# EFFECT OF BREEDER BODY CONDITION AND WEIGHT ON PREGNANCY AND CALF GROWTH IN THREE AGE GROUPS OF COMPOSITE-BRED BEEF CATTLE

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## SUMMARY
The reproductive performance of 4 herds of composite-bred (50% *Bos indicus*/Sanga, 50% *Bos taurus)* cattle grazing native pasture in the Barkly Tableland region (Northern Territory) was studied for 5 years. Predictive models of reproductive performance were developed from 6210 breeder records and 2006 calf records, based on the easily measurable indicators, breeder body condition (BCS; using a 9-point scale) and weight for heifers, second calf heifers and cows. Breeder BCS (mean = 6) and weight (mean = 504 kg) were higher than typically reported for northern Australia, as were pregnancy rates and calf growth rates from birth to weaning. Pregnancy rates for heifers (90%) were lower (P<0.05) than second calf heifers (93%) and cows (95%). Calf growth for progeny of heifers (853 g/d) was lower (P<0.05) than for second calf heifers (900 g/d) and cows (903 g/d). The exceptional reproductive performance of these herds is likely to be a consequence of above average nutrition, breed effects and management. Increasing pregnancy rates and earlier conception dates (as measured by rectal palpation) were associated with increasing breeder weight. Increasing pregnancy rates were also associated with increasing BCS. There was an inverse relationship between BCS and calf growth for progeny of breeders of BCS 4 and above. This study has established new reproductive performance benchmarks for this region of northern Australia, and has shown that breed composition of up to 62.5% *Bos taurus* in the tick-free regions can be highly productive. The results of this work support findings of previous research indicating that breeder BCS of approximately 5 (moderate condition) is optimum.

*Keywords*: reproductive performance, body condition, weight, calf growth, cattle, nutrition

## INTRODUCTION
Reproductive performance is 1 of the most important factors influencing the profitability of a beef breeding herd (Entwistle 1983). Under-nutrition will reduce pregnancy rates, increase the duration of anoestrus, and reduce calf growth and weaning weights. The impact of under-nutrition is expressed through its influence on breeder body condition and weight (O'Rourke *et al*. 1991a). Body condition score (BCS) of breeders is the most commonly used indicator of animal nutrient status and, therefore, is widely used for supplementation decisions (Derouen *et al*. 1994). A minimum BCS of 5 (using a 9-point scale) will minimise the duration of post-partum anoestrus in *Bos taurus* breeds (Osoro and Wright 1992). Nutrition management and pregnancy rates of beef herds in the Barkly Tableland region have improved in the last 20 years (Bortolussi *et al.* 1999). Another factor contributing to the improvement in pregnancy rates is that beef breeding operations in the region are now incorporating cross-breeding in their production systems. While average pregnancy rates for the region have been reported (Bortolussi *et al.* 1999), examination of pregnancy rates and duration of anoestrus for the new breed compositions and improved nutritional management have not been previously investigated. Due to large paddock sizes and herd numbers typical of the region, measurements of calf growth from birth to weaning have not been previously undertaken.

The aims of this study were to a) measure and report breeder pregnancy rates (%), foetal age (month; and, therefore, conception date), calf growth from birth to weaning (kg/d) and weaning weight (kg) in 4 commercial herds of a composite breed, b) analyse the effect of breeder BCS and weight on these 4 traits for 3 age groups, and c) discuss the potential implications of the relationships.

## MATERIALS AND METHODS
### *Animals, their management and measurement*
A total of 6210 breeder records and 2006 calf records were collected from 4 composite-bred (6/16 Brahman, 2/16 Africander, 5/16 Shorthorn, 2/16 Charolais, 1/16 Hereford) herds on Alexandria

Station, Northern Territory. A 4-month joining period (Jan–April) was practiced. Weaning was performed in May and pregnancy diagnosis (by rectal palpation) in August. Breeders were individually identified and joined as yearlings (14 to 18 months of age). It is a reasonable assumption that heifers exceeded 270 kg at joining, as the mean weight at pregnancy diagnosis (496 kg; s.d. 68 kg) indicated that if they weighed 270 kg at joining (180 days before pregnancy diagnosis), they would need to have grown at an average 1.25 kg/d. The records were categorised into age groups according to the number of pregnancies in a breeder's lifetime. Breeders were classified as heifers on their first pregnancy, second calf heifers and mature cows. Breeders were culled from the herd if they failed to conceive (based on pregnancy diagnosis) or successfully raise a calf to weaning (based on birth and weaning records). All calves were individually identified and cross-referenced to their dam at birth in Herds 1, 2 and 3. Approximately 20% of these animals were weighed to provide an estimate of mean birth weight. A value of 30 kg birth weight was subsequently assigned for the analyses. Calves in Herd 4 were not identified and weighed until weaning. Weaning date and weight were recorded for calves in all 4 herds.

Herds 1 and 4 were processed from 1996 to 2001 and Herds 2 and 3 from 1997 to 2001. The 4 herds were processed consecutively to minimise the effect of time. Above average annual rainfall (402 mm) was received in the study area every year from 1996 through to 2001. Available pasture biomass was plentiful throughout the study period. All 4 herds were supplemented at selected times of the year (late dry season and/or wet season) using commercially produced compressed blocks. The nutrient composition of the blocks was predominantly protein (nitrogen x 6.25; max. 40%) and salt (NaCl; max. 48%). Supplement intakes were recorded on a paddock basis each week of feeding, and were variable between months and years. Average annual nitrogen intakes from supplement ranged from 0.6 to 3.6 kg/breeder.

Animal data collection was undertaken biannually in May and August. At both rounds of processing, breeders were weighed following an overnight fast with *ad libitum* access to water. Breeder weights were adjusted for stage of gestation (O'Rourke *et al.* 1991b). Body condition score was assigned at both times using a 9-point scale (Wagner *et al.* 1988). Breeder lactation status was recorded by stripping of teats.

*Statistical analysis*

Data from the 4 herds were analysed collectively. The General Linear Models procedure in SAS was used to carry out analysis of variance on values for pregnancy (month), weaning weight and calf growth, allowing for BCS, breeder weight and age group. Pair-wise tests between mean values were also carried out. Least Square Means (LSM) values were adjusted for herd and muster round (biannually), and standardised to the average BCS and average breeder weight. Relationships between pregnancy (month), calf growth and weaning weight, BCS and breeder weight for the 4 herds and 3 age groups were described with a linear function. Breeders diagnosed as non-pregnant were removed from the analyses examining the month of pregnancy.

For the analyses of pregnancy rate, pregnancy diagnoses were converted to binomial data, with non-pregnant breeders assigned a value of 0 and pregnant breeders a value of 1. The probability of a breeder being pregnant was modelled using a generalised linear model with a logit link. Pregnancy was assumed to be a function of the herd-muster combination (group), breeder age group, BCS and weight. The GENMOD procedure in SAS was used to fit the model. Age group data were further evaluated on the logit scale for differences between heifers, second-calf heifers and cows. The results were adjusted for herd and muster effects, and standardised to the mean breeder BCS and weight. Relationships between pregnancy rate, BCS and weight for the 4 herds and 3 age groups were described with a linear function, and converted back to the original scale to obtain predicted pregnancy rates.

## RESULTS

Pregnancy rates and calf growth rates of second calf heifers and cows were higher than for heifers. The progeny of heifers were heavier and older at weaning (as a consequence of earlier conception) than for second calf heifers and cows (Table 1).

**Table 1. Least square means for pregnancy rate (with 95% confidence limits), pregnancy diagnosis, calf growth and weaning weight (± s.e.) for each breeder age group.**

| Age-group | Pregnancy rate (%)[A] | | Pregnancy (month) | | Calf growth (g/d) | | Weaning weight (kg) | |
|---|---|---|---|---|---|---|---|---|
| | n | Mean | n | Mean | n | Mean | n | Mean |
| Heifers | 2155 | 90 (87, 92)[a] | 2144 | 6.4 ± 0.05[a] | 1066 | 853 ± 5.9[a] | 1066 | 198 ± 1.3[a] |
| 2nd calf heifers | 1861 | 93 (92, 95)[b] | 1627 | 5.7 ± 0.05[b] | 567 | 900 ± 8.4[b] | 567 | 194 ± 1.8[ab] |
| Cows | 2194 | 95 (94, 96)[b] | 2078 | 5.5 ± 0.04[c] | 373 | 903 ± 9.6[b] | 373 | 188 ± 2.0[b] |

[A] Pregnancy rate refers to probability of pregnancy
Numbers in columns with different superscripts are significantly different (P<0.05)

Breeder BCS ranged from 4 to 9, with 89% of breeder records from 5 to 7. Mean pregnancy rate ranged from 80% (BCS = 4) to 99% (BCS = 9). The largest changes in pregnancy rate were associated with the lower half of the BCS range, with a 13% (80 to 93%) change in pregnancy rate from BCS 4 to 6 and a 3% (96 to 99%) change from BCS 7 to 9. Breeders that raised calves to weaning ranged in BCS from 4 to 9, with 84% of breeder records from 5 to 7. Mean calf growth ranged from 918 g/d (BCS = 4) to 808 g/d (BCS = 9). Mean weaning weight ranged from 200 kg (BCS = 4) to 177 kg (BCS = 9). There was a trend for calf growth and weaning weight to decrease more rapidly as breeder BCS approached 9. There was a trend for pregnancy rate to increase and calf growth to decrease as breeder BCS increased (Figure 1).

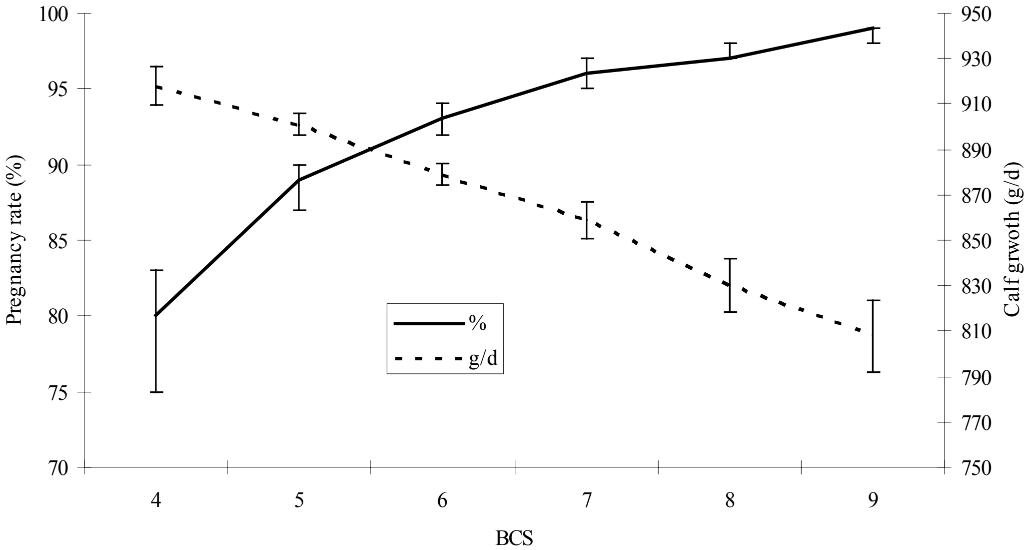


**Figure 1. The relationship between breeder body condition score (BCS), and pregnancy rate (± 95% confidence interval) and calf growth rate (± s.e.).**

Pregnancy rate, calf growth and weaning weight were influenced (P<0.01) by BCS and breeder weight (Equations 1a, 1b, 3 and 4, respectively). Pregnancy diagnosis (month) was not influenced (P>0.05) by BCS and, therefore, is not a parameter in the model (Equation 2). Pregnancy rate is expressed as the probability of the breeder being pregnant. If Py = probability of being pregnant, then $Log_e \{P[y]/(1-P[y])\} = Z$

where Z = intercept + 0.332*(BCS) + 0.008*(Weight) — Equation 1a

It can be shown that the predicted P[y] = 1 / (1 + exp(-Z)) — Equation 1b

The model for pregnancy diagnosis (month) is described by Equation 2:

Pregnancy diagnosis (month) = intercept + 0.0023*(Weight) — Equation 2

Calf growth (g/d) = intercept - 32.433*(BCS) + 0.327*(Weight) — Equation 3

Weaning weight (kg) = intercept - 6.863*(BCS) + 0.069*(Weight) — Equation 4

## DISCUSSION

The reproductive performance achieved by the breeders in this study exceeded industry benchmarks for northern Australia (Hasker 2001). The mean weight and BCS of breeders in the current study were higher than commonly reported for northern Australia (Hasker 2001). The improvements in weight and BCS have most likely been achieved through higher nutrient intakes as a consequence of good seasons and nutrient supplementation. In contrast to previous research (Hasker 2001), mean second calf heifer pregnancy rate was higher than heifer pregnancy, and the same as cow pregnancy rate. A minimum target weight of 270 kg for *Bos indicus*-cross heifers is necessary to achieve pregnancy rates of at least 80% (Doogan *et al.* 1991). It could be expected that heifers had reached puberty prior to joining, and without the inhibitory effects of lactation on oestrus, consequently conceived the earliest of all age groups.

The results of the current study indicate that calf growth and weaning weights will reduce as breeder BCS increases. An important caveat to this conclusion is that the relationship only applies for breeders at BCS 4 or above. Another factor that may be contributing to the difference between the current study and previous research was differences in the breeds studied. The current study used cattle of a new breed combination consisting of 37.5% *Bos taurus* and 62.5% *Bos indicus*, as opposed to the more common breeding for northern Australia with a high (>70%) *Bos indicus* content.

A possible explanation for the relationship between calf performance and breeder BCS is that cow milk production will drive the relationship. In particular, the higher milk producing cows will provide more nutrition to their calves, by partitioning nutrients to milk production in preference to growth and, therefore, show lower BCS. In the current study, increases in calf growth are associated with increasing breeder age, probably due to increased milk production. Results indicate that as breeders get older, they take longer to conceive and, thus, give birth at a later date. These were the reasons that the calves of heifers were the heaviest and oldest at weaning, yet experienced the lowest growth from birth to weaning.

When suitable nutrition is provided, yearling-mating of heifers and a 4-month joining period can be practiced and pregnancy rates above 90% and calf growth rates above 800 g/d can be achieved in north Australian semi-arid grazing conditions, with as low as 37.5% *Bos indicus* infusion. To balance the influence of breeder BCS on pregnancy and calf growth, a BCS of approximately 5 (moderate condition) is recommended as an optimum.

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