EFFECTS OF AGE STRUCTURE IN DAIRY HERDS

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SUMMARY

Age structures of dairy cattle populations were determined from 4 years of data from the Victorian Herd Improvement Program. The effects of herd size, major genotype being kept and region on age structure were significant. Historical fluctuations in the economic fortunes of the dairy industry have also affected age structure, Modelling the consequences of altering age structure suggests that varying age structures from those existing in Victoria will make little difference to possible genetic gain and productivity.

INTRODUCTION

Varying age structure can affect both level of current economic productivity and possible genetic progress in animal populations. While effects of age structure have been well studied in sheep (e.g. Turner and Young 1969) and beef cattle (e.g. Hopkins and James 1979) there has been little work on age structure in the dairy industry. Franklin et al. (1976) studied the effect of culling rate on production in the N.S.W. dairy population and included age structure with culling policy and herd recording as determinants of production levels.

In this paper we present the results of a study of age structure in herd-recorded Victorian dairy herds.

MATERIALS AND METHODS

The data were provided by the Herd Improvement Branch of the Victorian Department of Agriculture. They comprised 212830, 216772, 310489 and 359737 lactation records from all Victorian dairy areas in 1977, 1978, 1979 and 1980, respectively. Age of the cow, sire and dam identification and type of breeding (A.I. or natural) are available in the data as well as production information (e.g. milk yield in litres, butterfat yield in kg).

Limited computing capacity required sampling of the data. Accordingly random samples of 11694, 10142, 10406 and 10054 lactation records for the years 1977 to 1980, respectively, were analysed. Because of the way in which the herd records had been coded, the particular procedure for obtaining the sample was very important for subsequent interpretation of the data.

We were interested in finding whether age structures varied in herds of different breeds and different sizes. Cows with at least 75% Friesian (or Jersey) genes had been coded as Friesian (FRS) (or Jersey (JSY)). An F1 cow between FRS and JSY had been coded as a Friesian Jersey cross (FJX). This coding meant that a daughter of an FJX had to be either FRS or JSY depending on the breed

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of sire used, with the result that one herd could have had, e.g. old FJX cows and young FRS cows if there had historically been upgrading to FRS from JSY. If cows had been individually classified by breed such a herd would have shown a very old age for FJX and a very young age for FRS neither being a meaningful description of the age structure of the herd. Hence it was essential to define FRS (or JSY) herds as herds that in 1977 had 90% or more FRS (or JSY) cows while crossbreeding herds were defined as those that in 1977 had 50% or more FJX cows. However, about half of the cows in the samples analysed could not be allocated to herds classified by breed into these three categories. Only herds selected in 1977 were kept for the subsequent years, without altering the breed classification.

Similarly, herd size (small: 30-59; medium: 60-99; large: $\geqslant$100) was determined in 1977 and kept unchanged for later years. If these precautions had not been taken herds could have changed size and breed classification between years which could also have led to distorted age structures in different categories.

Type of breeding and registered-grade classifications were made separately for each cow, not on a herd basis.

The data contained only lactating cows, the youngest being 1½ years old when lactation began. Cows of 1½ to 2½ years old were included in the 2-year-old category and so on. There were very few cows older than 11½ years.

RESULTS

The results are described in detail by Ayied (1983).

Age structure varied in the different geographical areas into which Victoria's dairy industry is divided. The variation occurred within regions as well as between regions. For example, the western area in the western region (Area 4 - Western district) had a much lower proportion of young cows (2-and 3-year-olds) than the neighbouring eastern area of the western region (Area 5 - Colac).

Table 1 shows the average age of cows on farms with different breeds in the four years.

Table 1 Weighted average ages of cows (yrs)

Years	Breeds		
	FRS	JSY	FJX
1977	4.73	5.35	5.25
1978	4.80	5.36	5.42
1979	5.15	5.25	5.57
1980	5.22	5.23	5.68
Average	5.00	5.30	5.48

The age structures varied significantly between breeds. The separate age structures for each year show that Friesian herds had a high proportion of 2-yr-olds in 1977 while in Jersey herds the proportion of 2-yr-olds was highest in 1979. Herds with crossbreds generally had the oldest animals.

Herds of different sizes had cows of quite similar average ages except in 1980 when small herds had older cows. But the age structure of small herds was consistently different from that of both other categories in that the proportion of two-yr-olds was lower while that of 3- ,4-and 5-yr-olds was higher in each of the four years. This suggests strongly that small herds tend not to rear their own replacements, but to buy in cows that have already been milked in another herd.

Table 2 shows the average ages of cows classified by type of mating and by registered-grade category.

Table 2 Weighted average ages of cows (yrs)

Years	Code*			
	0	1	2	3
1977	5.21	5.00	4.58	4.32
1978	5.29	5.13	4.66	4.71
1979	5.36	4.93	4.86	4.84
1980	5.49	4.82	4.86	4.60
Average	5.34	4.97	4.74	4.62

* 0: naturally-bred grade; 1: naturally-bred, registered;
2: A.I., grade; 3: A.I., registered

The sample analysed contained very few (416 to 460 per year) A.I. bred, registered cows. The age structure for this classification fluctuated greatly from year to year, probably as a result of the small numbers. There were relatively more young cows that had been bred by A.I. than naturally-bred cows.

For any age structure it was possible to estimate from the proportion of cows 3-yr-old and older (times a factor of 0.94 to allow for wastage) the number of calves produced in a typical year. The proportion of 2-yr-olds can be taken as the number of replacements needed. If the number of replacements needed is set in relation to the number of calves produced, one can calculate an intensity of selection from the proportion of calves selected, on the assumption that truncation selection (i.e. maximum possible selection) for one trait only is being done among the cows. Using the further assumptions of h^2 for milk yield or fat yield being 0.25 and generation length for bulls being 9 years, we found maximum possible genetic gain, through selection among cows only, to be about ½% to 1/3% of milk or fat yield per year, for any of the actual age structures shown by the 3 breed types in the 4 years analysed.

When age structure of a theoretical herd was varied by altering replacement rate from 12% to 25% of 2-yr-olds, maximum possible genetic gain through selection of females only, was highest (though only 0.54%) with 12% replacements. This occurred because the intensity of possible selection more than offset the associated high generation length. An estimate of herd profitability, under several sets of assumptions showed that 15% (or 12%) replacements were most profitable.

DISCUSSION

Many non-genetic causes contribute to the elimination of cows from the herd and thus affect age structure. In our study it is clear that historical economic fluctuations in the Victorian dairy industry have caused restocking with young cows by Friesian breeders about 1977 and by Jersey breeders somewhat later. On the other hand, the higher average age of cows on crossbreeding farms may be a direct effect of hybrid vigour on longevity.

Our calculations (which concentrated entirely on age structure in the cow herd) suggest that low replacement numbers of calves from highly selected cows would lead to greater genetic gain than higher replacement rates. This result must, however, be seen in perspective. Firstly, the maximum possible gain through selection of cows is small relative to the gain through selection of bulls. Secondly, if rapid progress is being made through bull selection, young cows will be genetically better than older cows and higher replacement rates will be beneficial. From this perspective it seems unlikely that effort directed at deliberately varying age structures in dairy herds will produce great benefits through more rapid genetic improvement of dairy cattle. The age structures found (mean ages about 5 years) seem appropriate.

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