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INTERACTIONS BETWEEN GESTATION LENGTH, CALF SIZE, DYSTOCIA AND CALF MORTALITY

S. E. McClintock[1,3], K. T. Beard[2,4], M.E.Goddard[2,3] and D.J. Johnston[1]
[1]Animal Genetics and Breeding Unit*, University of New England, Armidale, NSW 2351
[2]Department of Primary Industries, Mickleham Road, Attwood, Victoria
[3]University of Melbourne, Parkville, Victoria
[4]Australian Dairy Herd Improvement Scheme, William Street, Melbourne

SUMMARY
In general, longer gestation lengths tend to result in larger calves, more calving difficulty and increased calf mortality rates. However, the relationships are complex, with increased calf mortality rates following short gestation lengths being associated with immaturity, whilst increased calf mortality rates following long gestation lengths are associated with size-related calving difficulty. These analyses were based on calving records of 134,141 Holstein-Friesian cows and calves.
Keywords: Genetic evaluation, dystocia, dairy cattle.

INTRODUCTION
Dystocia (an abnormally long or painful birthing process) increases the incidence of cow and calf mortality, reduces fertility of the cow, and consumes many resources (such as drugs, veterinary services and time). Perinatal calf mortality reduces the number of calves available as replacements or for sale, and consequently reduces profitability and compromises the welfare of farmer, cow and calf. Many non-genetic factors affect calving traits, such as calf sex, cow age and month of calving. The effects on dystocia of calving season, calf sex and cow age (or parity) have been extensively studied in the northern hemisphere (Bar-Anan, 1976; Berglund *et al.*, 1987; Dematawewa *et al.,* 1997). In Australia cows are generally managed under extensive pastoral conditions in a warm climate, rather than in the calving sheds of cooler climates. Relationships among calving traits such as gestation length, dystocia, calf size and mortality may help us to understand their interelationships with calf sex, cow age and calving season, and the causes of calf mortality in Australia.

Table 1. Summary of dataset

calving type	primiparous	multiparous
# Calving records	14,805	119,336
# Gestation records	2,698	23,866
Mean gestation length (days)	279.8	281.3
Mean size	3.1	3.2
Mean 3-level dystocia	1.4	1.2
Mean calf mortality %	10.8	4.4

MATERIALS AND METHODS
Calving information was provided by the Australian Dairy Herd Improvement Scheme (ADHIS), consisting of 801,652 calving records collected since 1981. The editing process and methods of recording and scoring dystocia (absent, mild or severe) is described by the authors elsewhere in these conference proceedings (McClintock *et al*., 2005). Calf size was scored subjectively on a scale of 1 (tiny) to

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5 (huge). Gestation length was calculated as the number of days between the last mating date and the date of the subsequent calving. Calf fate (mortality) was determined by the calf being dead at or shortly after birth. A summary of the traits is shown in Table 1. 134,141 records remained after editing, which were analysed with ASReml (Gilmour *et al* 2002) using the models summarised in Table 2, in which all effects are categorical fixed effects. Dystocia was scored as shown in another paper by the authors in papers at this conference. Models are summarised in Table 2, and were used in nine analyses, using response variables as shown in Table 3.

Table 2. Model descriptions

Factors	Model 1	2	3	4
Sex, parity$, herd-year, month*	●	●	●	●
Gestation length		●	●^	●
Calf size			●	
Dystocia				●

● = inclusions in models * = of calving
$ or age in months ^ = factor or polynomial nial

Table 3. Analyses by model

Response	Model 1	2	3	4
Gestation length	1			
Calf size	2	5		
Dystocia	3	6	8	
Calf mortality	4	7		9

RESULTS AND DISCUSSION

Analyses 1 - 4: *Calf sex***:** Bull calves are bigger, have gestation lengths about a day longer and have much more difficult calvings than female calves, (3.4 % more severe problems, 7.1% any dystocia). Male calves have a mortality rate 2% greater than female calves, although the differences between the sexes varied according to the parity of the cow, with primiparous calvings having much greater differences in incidence of calving problems between the two calf sexes (details available in McClintock (2004)).

Month of calving: Gestation lengths are longer, calf sizes greater and dystocia more frequent, in August, when more calves were born. Gestation lengths are shortest in February, which coincides with the hottest time of year. For comparison, the mean monthly temperature for Kyabram, a major dairying district in northern Victoria, is shown in Figure 2.

Age / parity: Primiparous cows have shorter gestation lengths, smaller calves, more dystocia and greater calf mortality than multiparous cows. Dystocia frequency is lowest in cows aged about 60 months, and increased slightly in older cows.

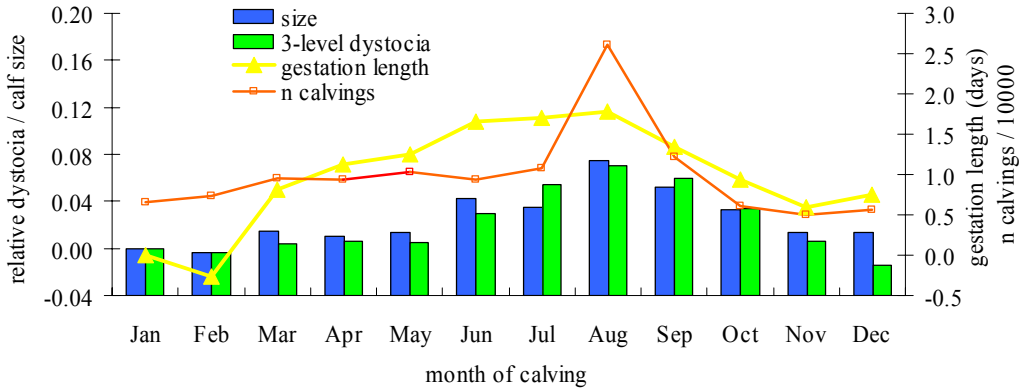

Figure 1. Effect of month of calving on gestation length, calf size and dystocia (analyses 1 – 4).

Analyses 5 – 7. These analyses are similar to analyses 1 - 4, but gestation length (as a covariate) is now included in all analyses. Analysis 5 (Figure 3) demonstrates that calf size increases with gestation length. Though the effect of gestation length on calf size is almost linear, but the effects of gestation length (6) and calf size (5) on dystocia is not linear.

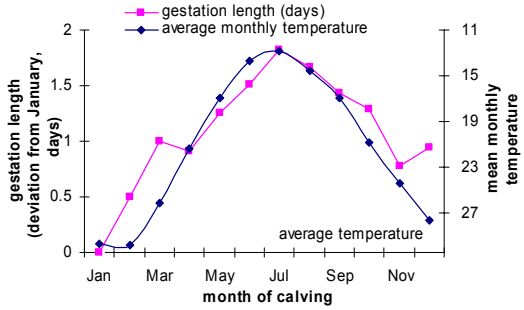

Figure 2. Colder temperatures are associated with longer gestation lengths (Kyabram).

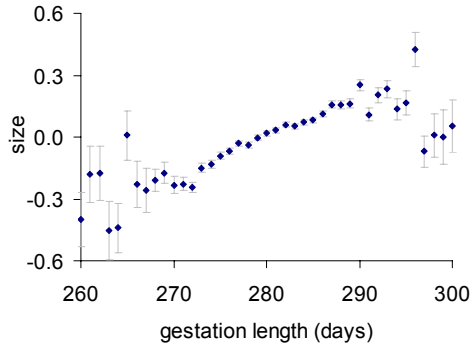

Figure 3. Calf size increased with longer gestation lengths (analysis 5).

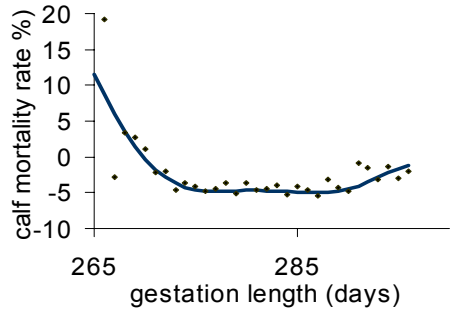

Figure 4. Gestation length on calf mortality (size included, analysis 7).

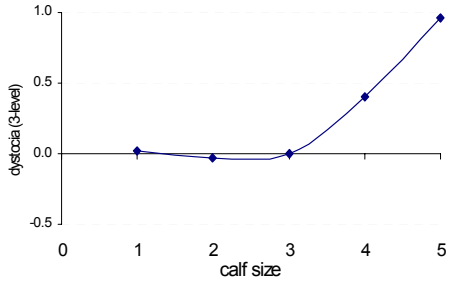

Figure 5. Dystocia more likely with greater calf size (analysis 8).

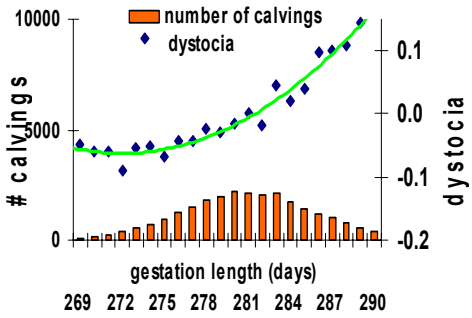

Figure 6. Longer gestation lengths associated with more dystocia (analysis 6).

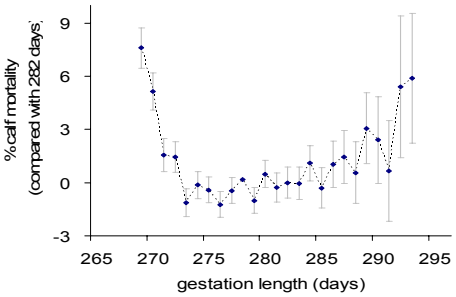

Figure 7. Extreme gestation lengths with calf mortality (analysis 9 size not included).

Dystocia becomes more frequent as gestation length increases (analysis 6, Figure 6). Calf mortality is more frequent at very low gestation lengths, reaches its minimum at about 273 to 275 days, and becomes increasingly common with increasing gestation length thereafter (Figure 7, analysis 7) .

Analysis 8 & 9. Analysis 8 (Figure 5) is similar to analysis 6 (Figure 6), an analysis of dystocia, but with the addition of size to the model (in addition to gestation length etc). Dystocia incidence increases with calf size, regardless of gestation length (Figure 5). This means that dystocia is largely caused by foetopelvic disproportion (relatively big calf and small cow). This suggests that the small increase in dystocia for premature calves seen in Figure 6 may be dystocia due to reasons other than foetopelvic disproportion, such as malpresentation. Analysis 9 (Figure 7) is similar to analysis 7 (Figure 4), except that size is absent. Calf mortality increases with short gestation (less than 273 days, when organs such as lungs are not yet fully functional). The increase in calf mortality associated with longer gestation length that was evident in analysis 9 (Figure 7) is accounted for by calf size (resulting in foetopelvic disproportion). However, this effect seems to disappear at about 286 days of gestation: post mature calves have increased mortality rates due to factors other than size. This is in keeping with Philipsson (1976), who found a marked increase in calving difficulty and in stillbirth (calf mortality) for calving at less than 268 days of gestation, and an accelerating rate of stillbirths after 268 days and increasing dystocia rates for gestations longer than 278 days. Longer than average gestation lengths result in increased calf mortality, due to increased dystocia caused by greater calf size. Very short gestation lengths are associated with increased calf mortality. Only a small proportion of calvings are in this high mortality short gestation length (less than 273 days) class. A larger proportion of calvings are in the long gestation (> 285 days) higher mortality rate class (see Figure 6).

CONCLUSIONS

Because longer gestation length leads to larger calves, which in turn lead to increased dystocia, it also increases calf mortality. However, independent of dystocia, very short (<273 day) and long (>288 day) gestation lengths are associated with increased calf mortality. Average gestation lengths are about 281 days, so moderate reduction of gestation length will lead to reduced calf mortality.

ACKNOWLEDGEMENTS

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