



Morphological and genetic characterization of Spanish heavy horse breeds: Implications for their conservation

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ABSTRACT

Spanish heavy horses play a very important role in keeping up ecologically important rural areas. The interest in their conservation and characterization has increased over the last few years. The aim of this work is to contribute to the characterization of the endangered Spanish heavy horse populations in order to obtain useful information to implement conservation strategies for these genetic stocks. A total of 426 horses from six Spanish heavy horse populations corresponding to the four main heavy horse breeds (Hispano-Breton (HB) – with most animals located in three areas: Burgos (HBbu), León (HBle) and Palencia (HBpa) – Jaca Navarra (JN), Burguete (B) and the Cavall Pirinenc Català (CPC)) were analysed using 22 body measurements, 10 indices calculated from the body measurements and 16 microsatellite markers. From a morphological point of view, all the populations are clearly differentiated, except for the HBpa female population, which is located between the HBbu and JN populations. The HBle has greater body size than the other populations analysed, especially when compared to the JN. The genetic analysis provides us with information about the history of the analysed breeds. However, the most important point borne out by this analysis is the clear identification of different genetic backgrounds within the Spanish heavy horse populations. The overall information given in this work leads us to consider that the genetic scenario of the Spanish heavy horses is more likely to be due to 'ancestrally' different genetic backgrounds. Spanish heavy horse breeds resulted from the crosses between native mares and foreign stallions. The CPC population was the first in which this introgression occurred and the use of foreign stallions became more common. This work presents results based on neutral genetic variation, but also within- and between-population differences in morphological traits that have undergone artificial or natural (adaptive) selection. This information should be taken into account in future conservation strategies in order to contribute towards the efficiency of conservation measures. In this sense, the main problems are the small population size and genetic degeneration, with the consequent future loss of diversity. Therefore, the most immediate and effective conservation priorities would be (1) to avoid inbreeding within populations, (2) to increase the population size, and (3) to facilitate genetic exchange among the populations.

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1. Introduction

Native Spanish horse breeds have traditionally been used for saddle and light draught because of their body shape. The interest in obtaining draught horses for agricultural and military purposes led to the introduction of heavy horses to increase body size. Among heavy breeds, Ardennes, Belgian Draught or Percheron stallions have been imported from the late 19th

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century onwards, to cross them with native Spanish mares (Aparicio, 1944; Pérez-Gutiérrez et al., 2008). Of the foreign horse breeds used, only Breton horses (mainly the Postier Breton variety) and their crosses adapted successfully to the Spanish environment and management conditions (Alonso, 1999; Pérez-Gutiérrez et al., 2008). Since the 1930s, the Spanish Military Cavalry services have encouraged the systematic crossing between Breton stallions and local mares of the Northern Spain mountain branches and the agricultural Levant to obtain heavy horses (Alonso, 1999). In the middle of the 20th century, the Spanish draught horse populations consisted of roughly 120,000 individuals (with well-defined populations in the Cerdaña area of Catalonia, Aragón, Navarra (Burguete), Northern Castilla-León, and also Valencia and Murcia in the Mediterranean area (Aparicio, 1944)). Since the 1960s, the Spanish Military Cavalry services have mainly used Breton stallions of the 'Spanish type', usually obtained from the Spanish draught horse populations, thus creating the Hispano-Breton (HB) breed (Alonso, 1999; Pérez-Gutiérrez et al., 2008).

During the latter part of the 20th century, the mechanisation of agriculture led to a marked decrease in the Spanish heavy horse population and some of them (such as those from Aragón and the Levant) disappeared, while those remaining were exploited on harsh mountain pastures to produce horse meat (Alonso, 1999).

At present, Spanish heavy horses play a very important role in keeping up the ecological importance of rural areas, and the interest in their conservation and characterisation has increased over the recent years. Three horse breeds, Jaca Navarra (JN), Burguete (B) and Hispano-Breton (HB), have recently established their studbooks, and are considered by the Government as endangered breeds. Moreover, a characterisation and conservation programme is being developed for the remaining *Cavall Pirinenc Català* (CPC) (Jordana et al., 2006). These populations make up about 90% of the total number of horses slaughtered in Spain nowadays.

The JN is a light draught breed located in the north of Navarra (South-Western Pyrenees). It is considered a remnant of the first crosses between the foreign heavy horses and the local mares, probably linked to the present Pottoka or Losino pony breeds (Solis et al., 2005). Despite its type differences, it has been included in genetic analyses as a Northern Celtic-Iberian native pony breed (Solis et al., 2005). Its studbook was established in 2001 and accounts for 595 registered animals.

The B is a medium-sized horse breed located in the north of Navarra. It is the result of the complete absorption of the local mares into the foreign heavy stallion stock. Its studbook was established in 1999 and has a total of 4007 registered animals.

The HB is mainly located in the north of Castilla-León, generally on the south side of the Cantabrian mountain range. Most animals are located in three different areas: Burgos (HBbu), León (HBle) and Palencia (HBpa). These populations have differences in their breeding programmes, and HBle is considered as the most representative of the breed (Alonso, 1999). This breed was officially recognised in 1960 and its studbook was established in 1998. It accounts for 6307 registered animals.

The CPC is what remains of the main Spanish heavy horse populations (the old Cerdaña horse). This population comprised

over a half of the total heavy horses in Spain during the first half of the 20th century, and shows a greater influence of the foreign Breton stallions (Aparicio, 1944). At present, it is located mainly in the Central and Western Catalonian Pyrenees, with a total of 4513 animals.

The characterization of livestock breeds has traditionally been based on their type characteristics. However, their morphology is greatly affected by the selection processes, and this fact has led to the characterization of livestock populations via neutral markers (Druml et al., 2007; Zuccaro et al., 2010). Nevertheless, Ruane (1999) has pointed out that the relative value of genetic distance studies for breed characterization is limited, and other criteria, such as morphology, should be used. Besides the characterization of the different breeds, animal conformation allows us to define the productive use of each breed, and the analysis of its conformation traits is of great interest to meat producers (Alberti et al., 2008; Wolf and Jones, 2007).

The interest of breeders and researchers in Spain has mainly focused on the native Spanish saddle horses (Azor et al., 2007; Cervantes et al., 2008, 2009; Gómez et al., 2009a, 2009b; Valera et al., 2005). However, interest in the characterisation of draught horses in Europe, mainly for conservation purposes, has increased over the last few years (Druml et al., 2007; Pérez-Gutiérrez et al., 2008; Zuccaro et al., 2010).

Within the framework of breed conservation, genetic characterization is important in the conservation of breed integrity and is a prerequisite for managing genetic resources. The combination of genetic diversity and relationship information provides important baseline data for future breed conservation efforts, especially for critically endangered breeds.

The aim of this work is to contribute to the characterisation of the endangered Spanish heavy horse populations in order to obtain useful information for the implementation of conservation strategies for these genetic stocks.

2. Material and methods

2.1. Breeds and sampling

Six different populations of the main four Spanish heavy horse breeds (JN, B, HBbu, HBle, HBpa and CPC) were sampled. Their geographical location in Spain is described in Fig. 1. All of them are located in the north of Spain, with similar environmental conditions and composition of pasture land.

A total of 426 individuals (327 females and 99 males) belonging to these six populations were sampled for genetic and conformation analyses. The sampling of closely-related individuals (full and half sibs) was excluded, and only breeding stocks older than 4 years were included, because their bodies were fully developed (Druml et al., 2008; Molina et al., 1999). Foals and pregnant mares were also excluded. The composition of the sample is summarised in Table 1. This sampling proved very difficult due to the extensive production system of the heavy horse populations. The number of males sampled was lower than females due to the scarcity of males present in these endangered breeds, because the ratio of females to males is around 15:1.

All the animals came from different farms (at least 5 animals per farm) with similar management system (feeding,

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