THE BREED STRUCTURE OF THE SANTA GERTRUDIS IN SOUTHERN AFRICA

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SUMMARY

The breed structure was analysed by means of four generation pedigrees of calves registered in 1980 and 1990. The structure of the breed had a pyramidal shape for both 1980 and 1990. During 1980 there was a higher intensity of gene flow from the top strata downwards than in 1990. No gene flow from the bottom to the top was found.

INTRODUCTION

Differences between herds are responsible for the formation of a breed structure, which in turn is dependent on the herd size and the relative number of herds in each strata. The genetic standard of a breed is dependent on the breeding strategy of a small, elite group of breeders (Robertson, 1953). A second group can be identified who buy bulls from the top group of breeders and sell their sons to the next group. These breeders multiply the genes from the top breeders and pass it on to the lower strata. Commercial breeders are responsible for the formation of the basis of the breed structure (Rae, 1964).

Genetic changes in the breed are largely determined by genetic changes in the elite group. The gap between the top and the basis of the structure can be narrowed down by supplying bulls from the top strata to the lower strata. In relative young breeds, like the Santa Gertrudis in southern Africa, herds have not yet found their position in the breed structure, which leads to continuous changes in the structure. Breed policies and selection goals tend to change more in younger breeds in order to find an optimum genetic goal that will best suit the breed in the environment in which it should reproduce and produce. This study was conducted to identify any problems or factors which may constrain the flow of superior genetic material from herds in the higher strata to those lower in the breed structure.

MATERIALS AND METHODS

In the analysis of the breed structure, four generation pedigrees were used from a 25% sample of all registrations in 1980 and 1990. Herds that registered animals were divided into different classes according to (a) bull provision to other herds and (b) registration practice within the herd. The method of Barker (1957), was used to classify the herds. Breeders herds (BH) were those herds that supply bulls to other stud herds. Multipliers herds (MH) were those herds that registered bulls, but the bulls were only used in the herd of origin (MH-H), or in commercial herds (MH-N).

The numerical description of the breed structure gives an indication as to which the breed strategy of a small group of breeders has an influence on the genetic estimate of the total breed. This parameter gives an indication as to what extent the ancestors are derived from a decreasing number of herds. The formula of Robertson (1953) was used for the numerical description of the breed structure:

$$Cs = \frac{\Sigma n_i (n_i - 1)}{\Sigma n (\Sigma n - 1)}$$

where n_1 = number of sires that originated from the first herd
n_2 = number of sires that originated from the second herd
n_i = number of fathers that originated from the i_{th} herd
Σn = total number of pedigrees

Cs calculates the chance of herd identity in the parent generation; Css for the grandparent generation and Csss for the great grandparent generation. Hs is the reciprocal of Cs and can be used to indicate the number of effective bull suppliers in a given generation.

RESULTS AND DISCUSSION

During 1980, the Santa Gertrudis breed was still in a develop-mental stage in southern Africa. The analysis was performed four years after official registration and 24 years after the first imports to the country. In 1980 the breed structure had already developed to such an extent that a BH1-herd existed. Due to the small size of the breed, the breeders herds were divided into only five groups, (BH1 - 5), according to their relative importance. A clear hierarchic structure was visible. One herd (S), filled the top stratum, with a small number of herds in the higher strata and the majority of herds in the lower strata. A clear distinction could be observed between the herds in the higher strata due to the prominent effects of only a few herds in this period. Bulls were supplied freely from the BH1 herd to the herds lower in the structure, which indicates the supply of genetic material through the breed. The breeders herds (BH) contributed 36,36% of the total breed structure, and the MH-H herds 19,64% of the total MH-herds.

During 1990, only two generations after 1980, there were 224 active herds in the Santa Gertrudis breed as compared to the 88 in 1980. The breed structure had developed to such an extent that the BH herds were divided into seven groups. During 1990 both bulls and semen were imported; in 1980 only semen were imported (Schutte, 1991). Similar to 1980, breeders in the top strata supplied bulls not only to strata directly below them, but also to herds in the lower strata. The BH1 herds played an important role here with consequent increased genetic progress in herds lower in the breed strata. In 1990, the BH contributed 40,89% of the total breed structure, an increase of 4,53% from 1980 (Van Zyl, 1994). The MH-H herds contributed 19,64% of the total MH herds.

In Figure 1, the structure of the breed is compared for 1980 and 1990 according to the method of Schoeman (1972). In both instances the structure is a typical pyramidal structure. The breed structure for 1990, is narrower than the one for 1980, which indicates more herds in the base of the breed structure in 1990. This places a considerable responsibility on the breeders in the top breeders herds (BH), since a small number of herds are responsible for the supply of genetic material to the whole breed. The genetic structure for 1990 is less desirable than that of 1980, since the 1990 structure restricts gene flow through the breed (Van Zyl, 1994).

Although there were 32 BH in 1980, the Hs-value indicates that only 0,98 herds were effective suppliers of bulls (Table 1). This indicates that only 3,13% of the breeder herds effectively supplied bulls to other herds. Several of the herds were small in 1980 and this could contributed to the low effective supply of genetic material. BH contributed 36,36% of the total herds which created a high demand on genetic material by MH and commercial herds, resulting in few bulls sold to other stud breeders. In 1990 the Hs-value decreased further, where from the 92 BH, less than 1,10% of the breeders herds supplied bulls in the parental generation.

CONCLUSIONS

Too many Santa Gertrudis breeders have small herds with a subsequent low potential for genetic progress. The breeding structure in 1980 favours the rapid flow of genetic material from higher to lower strata. The breeding structure in 1990 indicates a "bottle-neck" effect, which is an obstacle to the flow rate of genetic material. The importance of the Santa Gertrudis in southern Africa will depend on the ability of the breed to fulfil in the local demand. A scientifically founded breeding strategy based on economically important quantitative traits should be applied, together with more extensive use of artificial insemination.

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TABLE 1: Cs and Hs values for 1980 and 1990.

Year	Number of animals	Number of herds	Cs	Css	Csss
1980	766	88	1.021	0.356	0.376
			Hs	Hss	Hsss
			0.979	2.793	2.660
1990	2582	224	Cs	Css	Csss
			1.954	3.408	1.830
			Hs	Hss	Hsss
			0.512	0.293	0.546

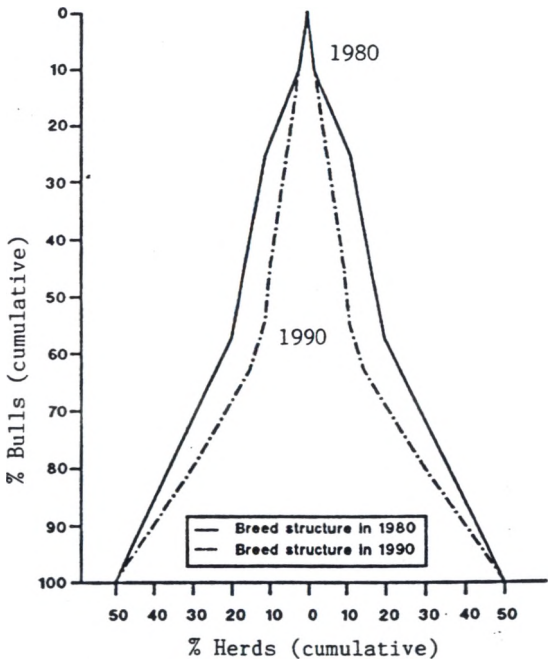

Figure 1: Schematical description of the breed structure in 1980 and 1990