Population and pedigree analysis of indigenous South African beef breeds

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Abstract

Population and pedigree information reports were generated for the Afrikaner, Bonsmara, Drakensberger and Nguni breeds in South Africa using APIIS software. The number of reproductive animals decreased over years for all breeds except for the Nguni breed. The generation interval of the Bonsmara was the shortest varying between 5.4 and 4.9 years and, on average, a year shorter than the Afrikaner breed. The generation interval for the Drakensberger has shortened by 1.2 years over the period 1981 to 1997 while the interval for the Nguni breed is increasing. The average inbreeding values for offspring are increasing for all breeds; however, they do fall within a low and acceptable rate of inbreeding. The highest rate of inbreeding was 0.08% per year for the Afrikaner followed by the 0.05% for the Drakensberger and Nguni and the 0.04% per year for the Bonsmara. APIIS software provided a quick and easy way of obtaining this information.

Introduction

Loading data into a well-structured database in order for it to be edited is a problem facing every genetic evaluation. Once data has been loaded into an organised database structure, it is easy to manage, edit and prepare for a genetic evaluation. The APIIS (Adaptable Platform Independent Information System) data base structure is a well-organised database structure and it makes use of software which was originally developed to managed pig performance data in Germany (Groeneveld, 2004). The APIIS data base structure was then generalised to accommodate data from any species into the data base framework.

Pedigree and population structures for most South African populations (breeds) are unknown. The APIIS software can generate population structures and pedigree information for any population loaded into APIIS.

The objective of this study was to load data for the indigenous South African Afrikaner, Bonsmara, Drakensberger and Nguni breeds into APIIS and to generate population structures and pedigree information reports for these breeds.

Methods and Materials

Data of the indigenous South African Afrikaner, Bonsmara, Drakensberger and Nguni breeds, obtained from the Agricultural Research Council's National Beef Cattle Improvement Scheme was used in this study. At the time of this study there were 214 825 animals in the pedigree file for the Afrikaner breed (born between 1965 and 2003), 1 124 535 pedigree animals for the Bonsmara breed (born between 1963 and 2003), 157 954 pedigree animals for the Drakensberger breed (born between 1963 and 2003) and 94 415 in the Nguni pedigree file (born between 1966 and 2003).

The APIIS database structure and software were adjusted to enable them to load South African beef data into the database structure (Groeneveld, 2004) where-after data from the four indigenous breeds was loaded.

Subsequently, population structure and pedigree analysis reports were generated for these breeds with the help of the APIIS software. Population structure and pedigree information obtained from these reports were the population size of animals in reproduction per year, generation intervals, effective population sizes and inbreeding.

The generation interval is the interval of time between corresponding generations (Falconer and Mackay, 1996), and is calculated as the average age of parents when the offspring are born that are destined to become parents in the next generation. The effective population size (N_e) is the actual number of animals that would give rise to the calculated sampling variance, or rate of inbreeding, if they were bred in the manner of an idealised population (Falconer and Mackay, 1996).

Inbreeding is defined as the mating of individuals that are related to each other by ancestry. The rate of inbreeding (ΔF) and average inbreeding were calculated as described in (Falconer and Mackay, 1996).

Results and Discussion

Figures 1 and 2 present the number of sires and dams used in reproduction per year for the Afrikaner, Bonsmara, Drakensberger and Nguni.

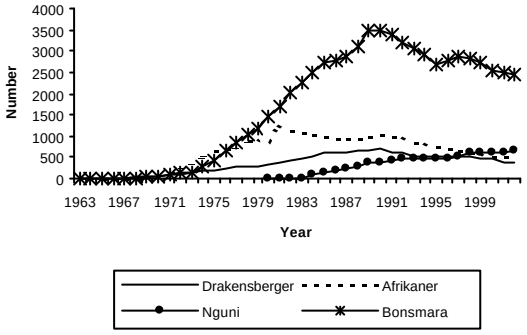

Figure 1: Number of Sires in reproduction

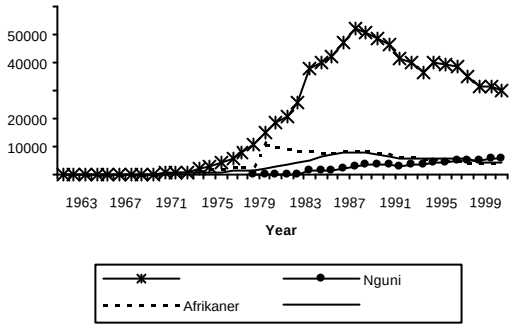

Figure 2: Number of Dams in reproduction

These Figures show that the number of parents in reproduction used per year increased for all breeds initially. The number parents for the Bonsmara showed a sharp increased between 1970 and 1990, where after the number of parents used in reproduction decreased to 2 428 bulls and 29 770 dams used in 2002 (only 69% of bulls and 59% of dams that were used in 1990 were used in 2002). The Drakensberger and Afrikaner breeds showed the same pattern as the Bonsmara with only 55% and 48% of the number of bulls and 54% and 50% of the number of dams that were used in 1990 were used in 2002, respectively. The Nguni breed is, however, still in an increasing phase.

Figure 3 presents the generation intervals for the respective breeds. In general, the generation interval for the Bonsmara breed (which varied between 5.4 and 4.9 years) was on average the shortest with the Afrikaner breed the longest. The generation intervals of the Afrikaner and Drakensberger have, however, decreased with time. In 1981 the generation interval for the Drakensbergers was 6.7 years, which decreased to 5.5 years by the end of 1997. The generation interval for the Nguni varied between 5.5 and 6 years and is still increasing.

Figure 4 shows the effective population size (N_e). The pattern of Figure 4 is comparable to pattern for the number of dams (Figure 2) and especially the number of sires used in reproduction (Figure 1) for the respective breeds. This is because the N_e values have been calculated from the actual population size. The N_e for all breeds, except for the Nguni breed, decreased over the years. The N_e for the Bonsmara breed increased rapidly to 8 420 in 1989 where after the N_e decreased to 5 975 in 2002 (71% of the N_e of 1989). The N_e for the Nguni, Afrikaner, and Drakensberger in 2002 were 1 515, 1 193 and 966, respectively.

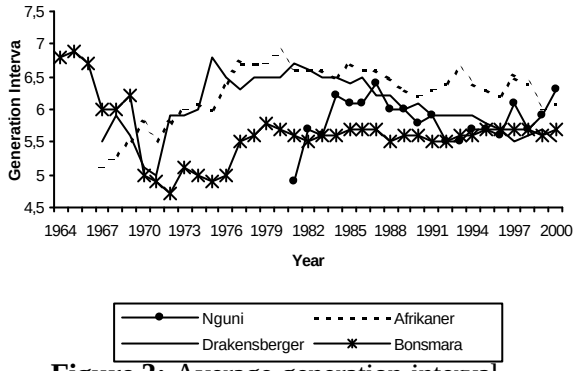

Figure 3: Average generation interval

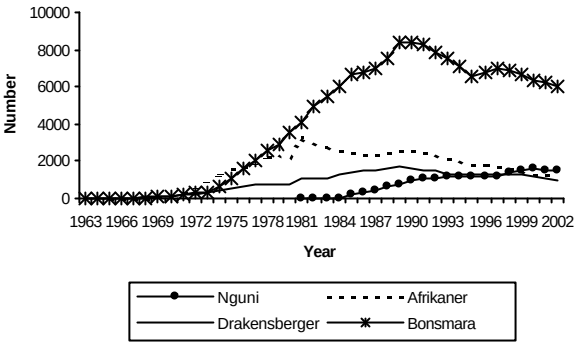

Figure 4: Number of effective population size (N_e)

Figure 5 presents the average inbreeding for all offspring in a specific year. The average inbreeding of offspring increased for all four breeds over the years, however, the average inbreeding values are still acceptable. The highest average inbreeding value was for the Afrikaner breed in 1996 of 2.9% where after it decreased to 2.5% in 2002. The average inbreeding value for offspring of the Bonsmara, Nguni and Drakensberger breeds in 2002 were 1.8, 1.0 and 2.9%, respectively. However the rate of inbreeding for all breeds was low.

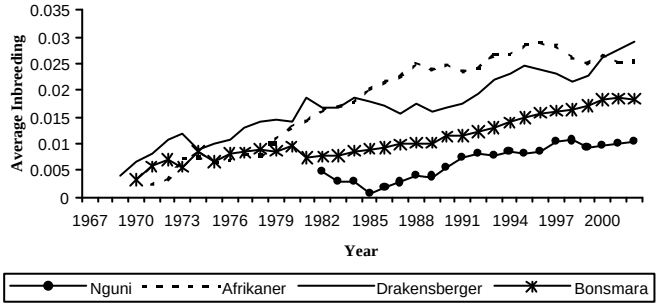

Figure 5: Average inbreeding per year

References

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