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# Inbreeding levels in the Italian Heavy Draught Horse population

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## Introduction

Selection programs cause accumulation of inbreeding in most livestock species. Performance, health, fertility and survival are negatively affected by inbreeding (Weigel, 2001). In horses, racing performance (Klemetsdal, 1998), carpal joint arthritis (Dolvik and Klemetsdal, 1994) and retained placenta (Servinga et al., 2004) have been demonstrated to be negatively correlated with inbreeding rate. Reviewing the inbreeding control in selection programs, Weigel (2001) indicated selection intensity as the main factor than can affect inbreeding, rather than population size. However, in small populations heritability of selected traits is generally lower (Meuwissen, 1997) and lower $h^2$ can lead to a more rapid accumulation of inbreeding (Strandén et al., 1991). Therefore, the control of inbreeding is still a key factor in selection programs employed for small populations. The aim of this study was to evaluate inbreeding in the Italian Heavy Draught Horse (IHDH) population and particularly:

1. To analyze the inbreeding rate over years.
2. To evaluate inbreeding accumulation in the five main districts (regions) of the country where the breed is diffused.
3. To calculate relationship between inbreeding and fertility or length of productive life in IHDH mares.

## Materials and Methods

A pedigree of 38128 Italian Heavy Draught Horses was used in the analysis.

The data were obtained from the National Breeders Association and accounted for 21368 registered females (129 of which from the French Breton studbook) and 16760 males (145 French Bretons).

The base population was set in 1970.

The individual inbreeding coefficient was computed using the algorithm of Van Raden and Hoeschele (1990) that adjusts for missing pedigree information.

Simple statistics were obtained to describe levels and trend in inbreeding, while REGR procedure (SAS, 1996) was used to calculate relationship between inbreeding and length of productive life or no. of abortion/year of productive life.

## Results and discussion

Relatively to the 1970 population the Inbreeding coefficient (IC) ranged from 0.7 to 40.0%. The inbreeding level within the period of study was upwards, although the annual increase in the IC was generally low (+0.07%/year; Figure 1) and only 1.6% of still alive animals (4900) had an IC higher than 12.5%. The trends in the level of inbreeding showed a cyclic pattern over years, due to the allowed use of stallions imported from the French Breton population (FB). Indeed, stallions obtained by mating IHDH mares with FB stallions in the last decade showed a lower mean IC than those obtained within the IHDH population (2.90 vs. 4.35%), although the Breton animals from the French studbook are more related within group than the IHDH population. Indeed, the present still alive population indicates a higher percentage of animals with IC>12.5% within the animals of FB origin than within the IHDH population (9.4% vs. 1.5%).

The comparison of inbreeding across the five most important district of the country where the IHDH is diffused (87% of the overall population) indicated a very similar level of inbreeding in the country. There was only a slightly higher percentage of animals in the centre of Italy that showed a higher accumulation of inbreeding than in the northern regions (1.8% vs. 1.2% of animals with F>12.5%). This could be due to a higher use of the natural mating in the centre than in the northern regions of Italy.

The coefficient obtained by regressing inbreeding with the length of productive life was not significant although it revealed an interesting negative relationship between inbreeding and length of life (Table 1).
Probably due to the high variability observed for fertility parameter (such as for the lifetime) also the regression between inbreeding and foals/year or un-foaled/year was not significant (Table 1).

*Figure 1: Trend for inbreeding in IHDH population*

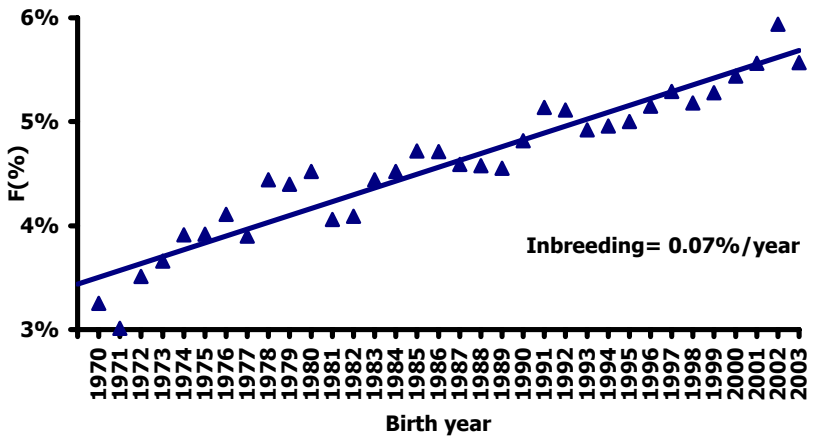
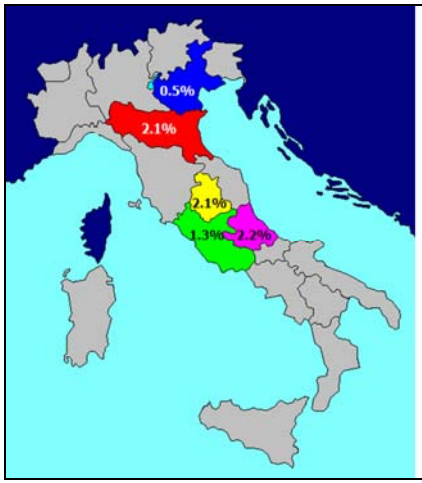



*Figure 2: Animals with F>12.5% within the 5 main regions*




| Region | % of Animals | Mean F |
|---|---|---|
| EMILIA ROMAGNA | 2.1% | 0.21 |
| VENETO | 0.5% | 0.24 |
| UMBRIA | 2.1% | 0.21 |
| LAZIO | 1.3% | 0.20 |
| ABRUZZO | 2.2% | 0.20 |

*Table 1: Relationship between inbreeding and lifetime or fertility parameters*

| Variable | Regression Coefficient | P |
|---|---|---|
| Length of Life (month) | -2.96 | n.s. |
| Foals/Year of life (No.) | -0.11 | n.s. |
| Un-Foaled /Year of life (No.) | 0.05 | n.s. |

## Conclusions

The mean inbreeding rate observed over years for the IHDH population resulted very low and of no great concern despite the small population size (i.e. about 3000 registered mares and 400 stallions).

This is the result of the opening of IHDH studbook both to mares with unknown pedigree but with minimum morphological score and to stallions from the French Breton population.

No great differences were observed for inbreeding among regions and no significant relationship were found between inbreeding and lifetime or fertility traits.

A constant control of inbreeding to optimise the selection scheme appear necessary.

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