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Inbreeding trend in a closed nucleus of Lipizzan horses

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Summary

The Italian Lipizzan stud consists of 160 horses, of which 43 mares and 8 stallions. All horses directly derive from ancestors of the Asburgic Imperial stud of Lipizza before the First World War. The nucleus possesses all the six male lines: Conversano, Neapolitano, Pluto, Favory, Maestoso and Siglavy; and eleven of the fifteen classical female families: Sardinia, Spadiglia, Argentina, Africa, Almerina, Fistula, Ivanka, Deflorata, Djebrin, Europa, Theodorosta; respecting in this way the genetic heritage of the Asburgic Empire. One of the major purposes of the stud is to maintain a pure breed, therefore respecting male and females families that were present at the Asburgic stud before 1915. In order to cope with the possible increase of inbreeding, breeding schemes are performed through mating groups, after simulation of the inbreeding coefficients of all potential newborn, then assigning to each mare the stallion based on the minor inbreeding that could be obtained, so to maximise genetic variability within the closed nucleus. Breeding animals are chosen among those that fully show the typical morphological and biometrical standards of the breed. Inbreeding coefficients were calculated for all individuals in the Herbdook archives, tracing back to 1,738, including about 965 males and 2,076 females. Inbreeding trend was estimated for the individuals born from 1945 to 2008, separately for males and females. Analysis of results indicated that percentage of homozygosity increased by 6% and, in detail, by 6.6% for stallions, and by 5.3% for the mares. These results, on one side, could be positively judged, because homozygosity might involve the fixation of desired traits; on the other side, they make evident that, in a closed nucleus, inbreeding trend should be regularly evaluated before the mating season, so to prevent an excess of inbreeding in the following generation.

Keywords: Horses, closed nucleus, inbreeding coefficients, relationship coefficients.

Introduction

The Lipizza breed of horses was created in the 16° century by Ferdinand of Asburg, Emperor of Austria, then officially recognized as a breed by the Queen Maria Teresa in 1700. It originates from Lipiza, a small town now in Slovenia, close to the Italian border. The breed is now reared in Austria, Slovenia, Italy, Czech Republic and Romania, and is derived from 6 male founder families: Pluto (Danish origin), Favory and Maestoso (Czech origin), Conversano and Napolitano (Italian origin) and Siglavy (Arabic origin). It is deirived from 15 female founder families, of which 11 still existing: Sardinia, Spadiglia, Argentina, Africa, Almerina, Fistula, Ivanka, Deflorata, Djebrin, Europa, Theodorosta.

After the Second World War the historical nucleus made of 7 stallions, 33 mares and 33 fowls was assigned to the Italian government together with the original herdbooks. The nucleus is now managed by the Research Centre for Agriculture, with the purpose of maintaining the genetic diversity of the breed through a sustainable use.

Materials and methods

We estimated relationship and inbreeding coefficients from a data set that included all horses born from 1738, and composed of 965 males and 2076 females. Inbreeding coefficient was calculated following Cruden (1949), Emik and Terrill (1949) and Plum (1954) through the common ancestry methodology. We treated the incomplete genealogical data as suggested by Folconer and Machay (1996), Kempthorne (1957) e Crow and Krimura (1970). The analysis was performed in SAS (1996) through the "Inbreeding" procedure, which simultaneously produces inbreeding and relationship coefficients. Average inbreeding and average relationship coefficient between the founders and the present breeders were also calculated.

Results and discussion

Average inbreeding of horses born before WW II , i.e. those that were in Slovenia at that time, was lower than the inbreeding coefficient of horses born in Italy between 1945 and 1955, which resulted 2.19 higher in males and 3.35 higher in females, compared to the Slovenian herd. Inbreeding of the present 8 stallions and the 45 mares was respectively 9.48% and 8.51% higher than inbreeding in the Slovenian herd (Table 1).
Inbreeding coefficient trend of horses born after 1955 (Figure 1) show high variability during the years, because of the mating plans that have to be performed by taking into account the maintaining of all the founder families.
Table 2 reports the coefficient of relationship between the 6 male founder families and the present breeders. We note that two founders, Napolitano and Siglavy, gave a higher contribution to the present population, being the coefficient of relationship > 20.

Table 1. Average inbreeding coefficient (c) for males and females born different periods

Period	Males			Females			Overall		
	n	c	ds	n	c	ds	n	c	ds
Born before 1945	619	4.83	0.28	1601	4.94	0.15	2220	4.92	0.13
Born between 1945 and 1955	16	7.20	0.66	56	8.34	0.36	72	8.08	0.32
Present breeders (2009)	8	14.31	1.08	45	13.45	0.46	53	13.58	0.42

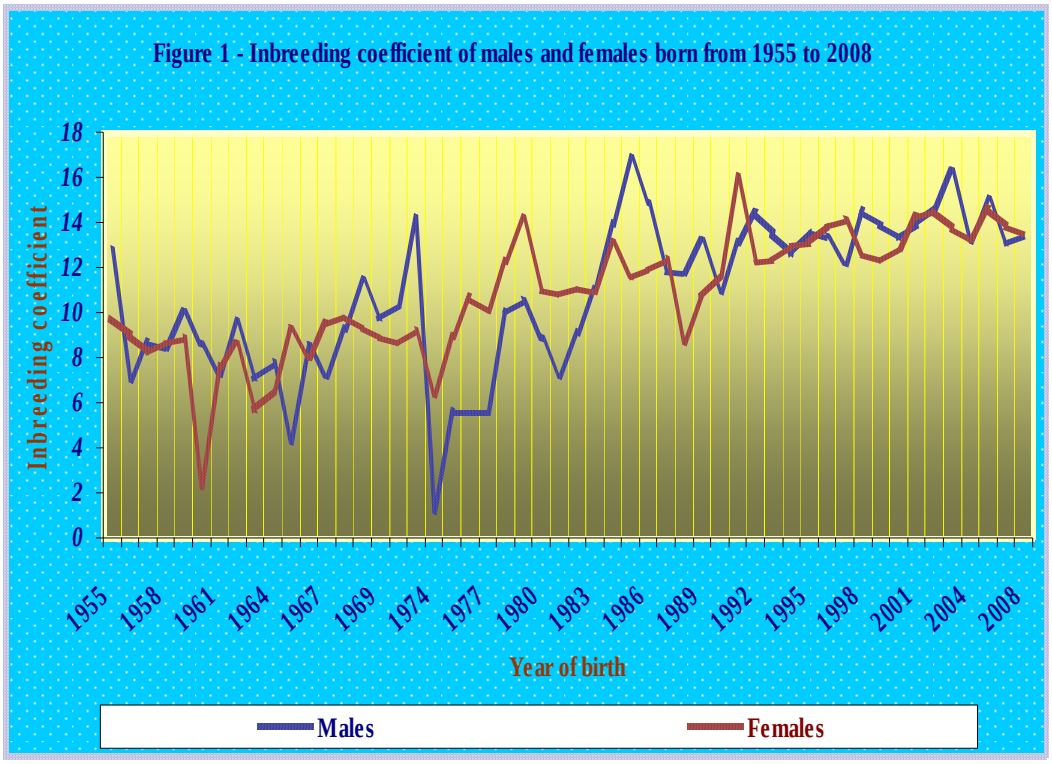

Table 2. Average coefficient of relationship (r) between the six male founder families and the present breeders (2009).

Family	Males		Females		Overall	
	r	ds	r	ds	r	ds
Conversano	19.56a	1.17	19.43bc	0.49	19.47b	0.49
Favory	18.40a	1.17	18.30c	0.49	18.34b	0.49
Maestoso	18.83a	1.17	19.07c	0.49	19.05b	0.49
Napolitano	20.34a	1.35	20.80ab	0.57	20.75a	0.56
Pluto	19.90a	1.35	19.21c	0.57	19.33b	0.56
Siglavy	21.53a	1.35	21.31a	0.57	21.37a	0.56

References

Cruden D.,1949. The computation of inbreeding coefficients in closed populations. *J. Hered., 40:248-251*;

Emik L. O. and Terrill C. E., 1949. Systematic procedures for calculating inbreeding coefficients. *J. Hered., 40:51-55*;

Plum M., 1954. Computation of inbreeding and relationship coefficients. *J. Hered., 45:92-94*;

Kempthorne O., 1957. An Introduction to Genetic Statistics, *chapter 5. John Wiley and Sons, Inc. New York*;

Crow J. F., and Krimura M., 1970. An Introduction to population Genetics Theory. *Harper and Row, New York*;

Falconer D. S. and Mackay T. F. C., 1996. Introduction to Quantitative Genetics, *chapter 5, Fourth Edition, Longman, London*;

SAS Institut Inc., 2006 , SAS/STAT Release 9.12. *Cary, NC, USA.*