Founder Analysis Of The Austrian Turopolje Population

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Introduction

The Turopolje pig is descended from the lard-type pigs of Croatia crossed with local meat pigs, then probably crossed with English Berkshire pigs in the 19th century. The Turopolje pig came close to extinction during the Yugoslavian war in the 1990s. Therefore a handful of animals was brought to Austria to assist in rescuing this valuable genetic resource. Since 2001 Arche Austria is the responsible breeding organisation to carry out an in situ conservation breeding programme in Austria.

Material and methods

Material. Arche Austria provided pedigree data from the electronic herd book consisting of records of 508 animals born between 1993 and 2008. The parentage of 16 animals could not be traced back further, for all other animals both parents were known. We defined animals born between 2004 and 2007as actual breeding population.

Pedigree Analyses. Applying the software packages PEDIG (Boichard (2002)) and ENDOG (Gutiérrez and Goyache (2005)) inbreeding coefficients, the average complete generation equivalent, the effective number of founders, ancestors and founder genomes, the expected total genetic contributions of each founder and the marginal genetic contributions of the most important ancestors to the actual population as well as to single birth cohorts were calculated. A detailed description of the used measures is given by Boichard et al. (1997).

Results and discussion

The actual population defined as described above consisted of 216 animals, 93% showed an inbreeding coefficient different from zero. The average inbreeding coefficient of inbred individuals was about 12% based on quite short pedigree information, i.e. with an average complete generation equivalent of about 4. Figure 1 shows mean inbreeding coefficients per birth cohort with a steep increase until 1999, a decrease between 2003 and 2005 and a phase of stagnation afterwards. To understand the fluctuations in mean inbreeding levels the small number of individuals per birth cohort must be taken into account, with just 3 to 4 breeding animals born per year until 1998, while in the year 1999 already 18 breeding animals were born. In the following years the number of recorded animals ranged from 36 (2000) to 82 (2002). Until 2008 the proportion of inbred animals increased to 100%. Comparable high

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inbreeding coefficients were detected mainly in horse breeds (e.g. Mahon and Cunningham (1982), Zechner et al. (2002)), which are usually based on deep and complete pedigree information. Maignel and Labroue (2001) investigated 5 local pig breeds in France and also found high inbreeding coefficients ranging from 8 to 18% based on average complete generation equivalents between 7.9 and 9.6.

For a better understanding of those patterns a founder analysis was carried out, showing that almost all animals can be traced back to 6 founders born in Croatia.

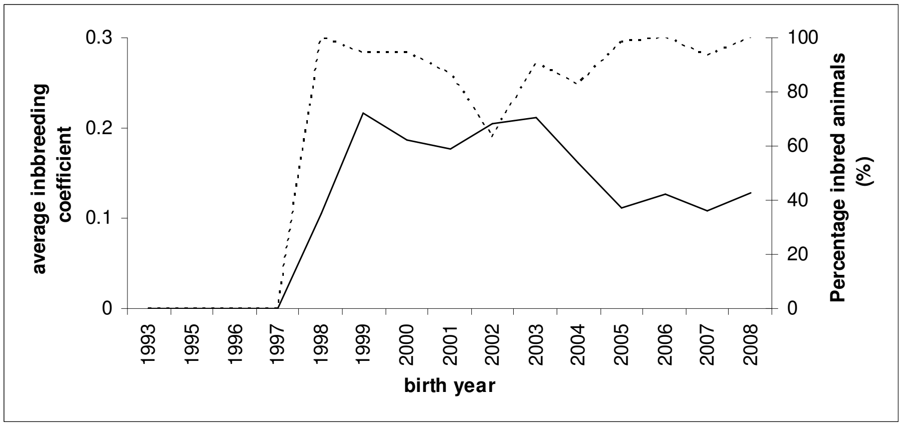

Figure 1: Average inbreeding coefficients (unbroken line) and percentage of inbred individuals (dotted line) per birth cohort.

Table 1 lists these 6 animals with their genetic contributions to the actual reference population and to the most recent available birth cohort 2008. Their summed contribution is just 98% for the defined reference population, which can be explained by the fact that the birth of 4 animals without known parentage falls within these period. These animals were born in the years 2004 and 2007 and contributed alleles just to their own birth cohort. Therefore we consider them as "pseudo founders" with no genetic contribution to following generations. Further 6 pseudo founders were born in 1999 and 2003.

Table 1: Founders and their contributions to the actual breeding population (2004 - 2007) and birth cohort 2008

Founder	Sex	Birth year of the founder	Contribution 2004-2007	Contribution 2008
ADAM	male	1993	7.6	8.6
BARON	male	2000	14.0	16.5
DIGGI	female	1993	25.8	26.3
DRAGA	female	1993	12.4	11.8
LORD	male	2000	10.8	11.6
MOHAR	male	1993	27.8	25.2

However the pedigrees of all animals born 2008 could be traced back entirely to the 6 founder individuals. Therefore their summed contribution is 100%.

A detailed insight into the founder contributions over time is presented in Figure 1.

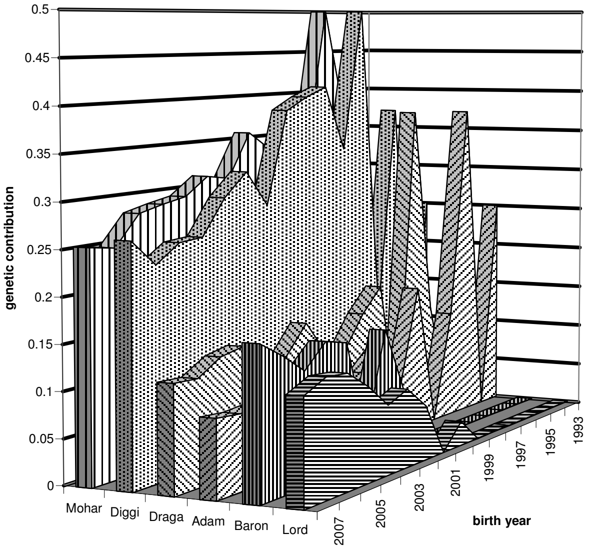

Figure 1: Genetic Contribution of 6 founder animals to the birth cohorts 1993 to 2008

In the year 1993 the whole population in Austria consisted of the 4 animals Adam, Mohar, Diggi and Draga, which were rescued from the chaos of war in Croatia. Their first offspring was born in 1995, Mohar and Diggi were the parents of the few breeding animals born in 1997, which explains their equal contributions of 0.5 to this birth cohort. In the year 2000 two further male animals, Baron and Lord, were sent from Croatia to Austria. Due to veterinarian reasons no further animals from the original breeding area in Croatia were imported. As shown in Figure 1, alleles of all founder animals are still present in the Austrian population with an overrepresentation of the boar Mohar and the sow Diggi.

This unequal founder contribution results in an effective number of founders of 5.6 for the reference population, a further reduction by bottlenecks leads to an effective number of ancestors of 4.9. In addition random genetic drift reduced genetic variability. Therefore, the effective number of founder genomes still present is 3.4. These results are comparably low as in 5 local French pig breeds (Maignel and Labroue (2001) where the effective number of founder genomes ranged from 2.4 to 5.9. However, the number of founders of those breeds was clearly higher, even in the smallest population of Bayeux the 81 animals born in the year 1999 could be traced back to 21 founders, while the total genetic variability of this reference population could be explained by 9 effective founders, 7 effective ancestors and 2.4 effective founder genomes.

Conclusion

Figures and measures presented show both the dramatic situation of the Austrian population with regard to the inevitable loss of genetic variability, but also a success for the conservation breeding programme, which seems to prohibit the complete loss of one of the founder genomes so far. However, inbreeding depression on reproduction traits must be feared. Opening the herd book and importation of breeding animals is highly recommended to increase the chance for a long term survival of the population.

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