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GENETIC AND ENVIRONMENTAL TRENDS FOR PREGNANCY RATE IN A HERD OF DROUGHTMASTER CATTLE IN NORTHERN AUSTRALIA

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INTRODUCTION

A common problem encountered by breeders is how to interpret changes in the mean performance of their herd over time. In the absence of a contemporary control or an unselected herd, it has not been possible in the past to separate genetic and environmental effects. The latter is taken to include seasonal influences on nutrition, parasite load, heat, diseases as well as changes in management practices. However, statistical methods using best linear unbiassed predictor (BLUP) now allow the separation of genetic and non-genetic effects. In the study reported here, BLUP techniques were used to estimate genetic and environmental trends in a stud herd in which pregnancy rate had been steadily declining since the mid 1970s.

MATERIALS AND METHODS

The registered Droughtmaster herd at the CSIRO Lansdown Research Station located 50 km south of Townsville was initiated in 1964. Mating is normally from January to April, calves are weaned at 5-7 months and pregnancy diagnosis is performed in June/July. Bulls are selected primarily on size at branding without correcting for age or dam age. Cows which fail to calve in two consecutive years are generally culled.

The data comprised 9086 records of pregnancy diagnosis in 2280 cows. The statistical model was :

$$y = X\beta + Zu + Zp + e$$

where y is a vector of pregnancy records (1 = pregnant, 0 = not pregnant), β is a vector of fixed effects, X and Z are incidence matrices, u is a random vector of breeding values (BV) and p is a random vector of permanent environment effects and e is a vector of residuals. The breeding values for female fertility of bulls were estimated using the relationship matrix in the BLUP equations. A heritability of 0.1 and repeatability of 0.2, previously estimated from the data (Goddard, unpublished) were used. The fixed effects fitted were year, cow age at mating and lactation, status. Environmental trends over time were derived from the age/lactation status solutions in each year. Genetic trends were estimated by averaging the estimated breeding values of cows by year of birth.

RESULTS AND DISCUSSION

The mean pregnancy rate for the herd between 1964 and 1984 was 68.6%. The average phenotypic trend was -0.65 ± 0.38 per cent per year. Between 1976 and 1983 pregnancy rate declined 32 per cent or at nearly seven times the long term trend.

By contrast, the genetic trend was + 0.075 ± 0.049 per cent per year, representing a genetic improvement in fertility of 1.5 per cent in 20 years. Genetic trends from BLUP analyses are dependent on the heritability assumed. Although moderate (0.22 - 0.44) estimates of heritability for fertility in Zebu cross herds have been reported (see Turner, 1982), the estimate from the Lansdown data set was thought appropriate. The only direct selection for fertility in the herd was the culling of cows which results in only a small selection differential. If the selection for body weight has been effective, correlated changes in fertility traits would be slight (Baker and Morris, 1984). Thus, the small genetic trend was not unexpected.

TABLE 1 Mean pregnancy per cent and environmental trends (b_g) between 1967 and 1984† in the Lansdown herd

Age (years)	Lactation Status	Mean pregnancy %	b_g (pregnancy %/year) ± s.e.
2	dry	67	0.2 ± 0.6
3	dry	80	- 0.2 ± 0.5
3	wet	45	- 2.0 ± 1.0 (p < .07)
4-8	dry	80	0.4 ± 0.5
4-8	wet	57	- 1.5 ± 0.8 (p < .08)
9+	dry	75	- 0.6 ± 1.0
9+	wet	51	- 2.7 ± 0.9 (p < .01)

† between 1971 and 1984 for 9 + year old cows.

Environmental trends varied with age/lactation status (Table 1). The trend was essentially zero in dry cows but large and negative in all ages of wet cows. Pasture quantity and quality are important environmental factors affecting pregnancy rate and presumably explain some of the large fluctuations from year to year. Lactating cows are more sensitive to nutritional stress than dry cows (Entwistle, 1983). Thus the negative trend in wet cows may indicate a general deterioration in the nutritional environment possibly compounded by higher stocking rates as herd size increased between 1976 and 1984 by nearly 40%.

REFERENCES

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