Acta Agraria Kaposváriensis (2010) Vol 14 No 2, 161-165
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Pedigree analysis of Burlina cattle population

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ABSTRACT

The aim of this study was to characterize the pedigree of Burlina cattle breed. The file was supplied by the Breeders Association of Treviso province (Italy) and included 2303 animals. About 79% of individuals had both parents known. The additive genetic relationship (f) among animals and the coefficient of inbreeding (F) were calculated as well as the number of generations and pedigree completeness index (PCI). The PCI increased over the studied period and individuals born in 2009 had an average value of 90% considering 2 generations and 69% considering 5 generations. The additive genetic relationship increased across years, reached a value of 1.95% in 2004 and then decreased slightly. Coefficient of inbreeding was low in 1990s and increased rapidly afterwards; in 2009 the F value was 4.81%. The monitoring of f and its use as weighting factor for selecting sires and dams of future bulls will be used to control inbreeding levels within the population.
(Keywords: additive genetic relationship, Burlina breed, inbreeding, pedigree completeness)

INTRODUCTION

Burlina is a native cattle breed reared in north-east Italy. The number of animals consistently decreased up to the end of 1970s, mainly because of the progressive substitution of this population with the more productive Holstein Friesian (*CNR*, 1983; *Del Bo et al.*, 2001). At the beginning of 1980s, the Burlina was enrolled in the Italian Herd Book of local breeds and pedigree information was registered more accurately.

An important step for the conservation of a native animal genetic resource is to assess the magnitude of its genetic variability (*Wright*, 1922; *Del Bo et al.*, 2001; *Dalvit et al.*, 2008); this can be achieved through the additive genetic relationship among animals and the coefficient of inbreeding, which are simply calculated using pedigree information as proposed by *Wright* (1922). However, problems in the reliability of these coefficients may arise if individual ancestry is not recorded back to a common base population (*VanRaden*, 1992).

The best strategy to manage a population under conservation is to optimize contributions of parents by minimizing the global additive genetic relationship weighted by those contributions (*Meuwissen and Sonesson*, 1998; *Fernández et al.*, 2005; *Sørensen et al.*, 2008). This is particularly true for small populations at risk of genetic erosion. The aim of this study was to characterize the pedigree of Burlina breed, particularly in relation to the completeness of the pedigree, the additive genetic relationship among animals and the coefficient of inbreeding.

MATERIALS AND METHODS

The pedigree file was supplied by the Breeders Association of Treviso province (Italy) and included 2303 animals. About 79% and 14% of individuals had both parents known

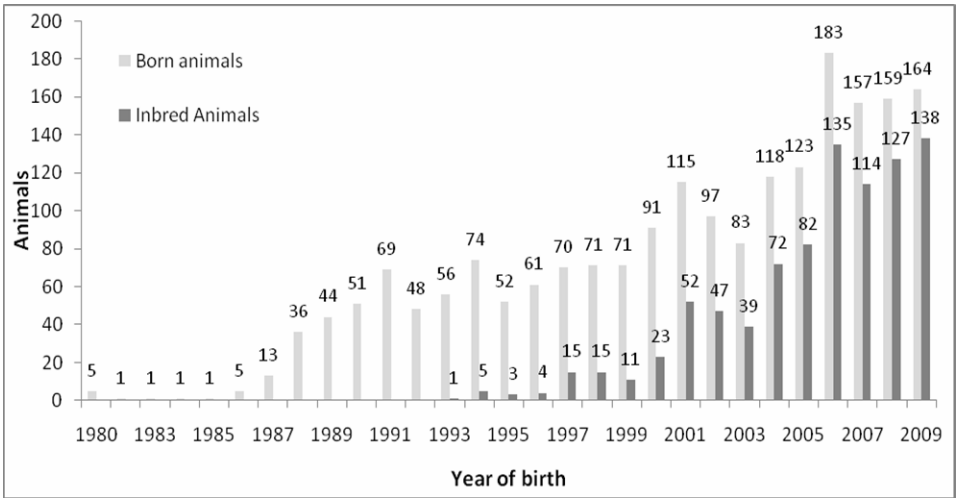
and unknown, respectively, while the remaining 7% had only one of the two parents unknown. The base population was assumed to be born in 1980. For individuals with both parents known, the year of birth ranged from 1986 to 2009. The additive genetic relationship (f) and the coefficient of inbreeding (F) were calculated using the INBREED procedure of *SAS* (2006), and number of generations and pedigree completeness index (PCI) were obtained through EVA software package (*Berg et al.*, 2007).

RESULTS AND DISCUSSION

Figure 1 displays the distribution of animals by year of birth. Programs to safeguard Burlina breed were set up in 1980s (*Bittante et al.*, 1992) and the number of individuals gradually increased during the last 20 years. At the beginning of the conservation program, bulls of the local breed were mated to pure and crossbred Burlina cows (*Bittante et al.*, 1992) and then backcross to Burlina was practiced. In fact, there were not inbred animals in 1980s while in the 1990s the number of inbred individuals increased. About 81% of female and 88% of male calves born in 2009 were inbred, with an average F of 5.49±5.21 and 6.02±4.97%, respectively (data not shown).

Figure 1

Distribution of animals by year of birth



The PCI is an important index to assess the quality of pedigree and investigates the depth of pedigree itself; it is proportionally inversed to the number of generations considered. For example, animals born in 2009 had an average PCI of 90% considering 2 generations and 69% considering 5 generations (*Figure 2*). An interesting approach is to evaluate how many animals had a PCI equal to 100%. In 2009, 74% of individuals had 2 generations completely known, but this percentage was only 23% when at least 3 generations were considered (*Figure 2*).

In this situation, it is more informative to look at the average f value over the years (*Figure 3*). The additive genetic relationship among animals increased across years; in 1980s it ranged from 0.00 to 0.51, from 1990 to 2004 the rate strongly increased (0.46 to

1.95%) and then slightly decreased. Animals born in 2009 had an average *f* of 1.86%. As expected, the trend of inbreeding resembled that of additive genetic relationship, i.e., it was low in 1990s and increased rapidly afterwards with a value of 4.81% in 2009. *Figure 4* shows the average *f* by year of birth of sires. In general, the *f* value was constant across the years, and ranged from 1.12 to 2.15%.

Figure 2

Pedigree completeness index (PCI, %) by year of birth considering 2 (PCI2), 3 (PCI3), 4(PCI4) and 5 (PCI5) generations

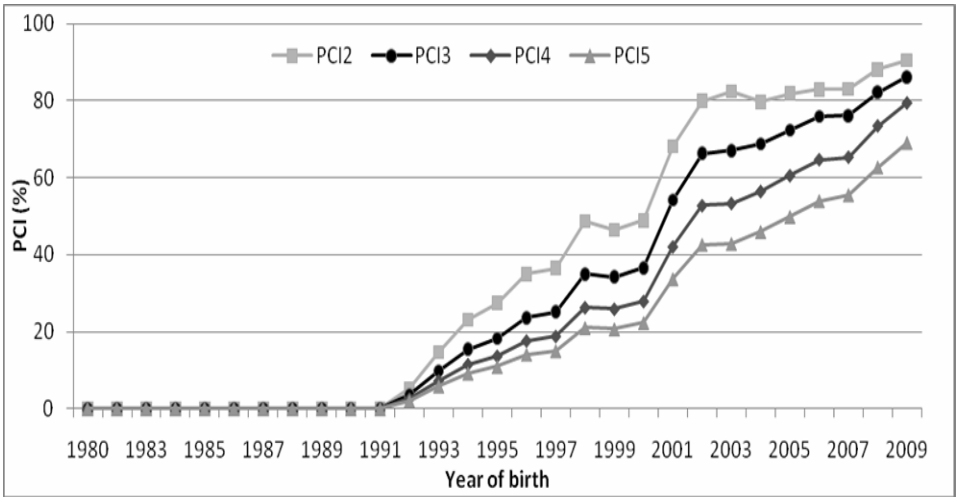


Figure 3

Average additive genetic relationship (%) and inreeding (%) by year of birth

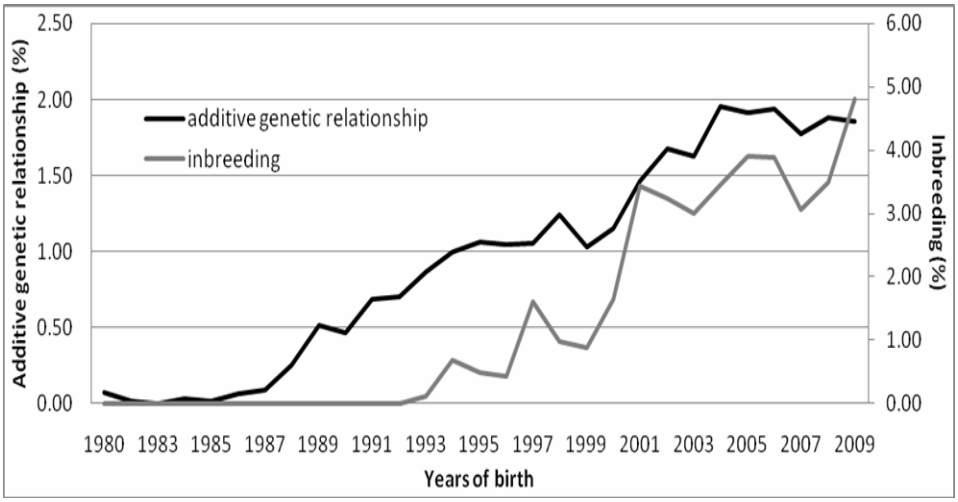
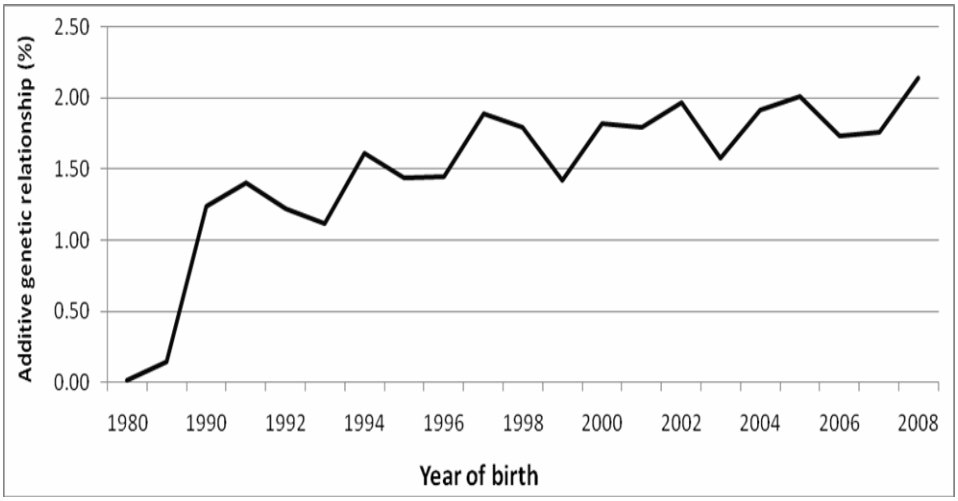


Figure 4

Average additive genetic relationship (%) of sires by year of birth



CONCLUSIONS

The number of inbred animals and the coefficient of inbreeding have increased over years. The same trend has been found for the additive genetic relationship among animals, but with a plateau during the last 5 years. The Burlina breed has an informative pedigree that could be used for further analyses. The monitoring of additive genetic relationship and its use as weighting factor for selecting sires and dams of future bulls as proposed by *Berg et al.* (2007) seems to be an important perspective to control inbreeding level and maintain genetic variability within the population.

ACKNOWLEDGEMENTS

Authors want to thank the Breeders Association of Treviso province (Italy) for providing data used in the study and Veneto Region (PSR 2007-2013, mis. 124 – DIVGEN project) for supporting the research.

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