trial cows	184	150	160	228	208	150	214	177	169
Av year of Birth in Trial cows	1994			1993			1993-1994		



(Hybrid vigour in Charolias X weaners from Desert Paddock could explain some variation)

Figure 4.12: Plot of mean weight for weaners for each paddock for all years (2002 dropped off due to low numbers)

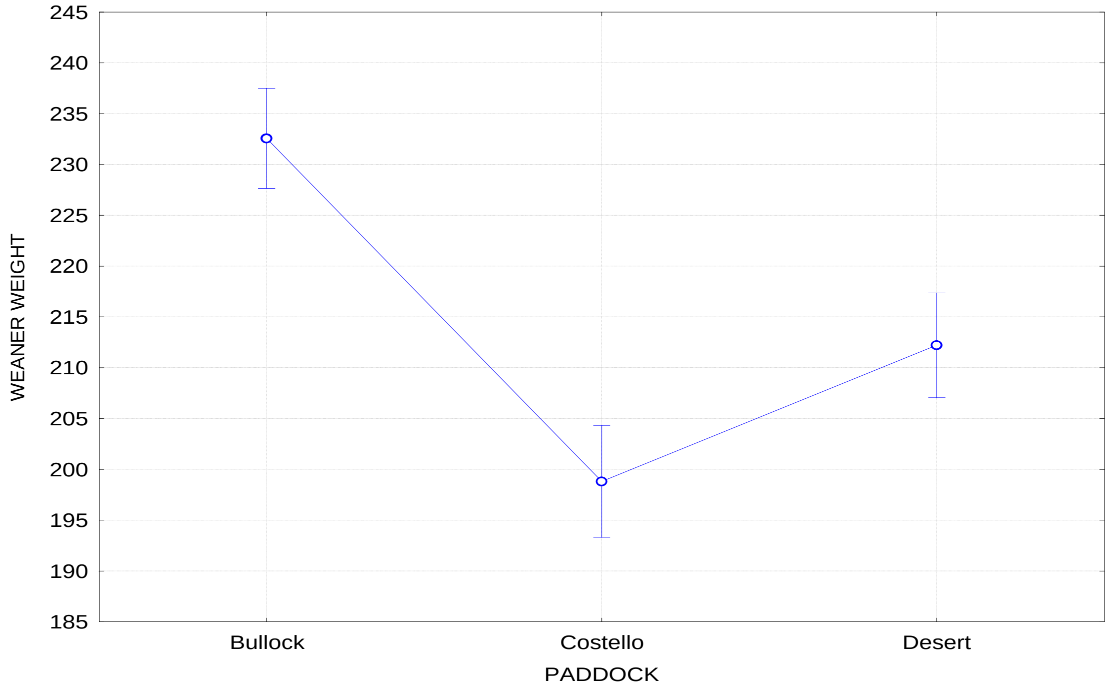


Figure 4.13: Plot of mean weaner weight for each paddock (all years combined)

4.8 Total Efficiencies across all paddocks.

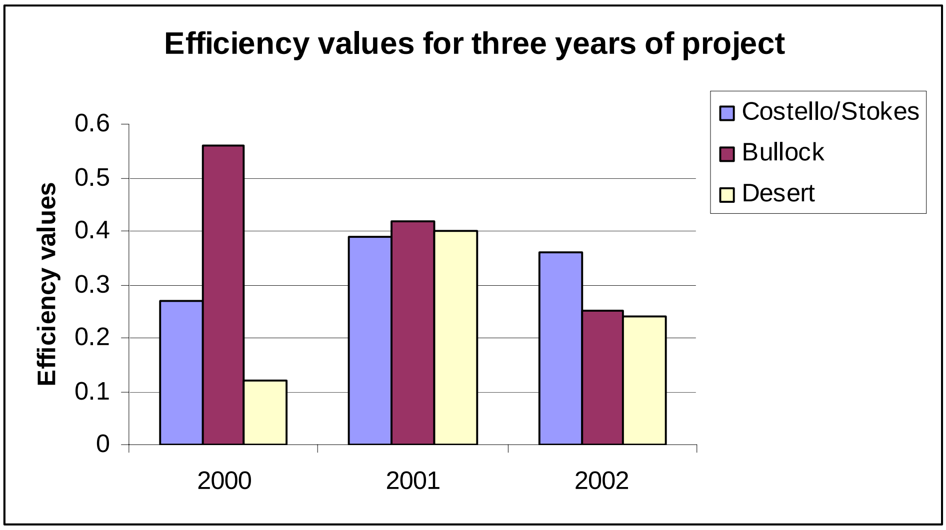


Figure 4.14: Efficiency Estimates for the 3 study groups over 3 years.

	2000	**2001**	**2002**
Costello/Stokes	26.9	38.9	35.8
Bullock	56.2	42.3	25.2
Desert	12.4	40.4	23.7

Table 4.9: Individual estimates of Breeder Cow efficiencies for each paddock over 3 years.

Costello/Stokes	Cows kg	Weaners kg	Efficiency
2000	1140060	306830	0.27
2001	540120	210600	0.39
2002	590880	212000	0.36
Average			**0.34**
Bullock			
2000	484660	272415	0.56
2001	455280	192855	0.42
2002	605760	152950	0.25
Average			**0.41**
Desert			
2000	355100	44268	0.12
2001	403200	163125	0.40
2002	379260	89997	0.24
Average			**0.26**

Table 4.10 : Table of cow and calf weights used in deriving Breeder Cow Efficiency indices.

The data above (Table 4.10) is probably of little value or relevance but has been included to show the type of calculations that may be possible if all the necessary data can be standardised and collated for such an exercise. Unfortunately the weights of the breeders at joining was not able to be collected and the weights of the breeders represents the weight of the breeders at weaning plus the weight of the cull cows sold (also at weaning).

4.9 Feeding Regime and Supplement Intakes

4.9.1 Costello/Stokes Paddock

Pasture – no supplementation supplied.

4.9.2 Georgina Bullock Paddock

On the 1st December 1999, 1900 kg of Ridley Maxibreed blocks were distributed. Due to the exceptional wet season no blocks were distributed in the 2000-2001 wet until it started drying out in March 2001.

On the 12th March 2001, 3600 kg of Ridley Maxibreed blocks were distributed. These were consumed by an average of 804 cows at a rate of 298 g/hd/d, which is 198g greater than recommended.

4.9.3 Desert Paddock

During 2000 dry season supplement with Ridley Custom Mix and wet season supplement with Ridley Maxibreed blocks were fed.

On December 1st 1999, one tonne of Maxibreed blocks was distributed in Desert Paddock. A further 1500 kg were added between May and June 2000 and 1200 kg on 5 July 2000. Therefore, between December 1999 and July 2000, an average of 640 cows consumed 2500 kg of Maxibreed (23 g/hd/d). Between the 5th and 28th July, an average of 730 head consumed 1200 kg Maxibreed (72 g/hd/d). Between July and October 2000 6180 kg of custom mix was consumed by approximately 820 cows (82 g/hd/d). Due to the exceptional season and the poor consumption over the previous wet season, there were no wet season blocks distributed in Desert paddock in late 2000.

On 12 March 2001 3500 kg of Ridley Maxibreed Blocks were distributed. On 1/8/2001 3280 kg of Ridley Custom Mix was added and 1000 kg on 26 September 2001. This was followed in November by the distribution of 360 kg of Custom Mix on the 13th and 1280 kg on the 23rd. In March 2001, an average of 678 cows consumed 3500 kg of Maxibreed at 344 g/hd/d, which is 244 g above the recommended rate.

Between August and November 2001, approximately 863 cows at an averaged rate of 50 g/hd/d consumed a total of 5290 kg of Custom Mix.

Very little valuable information could be gained from analysis of the supplement consumed. In relation to breeder cow productivity.

4.10 Results of Reproductive Disease Investigation

Overall seroconversions resulting from blood sampling since 1999 are described in the following table (Table 4.11). A seroconversion was determined as a positive to the serological test where the animal previously tested negative. A small number of animals reverted to negative on test and subsequently tested positive (especially BVD). These changes in serological reaction were included as seroconversions.

The denominators used in columns of *Leptospira* serovars and IBR indicate the number of heifers tested. Because of resource and cost implications, only 40 cows were tested in the first round of testing followed by these same cows in the first muster round in 2000. Subsequent to these testing rounds, all samples collected were tested.

Table 4.12 shows raw data by cross tabulating reproductive intervals against categories of reproductive incident and seroconversion. A number of reproductive intervals would be included for the same animal. It is assumed that animals with previous seropositive tests become immune for the subsequent interval against the infectious agent. These intervals are included as negative seroconversions. Testing differences within three sets of seroconversions (of diseases producing sufficient data) showed no difference between reproductive incidents calculated from true negative tests and those that had seroconverted on a previous occasion.

Table 4.11 : Results from blood sampling from 1999 to 2002

Date		lab no.	Stock sampled	Blu	BVD	AKA	BEF	Lepto hardjo	Lepto pomono	Lepto tarassovi	IBR
15/04/99	1st muster 1999		0								
19/10/99	2nd muster 1999	99/1964	100	0	99	0	47	2/40	0/40	0/40	36/40
21/03/00	1st muster 2000	00/517	88	3	0	34	20	1/33	0/33	0/33	2/33
15/08/00	2nd muster 2000		0								
4/12/00	3rd muster 2000	00/2307	93	0	1	14	16	6/93	0/93	2/93	44/93
1/05/01	1st muster 2001	01/977	66	0	0	3	3	2/66	0/66	1/66	0/66
7/10/01	2nd muster 2001	01/1917	67	0	2	9	4	3/67	0/67	2/67	5/67
04/05/02	1st muster 2002	02/0602	55	0	2	11	2	0/55	0/55	0/55	2/55

Table 4.13 illustrates the statistical calculations to calculate Relative Risk (or Odds Ratio) and significance testing to determine the influence of infectious agent exposure on reproductive incident. A strong association occurred for both BVD and IBR when sero positives were included where it was unclear whether seroconversions had occurred during the preceding interval.

Of greater interest was the influence of Akabane seroconversion on reproductive incidents. Table 4.13 indicates that the risk of reproductive incidents is actually halved when these cows seroconverted to Akabane virus. Table 4.14 demonstrates the effect seroconversion to Akabane virus has on the subsequent reproductive interval, highlighting the delayed effects of congenital abnormalities by increasing risk of losses by a factor of two.

40 bulls were sheath scraped for Vibrio or Trich culture samples on the 9 November 1999. No *Campylobacter fetus* was cultured but 12 bulls were culture positive for *Tritrichomonas foetus*. Five of fifteen cows sampled with vaginal swabs were positive to the Vibrio IgA ELISA.

Table 4.12

Reproductive Performance Cross - Tabulation

Bluetongue

	Positive, could have been seroconversion	Sero - conversion	Sero - converted Earlier (Negative)	Negative	Total
Aborted	0	0	0	17	17
Aborted or Calf loss	0	0	1	9	10
Conception failure	0	0	0	58	58
Normal	0	3	5	287	295
Total	0	3	6	371	380

BVD

	Positive, could have been seroconversion	Sero - conversion	Sero - converted Earlier (Negative)	Negative	Total
Aborted	5	0	12	0	17
Aborted or Calf loss	0	1	9	0	10
Conception failure	18	0	39	1	58
Normal	16	4	271	4	295
Total	39	5	331	5	380

Akabane

	Positive, could have been seroconversion	Sero - conversion	Sero - converted Earlier (Negative)	Negative	Total
Aborted	0	1	4	12	17
Aborted or Calf loss	0	2	1	7	10
Conception failure	1	4	9	44	58
Normal	5	55	50	185	295
Total	6	62	64	248	380

Bovine Ephemeral Fever

	Positive, could have been seroconversion	Sero - conversion	Sero - converted Earlier (Negative)	Negative	Total
Aborted	2	1	7	7	17
Aborted or Calf loss	0	3	6	1	10
Conception failure	10	4	29	15	58
Normal	8	35	159	93	295
Total	20	43	201	116	380

Leptospira interrogans var hardjo

	Positive, could have been seroconversion	Sero - conversion	Sero - converted Earlier (Negative)	Negative	Total
Aborted	0	0	1	13	14
Aborted or Calf loss	0	0	2	6	8
Conception failure	2	1	0	41	44
Normal	3	6	8	221	238
Total	5	7	11	281	304

Leptospira interrogans var pomono

	Positive, could have been seroconversion	Sero - conversion	Sero - converted Earlier (Negative)	Negative	Total
Aborted	0	0	0	14	14
Aborted or Calf loss	0	0	0	8	8
Conception failure	0	0	0	44	44
Normal	0	0	0	238	238

Table 4.13

Risk of Reproductive Incident associated with Seroconversion

Bluetongue

	Positive, could have been seroconversion	Sero - conversion	Negative or seroconverted earlier	Total
Reproductive incident	0	0	85	85
Normal	0	3	292	295
Total	0	3	377	380

	total sero - conversions	recent sero - conversions only	
OR	0	0	OR
Conf Int	0<OR>7.83	0<OR>7.83	Conf Int
Fishers Ex	1	1	Fishers Ex

BVD

	Positive, could have been seroconversion	Sero - conversion	Negative or seroconverted earlier	Total
Reproductive incident	23	1	61	85
Normal	16	4	275	295
Total	39	5	336	380

	total sero - conversions	recent sero - conversions only	
RR	3	1.1	RR
Conf Int	2.11<RR<4.27	0.19<RR<6.45	Conf Int
Chi Sqr	29.67		
p - value	0.0000001	1	Fishers Ex

Akabane

	Positive, could have been seroconversion	Sero - conversion	Negative or seroconverted earlier	Total
Reproductive incident	1	7	77	85
Normal	5	55	235	295
Total	6	62	312	380

	total sero - conversions	recent sero - conversions only	
RR	0.48	0.46	RR
Conf Int	0.24<RR<0.94	.22<RR<.94	Conf Int
Chi Sqr	5.36	5.32	Chi Sqr
p - value	0.02	0.021	p - value

Bovine Ephemeral Fever

	Positive, could have been seroconversion	Sero - conversion	Negative or seroconverted earlier	Total
Reproductive incident	12	8	65	85
Normal	8	35	252	295
Total	20	43	317	380

	total sero - conversions	recent sero - conversions only	
RR	1.55	0.91	RR
Conf Int	1.02<RR<2.36	0.47<RR<1.76	Conf Int
Chi Sqr	3.82	0.08	Chi Sqr
p - value	0.05	0.771	p - value

Leptospira interrogans var hardjo

	Positive, could have been seroconversion	Sero - conversion	Negative or seroconverted earlier	Total
Reproductive incident	2	1	63	66
Normal	3	6	229	238
Total	5	7	292	304

	total sero - conversions	recent sero - conversions only	
RR	1.16	0.66	RR
Conf Int	0.42<RR<3.16	0.11<RR<4.12	Conf Int
Fishers Ex	0.73	1	Fishers Ex

Leptospira interrogans var pomono

	Positive, could have been seroconversion	Sero - conversion	Negative or seroconverted earlier	Total
Reproductive incident	0	0	66	66
Normal	0	0	238	238
Total	0	0	304	304

	total sero - conversions	recent sero - conversions only	
	exposure row totals 0		

Leptospira interrogans var tarassovi

	Positive, could have been seroconversion	Sero - conversion	Negative or seroconverted earlier	Total
Reproductive incident	0	1	65	66
Normal	1	2	235	238
Total	1	3	300	304

	total sero - conversions	recent sero - conversions only	
RR		1.54	RR
Conf Int		0.31<RR<7.73	Conf Int
Fishers Ex		0.523	Fishers Ex

Infectious Bovine Rhinotracheitis

	Positive, could have been seroconversion	Sero - conversion	Negative or seroconverted earlier	Total
Reproductive incident	26	1	39	66
Normal	30	7	201	238
Total	56	8	240	304

	total sero - conversions	recent sero - conversions only	
RR	2.6	0.77	RR
Conf Int	1.73<RR<3.90	0.12<RR<4.92	Conf Int
Chi Sqr	20		
p - value	0.0000077	1	Fishers Ex

Table 4.14

The Risk of Incidents occurring in Subsequent Reproductive Intervals following Seroconversion to Akabane Virus.

Akabane

	Seroconverted Previous Period	Negative Previous Period	Total
Reproductive incident	17	50	67
Normal	39	242	281
Total	56	292	348

RR	1.77
Conf Int	1.11<RR<2.84
Chi Sqr	5.29
p - value	0.02

5 Discussion

Throughout the duration of this project, annual rainfall exceeded average rainfall for Lake Nash Station and in 2000 was one of the highest rainfall records in over 100 years. As a result, the quantity of available pasture was plentiful (average biomass >3000 kg/ha). Pasture composition was recorded annually for the presence of palatable perennial, annual and forb species in two plant communities (Arid short grasslands and Mitchell grasslands).

All three paddocks were dominated by palatable perennial grasses (mostly *Astrebla* spp.). The most obvious difference in pasture composition was seen in Bullock paddock, with low annual grass content (25% – 43%) in its short arid grassland communities compared with Desert (65% - 88%) and Costello paddocks (63% - 79%). Bullock paddock appeared to support a higher composition of palatable perennial grasses than the other two paddocks.

2001 saw a marked increase in total pasture biomass in all trial paddocks. Two consecutive above average wet seasons during the trial period and a short dry season would have resulted in the pasture condition remaining high at the end of 2000, allowing the pasture to build upon this biomass during the 2000-2001 wet season.

Pasture quality was measured monthly when possible as a function of nitrogen and phosphorus concentration. Plant dry matter digestibility was also measured. While the general pattern of pasture quality changes was similar between the three study paddocks, nitrogen and phosphorus concentrations appeared higher in Bullock paddock. This finding was supported by measurement of monthly faecal samples for phosphorus and nitrogen concentration that were analysed using wet chemistry methods.

Faecal samples were also analysed using NIRS (Near Infra-Red Reflectance Spectroscopy) technology to predict diet crude protein content. Wet chemistry analysis showed some important changes in faecal nitrogen levels between seasons that appear to be driven by the timing of rainfall events. The duration of time at which faecal nitrogen levels were below 1.3% (the point where a response to supplementation can be expected) was different between years, ranging from 6 months in 1999 to 1 month in 2001. This has significant implications for supplementation management. These changes as measured by faecal nitrogen sampling were inconsistent with predictions of diet crude protein. This is not a surprising outcome as NIRS prediction equations specific for the Barkly Tableland pasture communities are yet to be developed.

Breeding herd performance records were collected from three herds of Santa Gertrudis cattle running in paddocks adjacent to each other in the Georgina Downs area of Lake Nash Station. As mentioned above briefly and discussed earlier in further detail, quality of available herbage between the paddocks was not uniform. This coupled with the absence of replication of paddocks means that statistical comparison of animal performance between paddocks is inappropriate. However, investigation of the arithmetic means for certain animal performance measures is considered a worthwhile exercise. Trends in animal performance and attempts at average levels of breeding efficiency are undocumented for this area of northern Australia.

The mean body condition of breeders in all three paddocks was the same (BCS = 5; using a nine-point scale). A noticeable trend was observed for the body condition of lactating cows and mean weaning weight between the three paddocks. In particular, the two supplemented paddocks, Georgina Bullock paddock and Desert paddock showed a pattern where lactating breeders recorded higher body condition (Georgina Bullock = 5; Desert = 5.1) than the non-supplemented paddock (Costello = 4.7). Mean weaning weights between the paddocks displayed the same trend, with Georgina Bullock and Desert paddocks measuring 222 kg and 219 kg respectively, while mean weaning weight for Costello paddock was 196 kg.

An 'efficiency' calculation for evaluating the performance of a breeding herd has been used in the presentation this report. The formula for the 'efficiency' rate is:

Efficiency = kg of turn-off (weaners) / 100 kg of breeders joined.

A summary of an estimate of the efficiency for the three paddocks studied is presented below but the large variation between years suggests that further refinement is still required before it can be applied across different herds and different stations. Furthermore, the weight of the cows at weaning was used in the calculations, not the weight of the cows at joining. Because of cows missing in the trial and some mortalities, it does not accurately reflect the intent of the original formula.

	2000	2001	2002	Average
Costello/Stokes	27	39	36	34
Bullock	56	42	25	41
Desert	12	40	24	25

5.1 Efficiency

The control (no supplement provided – Stokes/Costello paddock) and two differing treatments (wet season supplementation – Georgina Bullock Paddock & both wet and dry season supplementation – Desert Paddock) all showed different efficiency but the variation in paddocks and the good seasonal conditions did not allow any meaningful assessment of supplementation regimes.

The wet season supplemented herd has shown the best breeding herd efficiency average values while the wet and dry season supplemented herd has shown the lowest efficiency average values. However, this is more a reflection of the paddock than the supplementation strategy as it was originally the designated bullock paddock on Georgina Downs. The control herd (unsupplemented) has shown average efficiency values lower than the wet season supplemented herd and higher than the wet and dry season supplemented herd. These results may be affected by the variable pasture quality among the paddocks and also as a result of the changed grazing strategy that resulted from the gidyea poisoning incidences.

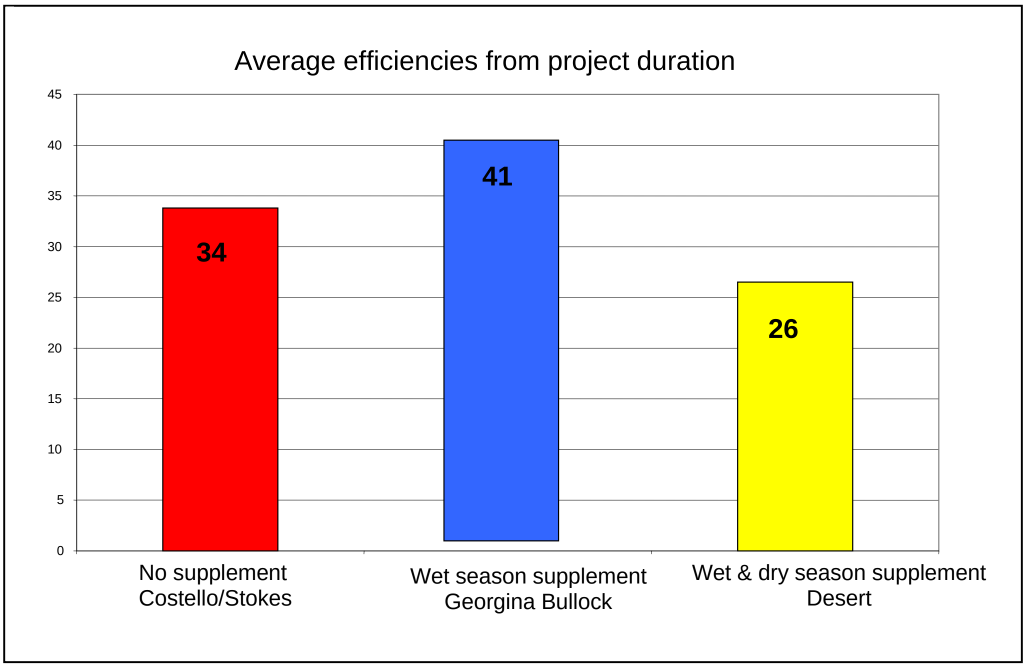


Figure 4.15 : Average efficiencies for each paddock over project duration

Moving cattle between Stokes and Costello to reduce the effect of gidyea poisoning resulted in this herd being managed under rotational grazing rather than the continuous grazing strategy experienced in the other two herds for the duration of the trial.

5.2 Supplement Intake

Both herds on supplement consumed greater than the recommended rate when supplement was distributed in March 2001.

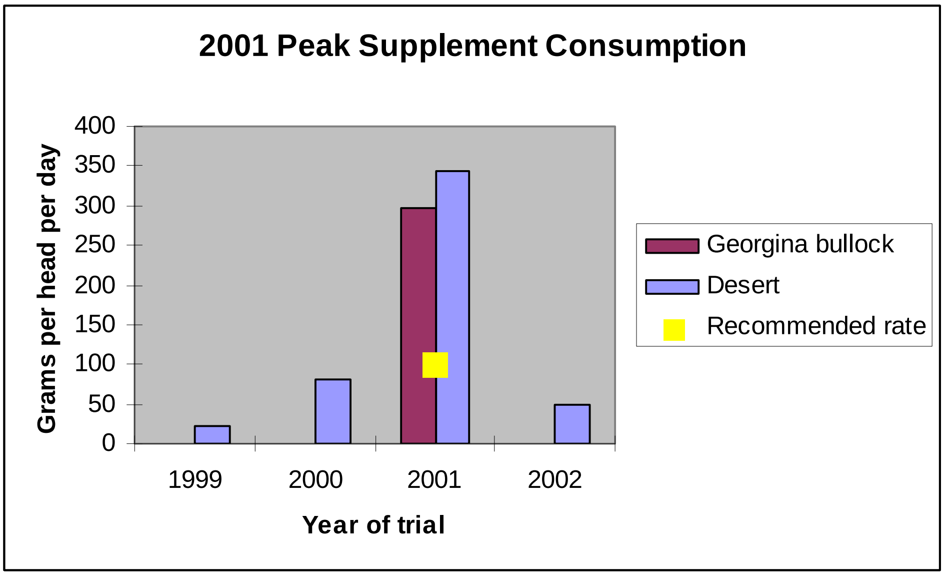


Figure 4.16: Graph showing the peak consumption of wet season supplement

6 Success in Achieving Objectives

- Objective 1:- Measuring and reporting on the effect of dry season and wet season supplementation on breeding herd efficiency (kg of calf weaned per 100 kg cow mated) for the duration of the project at Lake Nash Station, Barkly Tableland.

Pasture and animal production parameters were measured and are reported for the duration of the trial. Breeder Cow Efficiency Indices were calculated for each of the herds for the duration of the trial. This is a first attempt at such an index and it was difficult to get the weight of the cow joined. Weight of cow at weaning was used in the calculation but this does not accurately reflect the numbers at the time of mating. It was obvious from the variation of the results between and within herds and years that further work needs to be directed at defining the parameters actually being measured. Furthermore, the addition of the weight of cull fat cows in the index would tend to drive the index down and this would not accurately reflect accurately the profitability of the operation.

- Measuring and reporting on supplement intake, pasture crude protein, phosphorus and in-vitro digestibility, faecal phosphorus and crude protein levels and cow body condition monthly for the duration of the project and analysing the relationship between each

Supplement intake, pasture crude protein, phosphorus and in vitro digestibility, faecal phosphorus and crude protein and body cow condition were recorded monthly for the project.

- Sampling three breeding herds and reporting the presence of disease known to affect reproductive performance in bulls and/or cows for the duration of the project

Sampling of designated breeding animals occurred over the duration of the trial and the prevalence and significance of all common reproductive diseases were recorded. It should be noted that this was a very favourable period for arbo viruses (such as Ephemeral Fever, Bluetongue and Akabane Disease) in the breeding herd and the data obtained would probably represent a worst case scenario for these insect borne diseases.

- Assessing and reporting on rangeland condition, the nutritional value of herbage samples and the pattern and amount of rainfall in three paddocks grazed by breeding cattle

Pasture assessments were recorded regularly over the duration of the trial but because of the good seasons, stocking rates and pasture utilisation were not major areas of concern.

7 Impact on Meat and Livestock Industry – now & in five years time

This trial will not have a major impact on the Meat and Livestock industry. It is 5 years since the trial was completed and due to unforeseen circumstances such as staff resignations, ambiguity in interpretation of data and at times inaccurate pregnancy diagnosis the results are not totally reliable per se and it has been 5 years getting the report finalised. However, the methodology and approach to pasture sampling and the attempt at deriving a breeder cow index should lay the foundation and pave the direction for future work in northern Australia. The results on losses due to abortion are quite sound and should provide confidence to industry in this area as to any future herd health programs that may be implemented.

8 Conclusions and Recommendations

This trial has highlighted some of the pitfalls in attempting to undertake “on farm” research. Loss of cattle, loss of data and even events such as Gidyea poisoning all compromise the outcomes achieved. This does not mean that such projects should not be considered in the future but it does mean that contingency plans and careful planning needs to occur prior to embarking on such work. It is only when ‘on farm’ research gets applied that some of these problems actually get identified. This trial has not been able to improve on recommendations as to what and when to supplement. It has however laid the framework for using technologies such as NIRS to assess pasture quality as well as even simple tools like effective rainfall, pasture quantity (biomass) and length of dry season to provide a framework for better decision making in supplementation. For instance, in some exceptional seasons and in some paddocks/regions, the need to provide supplement to breeder cows may be only be necessary for 1 month. The breeder cow efficiency index is a good concept and once all the inputs and outputs can be measured and included, it will ensure that producers have a very useful means to measure the efficiency of their breeding cow operation between paddocks and between herds. By definition it is the weight of weaners produced over the weight of each 100Kgs of cows mated however, even in this project, the weight of the cow at weaning was used and not the weight of the cow mated. This method of calculating the formula means that it does not incorporate any cows that are lost between joining and weaning i.e. mortality rates. Finally, the data on reproductive performance will provide a very good bench mark for the level of reproductive disease present on the Barkly Tableland at the turn of the century. Disease prevalence can change with season, climate and virulence of the infective agent, therefore any accurate assessment at a particular point in time will not only be relevant to decisions made at that time but also in future studies on any of the particular diseases in question.

Recommendations are to encourage stations to use the full range of tools available to assess feed availability and timing and amount of supplement. Also the breeder Cow Efficiency Index needs to be further refined and developed as a bench mark to assess reproductive performance in northern Australian herds.

9 Bibliography

Allan P.J. Denett D.P. and Johnson R.H. (1975) “Studies on the effects of Infectious Bovine Rhinotracheitis Virus on reproduction in heifers” *Australian Veterinary Journal,* 51: 370-374.

Andrews L. (1972) “The major Non-infectious Causes of Reproductive Wastage in Beef Cattle in the Northern Territory” *Australian Veterinary Journal,* 48***.***

Andrews L.G. (1976) *Reproductive Performance of Beef Cattle in the Northern Territory*, Masters Thesis, James Cook University, Townsville, Queensland.

Ash J. and McIvor J.G. (1995) "Land condition in the tropical tallgrass pasture lands. 2. Effects on herbage quality and nutrient uptake" *Rangeland Journal,* 17 (1), 86-98.

Atkinson R.A. Cook R.W. and Reddacliff L. (2000) "Seroprevalence of *Neospora caninum* infection following an abortion outbreak in a New South Wales Dairy Herd" *Australian Veterinary Journal,* 78.

Baker R.L. Carter A.H. (1976) “Influence of breed and crossbreeding on beef cow performance” *Proceedings of the Ruakura Farmers Conference,* pp. 39-44.

Beveridge W.I.B. (1983) “Bacterial Diseases of Cattle, Sheep and Goats*” Animal Health in Australia,* Vol. 4.

Beveridge W.I.B. (1981) “Virus Diseases of Farm Livestock” *Animal Health in Australia,* Vol. 1.

Black P.F. *et al.* (2001) “Prevalence of Antibodies To Leptospira Serovars In Beef Cattle In Central Queensland” *Australian Veterinary Journal,* 79, No.5, May 2001

Braithwaite I.D. & deWitte K.W. (1999) "Strategies to Optimise Beef Cattle Production in North Australia" *Proceedings of the Australian Association of Cattle Veterinarians,* Hobart, 16-21st May 1999, pp 232 – 249.

Brown A.T. Schlink A. & Carpenter M. (1994)" Production Parameters of Brahman Cross Cattle in the Gulf Area of the NT over 5 Years" *Technical Bulletin No.217*, Department of Primary Industry and Fisheries.

Brown A.T. (1998) "Production Parameters of a Barkly Breeding Herd", *Technote No. 100*, Department of Primary Industry and Fisheries.

Christian *et al.* (1947-1948) *Land Systems of the Barkly region*. CSIRO, Alice Springs, NT.

Entwistle K.W. (1983) *Factors Influencing Reproduction in Beef Cattle in Australia*, AMRC Review No.43.

Ford G. (1992) "Mitchell Grass (Astrebla spp) Pasture Dynamics on the Barkly Tableland, Northern Territory: comparison of a long term study with research in Queensland" *Technote*, Alice Springs.

Fordyce G. and Cooper N. (1997) "Breeder Herd Management and Production" *Swans Lagoon Research Report*, QBII, pp 5 -17.

Herd D.B. and Sprott L.R. (1996) *Body condition, nutrition and reproduction of beef cows*, Texas A&M University.

Holroyd R.G. (1980) "Leptospira interrogans var hardjo Vaccination of Pregnant Beef Cows and Subsequent Growth Rate of Progeny" *Australian Veterinary Journal.*

Holroyd R.G. (1981) *Australian Advances in Veterinary Science,* p 176.

Holroyd R.G. (1987) "Foetal and Calf Wastage in *Bos indicus* Cross Beef Genotypes" *Australian Veterinary Journal,* 64.

Holroyd R.G. *et al.* (1979) "Reproductive Performance of Beef Cattle in North Western Queensland" *Australian Veterinary Journal,* 55.

Holt R.M. and Bertram J.D. (1980) *The Barkly Tableland Beef Industry*, Department of Primary Production, Northern Territory Division of Agriculture and Stock.

Hum S. Quinn C. and Kennedy D. (1994) "Diagnosis of bovine venereal campylobacteriosis by ELISA" *Australian Veterinary Journal,* 71, pp 140-143.

Hungerford T.G. (1990) *Diseases of Cattle: Abortion in Diseases of Livestock*, pp 204 – 206.

Landman J. and Taylor L. (2003) *Investigation of the prevalence of Neospora caninum in Queensland Beef Cattle*, Project ATTW.013 Final Report to MLA.

Lyons R.K. and Stuth J.W. (1992) "Faecal NIRS equations for predicting diet quality of free-ranging cattle" *Journal of Range Management,* 45, pp 238-244.

MacDonald N. *et al.* (1997) *Mt Sanford Project Pasture Trends and Calving Patterns* 1993-1996 DPIF Report 97/1, NT.

Norman S.T. *et al.* (2002) "The Identification and Management of Reproductive Diseases of Bulls" *Bull Fertility : Selection and Management in Australia,* Australian Association of Cattle Veterinarians Conference Darwin, July, 2002

Sullivan R.M. and O'Rourke P.K. (1997) "A comparison of once and twice yearly weaning of an extensive herd in northern Australia" *Australian Journal of Experimental Agriculture,* **37**, pp 279 – 286.

Wilson B.A. Brocklehurst P.S. Clark M.J. and Dickinson K.J.M. (1991) *Vegetation Survey of the Northern Territory*, Conservation Commission of the Northern Territory, Palmerston, NT.

Winks L. Laing A.R. Wright G.S. and Stokoe J. (1976) "Effect of nitrogen, phosphorus and molasses supplements on the performance of weaner cattle during the dry season in North Queensland" *Journal of the Australian Institute of Agricultural Science,* 42, pp 246-251.

10 Appendices

10.1 Appendix 1

Body condition scoring system used for the study

Body Condition Score (BCS)

All assessments for this project are gauged on a nine-point scale.

One Emaciated

Extremely weak and has difficulty standing or walking. No filling in the brisket. Short ribs can be easily felt or seen and are very angular. No muscling between hooks and pins. Each individual long rib can be easily felt behind the shoulder. No visible/palpable fat cover. Appearance is that of an easily visible skeleton or "bony" animal

Two Poor

Able to stand and walk. No filling in the brisket. Short ribs can be easily felt or seen but are not as obvious as BCS 1. Almost no muscling between hooks and pins. Each individual long rib can be easily felt behind the shoulder. No visible fat cover. Appearance is that of an easily visible skeleton.

Three Backward Store

No filling in the brisket. Short ribs can be easily felt or seen and have very little roundness, they feel blunt. Easily visible long ribs and spinal process. Very visible or palpable muscling between hooks and pins. No filling in flank. Appears very gaunt looking but is more stable than previous scores.

Four Store

Some filling in brisket. Short ribs can be easily felt, but are slightly rounded. Spinal process still clearly defined. Some muscling between hooks and pins but not rounded. Fore ribs are not noticeable, but rear ribs are noticeable. Light muscling over skeleton.

Five Good Store

Average filling in brisket. Short ribs can be felt with a little pressure and feel well rounded. Hips, hooks and pins can still be seen with average muscling between hooks and pins and slightly rounded. Fore ribs are not noticeable with fat cover over ribs feeling spongy. Rear ribs only slightly noticeable. Average muscling on skeleton. Starting to look smooth in appearance.

Six Forward Store

Moderate fat deposit in brisket. Short ribs can only be felt with very firm pressure. Spinal process not clearly visible. Fat around tail head is spongy and slightly dimpled. Hips and hooks can only just be seen. Moderate muscling between hooks and pins. Long ribs behind shoulder will feel smooth and spongy. This animal has a good smooth appearance all over.

Seven Fat

Well developed brisket. Difficulty in feeling short ribs. Spinal process not visible, just palpable. Very spongy fat on tail head and between rear legs. Obvious protruding deposits of fat are beginning to become noticeable on hips and hooks. Rounded and almost square looking muscling between hooks and pins. Long ribs are almost completely covered in fat. Smooth rounded appearance all over and seems fleshy with obvious fat cover and full flank.

Eight Prime

Brisket distended with fat and neck is thick. Almost impossible to feel short ribs. Spinal process can not be felt. Protruding deposits of fat over and around tail head. Square looking back, muscling between hooks and pins over developed. Obvious protruding deposits of fat. Long ribs can not be felt at all, smooth feeling. Very fleshy and over conditioned animal with full flabby flank.

Nine Over Fat/Obese

Large pendulous brisket. Short ribs can not be felt and bone structure is no longer visible. The animal is blocky and mobility may be impaired by fat, giving the appearance of a waddling gait. Large protruding deposits of fat around tail head, it seems to be sunken and dimply. Fatty folds are apparent over long ribs, flanks and thighs. This animal is extremely fleshy and over conditioned.

10.2 Appendix 2

ANALYTICAL TECHNIQUE FOR WET CHEMISTRY FAECAL ANALYSIS

DRY MATTER

10 grams wet dried at 100°C for 24 hours.
Wet weight and dry weight include the container weight.
Sample size = (wet weight - dry weight) x 10
then 100 - sample size = DM
E.g. 61.700 - 55.160 = 6.540 x 10
= 65.4
100 - 65.4 = 34.6 % DRY MATTER

D.M.D's
DRY MATTER DISAPPEARANCE
DRY MATTER DIGESTIBILITIES
PEPSIN / CELLULASE SOLUBILITIES
(Method used in Animal Production Laboratory)

REFERENCE :
Jones, IH and Hayward, MV, Journal. Sci. Fd. Agric, 1975, 26, p.711-718. (modified, different cellulase.)

REAGENTS

1.1 0.6 % PEPSIN (Sigma pepsin powder P7000 activity 1:10 000)
0.6g to 100ml distilled water or 6g to 1000ml water

1.2 0.1 N Hcl (straight from brown bottle)
e.g. 40ml Hcl + 4480ml distilled water (1 : 112)

1.3 Combine and mix - on mixer

2.1 Cellulase 500mg / 20ml (from Trichoderma Reesei pH range 3 - 7 Solvay Enzymes Mulgrave Vic. 3170) (500mg = 0.5g) be careful with stuff use gloves and try not to breathe in

2.2 Citrate buffer pH 4.6 [10.65ml 0.1M Citric Acid + 9.35ml 0.2M Na_2HPO_4 (anhydrous) making 20ml]

Di Sodium hydrogen orthophosphate)
(anhydrous) (Na_2HPO_4)
1M = 141.96g/L
0.1M=14.196g/L
.2M = 28.392g/L

Citric acid
1M = 210.4g/L
.1M = 21.014g/L

METHOD

1. ALWAYS TARE FIRST
Weighed into centrifuge tubes 0.2g (200mg) dried plant material. Incubated in 20ml 0.1 HCl and 0.6 % pepsin, for 48 hours at 37-38°C in a water bath.
Do 3 blanks and 3 standards at beginning and end of samples
Use the vial filler - pepsin mixture remains on mixer.

2. The tubes are twirled gently approximately every 2 hours to prevent adhesion of sample to side of tube. (Do not shake vigorously).

3. After 48 hours the supernatent is removed using a filter stick Porosity 1 .The sticks are washed with as little water as possible.

4. 20ml cellulase solution is added to the tubes (500mg cellulase / 20ml Buffer pH 4.6)
Use the vial filler, cellulase mixture remains on mixer.
Use gloves when handling cellulase

5. The tubes are returned to the water bath for a further 48 hours at 44 - 46 °C shaken as before.

6. After 48 hours the supernatent is removed as before. However the tubes are refilled with distilled water and allowed to stand for 2 hours or so, supernatent removed again. The residue is washed into pre-weighed dry aluminium dishes (placed in heater overnight prior to dry tin weighing) which are placed into a 100°C oven for 24 - 48 hours.
Triplicate standard and blanks are added to the run to give an indication of accuracy.

Samples can be duplicated. Depends on size of batch.

NOTE: standards are your reference - results should be around that value BLK should be around 0.005 (take any funny results out)

Calculations: {[(sample-blank) x 500]- 100} x (known reference sample / batch reference sample)
Sample = dry tin weight from the empty tin weight = a

To obtain blank figure
For all the blanks in the sequence take the dry tin weight from the empty tin weight (call the final value y)
then for e.g. there are 3 blanks y_1
y_2
y_3
then Blank = $(y_1 + y_2 + y_3) / 3$
$= y$

To obtain ref sample
For all the standards in the sequence take the dry tin weight from the empty tin weight (call the final value x)

NITROGEN and PROTEIN Micro - Kjeldahl Method

Reference: McKenzie and Wallace (1954). Aust. J. Chem. 1: p55. 70
Research Techniques - Grassland Research Institute, Hurley, Bulletin 45, p.155 Publisher - Comm. Agric. Bureau (1961)

Boric Acid Indicator
Fawcett (1954) J. Med. Lab. Tech. 12, p 1-22

Reagents

A.R Sulphuric acid (36N)
Kjeldahl catalyst tablets copper (B.D.H). Each tablet contains 1g Na_2SO_4 and 0.1g CuSO4 5H2O.
Approx. 10N NaOH - when adding NaOH wear gloves, turn on exhaust fan, mix the solution in the sink with chilled water running around base.
800g NaOH made up to 2 litres with distilled water X 2
N/14 Hcl (N = 0.07144)
Indicator 40g Boric Acid dissolved in 1200ml warm distilled water. Add 10ml 0.1 % ethanolic Methyl red and 20ml 0.1 % bromocresol green and shake alot to dissolve (distilled water) and 370ml absolute ethanol. Add dilute NaOH (just a bit in a very small beaker - only add to 2l a drop at a time) until solution is neutral purple colour (if you go too far off the colour add HCL (pH 5.0). Make up to 2 litres

Order of adding
Water + Boric acid + ethanol + 10ml methyl red + 20ml bromo. green

Remember - do a blank when making new indicator - same process as samples but using .5g of sucrose

METHOD

Weigh 500mg (0.5g) dried plant sample (or 2g wet faecal sample) on round blotting paper (making sure you tare the paper) transfer to Kjeldahl flask.
For this flask add 2 tablets & 10ml acid

Add 5ml conc. H_2SO_4 (using the glass preset volume dispenser) and Kjeldahl catalyst tablets, copper. (Add acid last)
Digest (i.e. heat) sample to clear green (with no yellow).(Remember turn on fan)
Cool, dilute carefully (such that total liquid will not exceed 50ml) with distilled water transfer to 50ml volumetric flask (use wire and funnel for easier flow) and make up 50mL volume.
Transfer 10mL Aliquat (sample) (use automatic pipette) to TECATOR add sufficient NaOH to turn solution blue.
Steam distil solution into 10 mL of Boric Acid Indicator (use preset volume dispenser to measure amount) keeping condenser tip under the surface of the indicator. Allow distillation for 2-3 minutes or at 50mls from time of colour change.
Titrate green solution with N/14 HCl to original pink colour.
NOTE: 1mL N/14 HCl = 1 % N

A reagents blank using starch or sucrose should be carried out for each new batch of N/14 acid or indicator solution.

CALCULATIONS

PLANTS:

(100 / wt of sample) x (Final volume / aliquat) x (1 / 1000)

Eg. (100 / 0.5) x 50 / 10 x 1 /1000) = 1

% N = Titre – Blank
% Crude Protein = % N x 6.25 (Most proteins have 16% Nitrogen therefore 100 / 16 = 6.25)

FAECES

2 gram wet weight

% N = Titre - Blank x 25 / dry matter

REFERENCES

Piper CS (1950) Soil and Plant Analysis. University of Adelaide, p 293-294 A.O.A.C. (1960), p 43

Ashing

Weigh 2g dried plant or 4g wet faecal material into a silica crucible and place in a cold muffle furnace. Switch on in box on wall then press in red button for the timer. Turn on exhaust fan every 2 hours.
Bring muffle to 300°C and leave at this temperature for 30mins then raise this temperature to 500°C. Not to exceed 550°C. There are black marks on the temp dial for these temps.
Allow ignition to continue overnight then cool crucible. If % Ash is wanted dry in desiccator and weigh.
% Ash = wt Ash x 50

Reagents

Ammonium Molybdate Solution (dissolve 50g Ammonium Molybdate $(NH_4)_6Mo_7O_{24}.4H_2O$ in 600ml warm distilled water.
Dilute 150ml conc. H_2SO_4 to 400ml with distilled water. Should make 1 litre.
Note: ACID INTO WATER
2. Hydroquinone solution (0.5g Hydroquinone to 100ml with distilled water. Prepare fresh for each batch.
3. Sodium sulfite solution. (20g Na_2SO_3 to 100ml with distilled water). Prepare fresh each batch.
4. Standard P. Solution (0.2197g dry potassium dihydrogen phosphate KH_2PO_4 in distilled water and make to 500ml.
50ml of this solution is diluted to 200ml.
2ml = 0.05 mg P

METHOD

Take up ash with 20 % HCl (1 acid & 4 water) and transfer to 100mL beaker.
Add 5ml conc. HCl and evaporate to dryness on a steam bath to dehydrate silica (SiO_2).
Moisten residue with 2ml conc. HCl add approx. 25ml distilled water and warm on a steam bath. (Aids filtration)
Filter through Whatman 41 9cm into a 50ml volumetric flask. Cool and make to volume.
Use the automatic pipette
Put 6ml of distilled water in a glass centritube (test tube) Note: blank 7 ml
add 1ml of the ash solution (in small glass bottles)
NOTE: If you are leaving for awhile e.g. to wait the 30 min do not add the Amm. mol
Add 1ml Amm. molybdate solution. Mix.
Add 1ml Hydroquinone solution. Mix
Add 1ml Sodium Sulfite sol'n. Mix. All should now have 10ml
Allow to stand 30 min. Mix again at 20 min
Blank = 7ml H_2O + 1ml Amm moly = 1ml Hyd. + 1ml $NaSO_3$.
Standard = 6ml H_20 + 1 ml standard P solution + 1ml HCl + 1ml $NaNO_3$

a) Solution from test Tubes to absorptiometer cells.
b) Blank solution to zero
c) Measure standards then samples

All readings are made singly and against blank.

CALCULATIONS

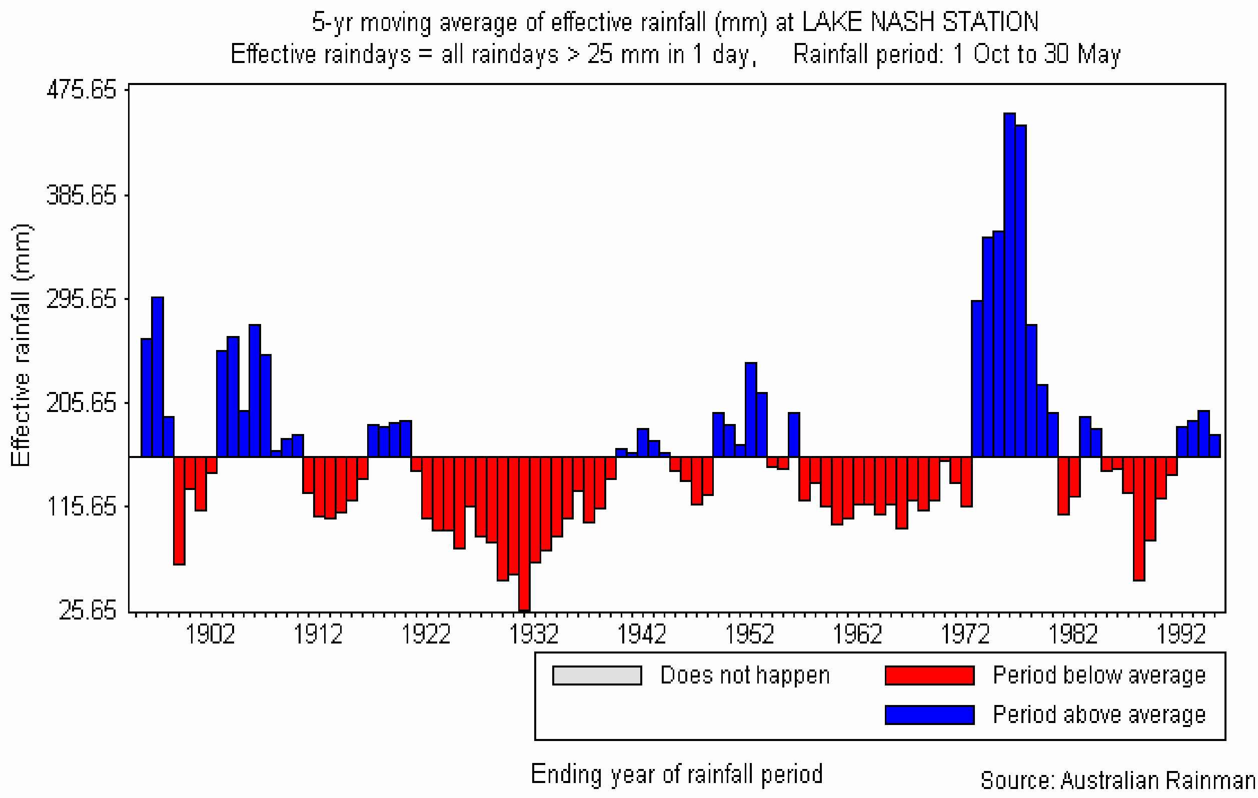
Pasture (2g dry)

% P = (TEST / STANDARD readings) x (50 / Aliquot) x (0.025mg P / 1) x (100 / sample wt) x (1 / 1000
= (T / S) x (50 / 1) X (0.025 / 1) x (100 / 2) x (1 / 1000)
= (T / S) x 0.0625
= Test / Standard x 0.0625 (for 2g)

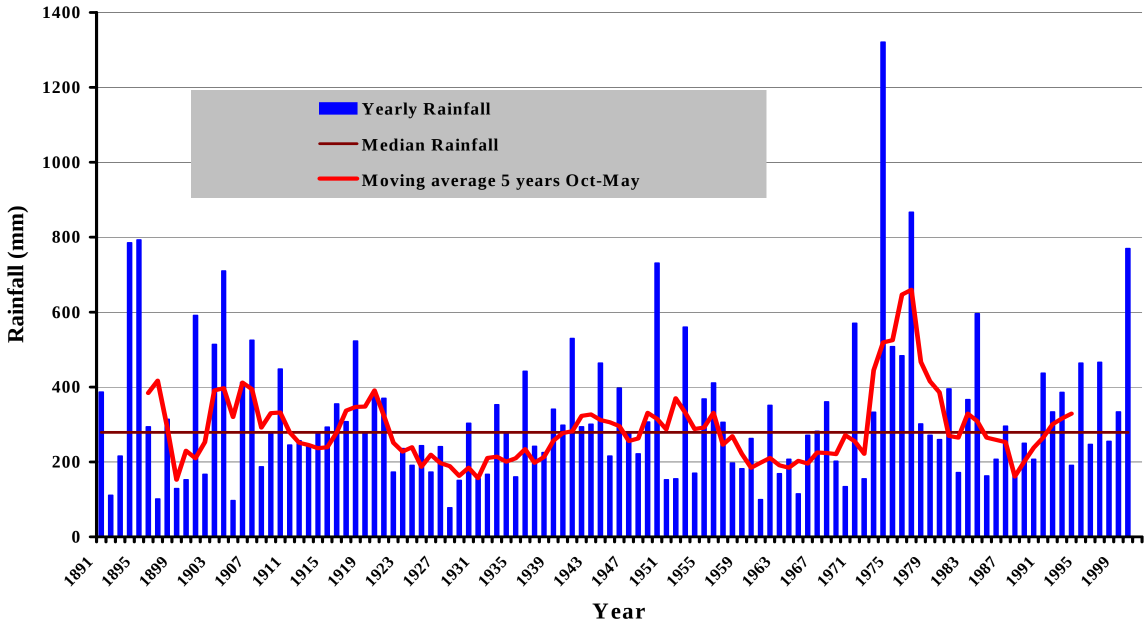
Faeces (4g wet)
% P = (test / dry matter) x (3.125 / standard)

10.3 Appendix 3

Historical Rainfall Records



5-year moving average of rainfall between October to April for Lake Nash.



Historical rainfall records for Lake Nash Station

10.4 Appendix 4

Efficiency equation

(weaner weight / weight of cows + culls)

COSTELLO

In 2000, 1535 weaners (306,830 kg) were harvested off 2518 cows (1,057,560 kg), and 165 empty cows were sold to works (82,500 kg). This gave an efficiency rate of 26.9. 306,830 / (1,057,560 + 82,500)

In 2001, 936 weaners (210,600 kg) were harvested off 1198 cows (503,160kg), and 88 empty cows were sold to meatworks (36,960 kg). This gave an efficiency rate of 38.9. 210600 / (503160 + 36960)

In 2002, 848 weaners (212,000 kg) were harvested off 1037 cows (497,760 kg) and 194 (93,120) were drafted off for future sale to meatworks. This gave an efficiency rate of 35.8. 212000 / (497760 + 93120)

GEORGINA

In 2000, 1014 weaners (272,415kg) were harvested off 1048 cows (440,160kg), and 89 empty cows were sold to works (44,500kg). This gave an efficiency rate of 56.2. The exceptional efficiency rate in this paddock was due to the weight of weaners.
272415 / (440160 + 44500)

In 2001, 897 weaners (192,855kg) were harvested off 1035 cows (435,960kg), and 46 breeders were culled (19,320kg). From this an efficiency rate of 42.3 can be calculated. This large decrease in efficiency from 56.2 to 42.3 is a result of breeder drift and a larger proportion of calves to weaners. 192855 / (435960 + 19320)

In 2002, 575 weaners weighing 152,950kg were harvested off 932 cows at 447,360kg and 330 (158,400kg) breeders were drafted off for future meat work sales. This gave an efficiency of 25.2
152950 / (447360 + 158400)

DESERT

In 2000, 215 weaners (44,268 kg) were harvested off 830 cows (348,600 kg), and 13 empty cows were sold to works (6,500 kg). This gives an efficiency rate of 12.4.
44,268 / (6,500 + 348,600) In November 2000 there were 667 PTIC weaner mums and 24 (3.6%) bulls in Desert paddock. This was increased to 863 cows by May 2001 with 693 returned to Desert after pregnancy testing.

In 2001, 725 weaners (163,125kg) were harvested off 863 cows (362,460kg) and 97 empty cows were culled (40,740kg). This gave an efficiency rate of 40.4 which is an improvement on 2000 and attributable to PTIC cows being put in Desert Paddock in November 2000. 163,125 / (40,740 + 362,460)

In 2002, 393 weaners at 89,997 kg were harvested off 681 cows at 333,690 kg and 93 weighing 45,570 kg were segregated for future sale to meatworks. The resulting efficiency rate from this was 23.7. 89,997 / (45,570 + 333,690)

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