GENETIC EROSION ON CAMELIDAE

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RESUMEN

El autor describe la situación actual de los camélidos en América del Sur, aportando información sobre la geografia, distribución y número de las tres especies existentes: llama, alpaca y vicuña. Vienen presentados igualmente datos estadísticos importantes sobre las razas y sus sistemas de producción. Algunas indicaciones también sobre la escasa, pero cierta, erosión genética como consecuencia de las transformaciones ambientales y de gestión, asi como del cambio registrado en la demanda de productos.

Palabras clave: Recurso genético, *canieliclae,* America del Sur

SUMMARY

The author describes the actual situation of the South American *Caiiielidae with* information on the geographic distribution and numbers of the three existing species, namely the llama, the alpaca and the guanaco. Data on vital statistics and products and on the existing breeds and production systems compl ete the picture. The available indication on the scarse but certainly occurring genetic erosion are described as a consequence of environmental and management changes but also changing demand in the products.

Key words: Genetic Resources, *Cameli'dae,* South America

1.0 INTRODUCTION

The fmfly *Camelidae,* which originated in North America during the Eocene 40-45 million years ago, comprises two distinct groups of animals. One group, usually referred to as Old-world Camelids, includes two living species: *Camelus bactrianus* (two-humped camel) and *C dromedarius* (one-humped camel). Both are primarily domesticated animals although some wild ancestors of the Bactrian camel exist in the Gobi Desert. The second group, referred to as New-World camelids, includes two genera: Lama with three species: *L. glama (llama), L. pacos* (alpaca) and *L. guanicoe* (guanaco), and the genus ***Vicugna*** with only one species, *V. vicugna* (vicuna). The llama and the alpaca are domestic animals whereas the vicuna and the guanaco exist only in the wild state. All six species of *Canielidae* have similar karyotypes (2n=74) in spite of the fact that their separation and subsequent migration into two different continents occurred about three million years ago. Crosses between members of the genus *Camelus* as well as between Lama have been reported and the resulting hybrids are fertile. Particularly common in the South American highlands are the crosses between llama and alpaca and between mate alpaca and female vicuna. Domestication of llama and alpaca occurred in the Peruvian Andes about 6 000 to 7 000 years ago. It is generally thought that the llama originated from the guanaco whereas the alpaca has often been described as descending from the vicuna, from the guanaco or a llama-vicuna hybrid (Hemmer, I 990).

2.0 NEW-WORLD CAMELIDS (NWC)

The numbers of the four species of NWC in South America are shown in Table 1. Peru and Bolivia possess more than 90% of llamas and alpacas whereas most of the guanacos are located in the southern tip of the continent, in Argentina. Other countries such as the USA, New Zealand and Australia also possess increasing numbers of llamas and alpacas.

The present distribution of NWC extends from about 8 degrees South (Calipuy guanaco reserve in Peru) to about 55 degrees south in the Navarino Island, Chile at altitudes varying from sea level to more than 5,000 m above sea level. Guanaco has the widest distribution among the four species.

The domestic species, llama and alpaca, play a very important role in the economy of a large population of the Andean region of Peru and Bolivia and, to a lesser extent, Chile and Argentina. They are the only means of utilizing the extensive highland resources since neither crops nor sheep or cattle can be raised profitably due to limitations imposed by the high altitude. Even though most of alpacas and llamas are at present raised at altitudes varying from 3 000 up to 5 000 m above sea level, there is historical evidence that during the Incas empire they were more widely distributed among the coastal regions and the highlands. With the arrival of the European conquerors and the introduction of sheep and cattle, camelids were confined to marginal areas where the newly introduced species were unable to survive; their rational breeding was also totally neglected. The main products derived from them are wool (usually called fibre), meat, pelts, hide and dung which is used as fertilizer and fuel. Alpacas are raised mostly for fibre production (commercially called Alpaca); however the contribution of meat to total income may be close to 50%. Llamas produce a coarser fibre but because of their larger size they are a very important source of meat. They are also used as pack animals.

Alpaca Suri (Peru)

TABLE 1
Estimated numbers of NWC in South America (000)

	Alpaca	Llama	Vicuna	Guanaco
Peru	2,687	1070	60	1,6
Bolivia	324	2023	12	—
Chili	47	58	30	25
Argentina	1	135	23	578,7
Ecuador	0,2	10	0,4	—
Total	3059,2	3296	125,4	605,3

There are two well defined breeds of alpacas: Suri and Huacaya. They differ in the type of fibre they produce. Suri fleece is similar to that of Lincoln sheep whereas Huacaya fleece resembles that of Corriedale sheep. The Suri breed exists only in Peru and its number is declining. From an estimated 22% of the total population about three decades ago it has decreased to only 5%.

Two breeds of llama are also recognized: Kara and Chaku. Kara is characterized by a shorter fibre and a stronger body conformation than Chaku that makes them more suited as pack animals. Chaku is a more woolly type, somewhat intermediate between llama and alpaca. This appearance gave rise to the question whether Chaku is a true breed or just a llama-alpaca crossbred. On average, llama populations are composed of 80% Kara and 20% Chaku.

Coat color in both llamas and alpacas vary from white to black and different shades of brown; combinations of white with black or brown patches also occur frequently The predominant color in alpacas is white, especially in large commercial farms, because of the higher demand and better prices paid by the industry for this kind of fibre. The exact mechanism of transmission of fibre color in both alpacas and llamas is unknown.

More than 80% of alpacas and llamas belong to small farms and are usually kept in association with sheep and cattle in extensive systems where the natural pastures are the only feed source. The relative numbers of this species vary according to the altitude; the higher the location the fewer the presence of cattle and sheep. Most of the grazing lands are communal properties while animals are individually owned. This situation usually gives rise to overgrazing since each individual tends to keep as many animals as possible regardless of the carrying capacity of the grasslands. The management of the animals in the small farms is in general.very poor which results in low reproductive rates, high mortality, especially of newborns, and low fibre and meat production. Some large farms, some of which belong to cooperatives, have improved management systems thereby obtaining higher production levels.

Some biological and production parameters of llamas and alpacas are shown in Table 2. The values are the best estimates based on different reports; they may vary with the altitude at which farms are located and the level of management.

TABLE 2

Some production parameters in alpacas and llamav

	Alpaca	Llama
Gestation length (d)	342-345	348
Birth weight (kg)	7,0	11,9
Adult weight (kg)	60	90-110
Fleece weight (kg)	1,8*	1,0*
Diameter of fibre ([i)	23-24	24-30
Age at first parturition (mo)	36	36
Parturition rate Clo)	47-50	55-60
Mortality rate (%)**	27-50	<20

** in 12 months*

*** up to 6 months of age*

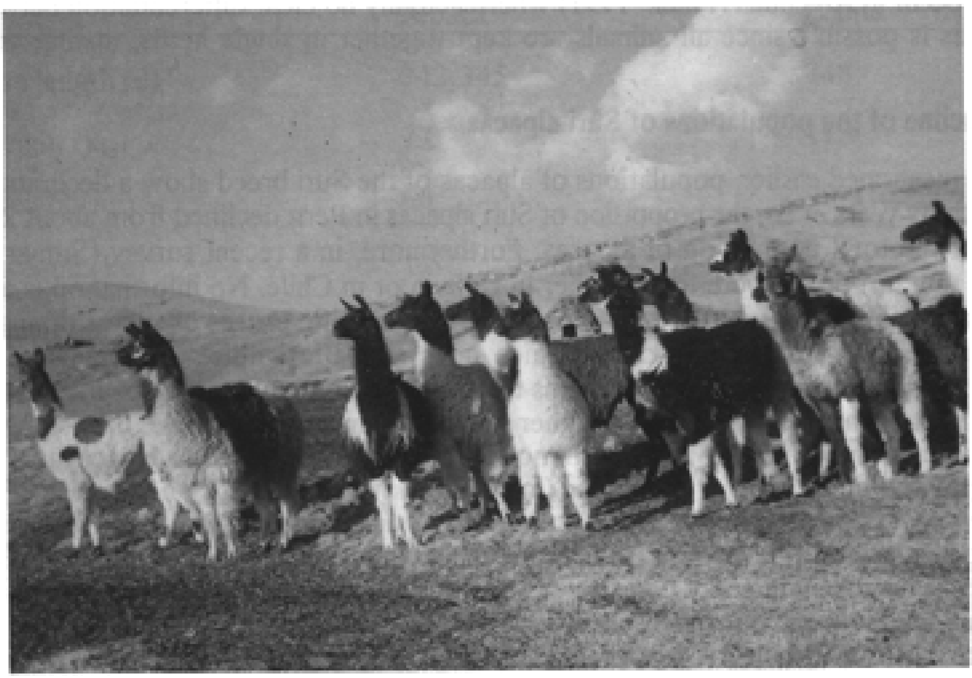
3.0 INDICATORS OF GENETIC CHANGE (EROSION)

Even though documented information on genetic erosion in *Camelidae* is almost non-existent, there is some evidence indicating that many factors related to management, environment and commercial preferences are causing changes in the genetic diversity of camelids particularly in the domestic species, llama and alpaca. Such factors include:

3.1 Hybridization

The introduction to the Incas Empire of new domestic species with the Spanish conquerors in 1532 brought about a drastic change in the management of llamas and alpacas. They were confined to the most marginal lands, the controlled breeding practices of the Incas were disrupted and the numbers of llamas and alpacas were reduced possibly by up to 90%. The ensuing uncontrolled hybridization probably altered the genetic make-up of the surviving populations. Therefore the present populations of llamas and alpacas may not necessarily be the same as those that existed during the times of the Incas Empire. In fact, the recent discovery of 900 1000-year-old naturally mummified llamas and alpacas in Southern Peru exhibiting a uniformity of fibre fineness and colour absent in contemporary animals suggests that they either represent presently unknown varieties or are simply pure, unhybridized animals (Wheeler et al., 1992). It is likely that the changes in environment and management conditions imposed on domestic

Llama Kaba (Peru)



Llamas Chaqu and Kara (Peru)

Alpaca Hurcaya (Peru)

Vicuñas (Peru)

camelids as a consequence of the introduction of other exotic species may have caused the disappearance of some genetic groups unable to withstand the highlands environment to which they were confined.

On the other hand, recent data on molecular evolution in Camelids (Stanley et al., 1994) seems to provide genetic evidence that hybridization has occurred in the history of the NWC thus supporting observations made by llama and alpaca breeders based on phenotypic characters alone. Hybridization also occurs to a great extent in present day farming conditions when llamas and alpacas are run together as happens quite often in small farms. An extreme case of hybridization appears to occur in Argentina (Frank, 1991) where actually no clear differentiation between llamas and alpacas is possible since all animals are kept together in single herds, mating occurring at random.

3.2 Decline of the populations of Suri alpacas

As mentioned earlier, populations of alpacas of the Suri breed show a declining tendency. In the last thirty years or so, the proportion of Suri alpacas in Peru declined from about 22% to less than 5% of the total population of alpacas. Furthermore, in a recent survey (Sumar, 1991) no alpacas of the Suri breed were found either in Bolivia or in Chile. No information is available of past populations of the Suri in these two countries. The specific causes of such a dramatic decline of the Suri populations are not known since no systematic studies are available. However, according to breeders' observations, it seems that Suri alpacas are more susceptible to the effects of high altitudes. When kept at altitudes higher than 4 200 m above sea level they show decreased reproductive efficiency and high new- born mortality rates as compared to Huacaya. Whether this is a consequence of their peculiar phenotype (long shaggy hair that hangs on the sides of the animal leaving the upper body parts uncovered) or some other genetic factors, is not known. On the other hand, since death rates of new-born alpacas are usually high (sometimes more than 50%) the sale of pelts for the handicraft industry constitutes an important source of income. Suri pelts are not as desirable as the Huacaya ones for that purpose; therefore, they are sold at lower prices. These factors are likely to influence breeders' preference for Huacaya in detriment of Suri. If this tendency persists it may lead to the total loss of this valuable genetic group and with it the loss of some unique traits not found in Huacaya such as fibre length.

3.3 Color preferences

The higher commercial demand for white alpaca fibre has resulted in the adoption of selection criteria based exclusively on color without regard to other important traits. As a consequence the proportion of the white population has increased considerably in detriment of other solid coat colors such as black and brown. This is especially true in Peru where white alpacas constitute about 56% of the total population as compared to 24% of brown and 4% black. In contrast, alpaca populations in Chile and Bolivia are reported to be composed of 13% white, 41-52°/o brown and 14% black. This is explained by the fact that selection intensity for white color in the two latter countries is low since commercial alpaca production is of much less magnitude than in Peru.

Studies on the effects that selectionbased on a single trait (white coat color) may have on other traits of economic importance such as body weight, fleece yield, fibre length and fineness, are unfortunately lacking. However it seems obvious that this breeding practice may in the long run cause serious loss of alpaca genetic diversity.

3.4 Effects of management practices

Some management practices are likely to bring about genetic changes in both alpacas and llamas in addition to the extensive hybridization already mentioned, For instance in some commercial alpaca farms an increasing incidence of genetic abnormalities has been observed as a possible consequence of high inbreeding coefficients resulting from the use of small groups of males for several generations; the life-span of alpacas may be as long as 15 to 20 years. Artificial selection for traits other than color of fibre is hardly practised; therefore culling of animals with undesirable characteristics such as genetic abnormalities is not the usual practice. In addition, because of low reproductive rates (an average of about 500/o) and high mortality of the newborns, which may reach 40-50% in some years, the number of available replacements is generally low which discourages any extensive cuflings. Tlis situation may be aggravated by the common practice of keeping a high proportion of castrated males for fibre production in detriment of breeding females which constitute only about 40% of the total alpacas in a farm. The situation is likely to be similar in llamas where selection for traits of economic importance is hardly practised or non-existent.

4.0 **GENERAL COMMENTS**

Even though documented information on genetic erosion in domestic South American camelids is very scarce, there are some clear indications that such genetic erosion is occurring as a consequence of several factors such as changes in the environment where they are raised, breeders' preferences, management practices, and preferential demand of products by the industry. These changes, should they persist, may affect seriously the genetic diversity of both llamas and alpacas in the long run. There is an urgent need to determine more precisely the extent to which these factors and others are contributing to genetic erosion on Camelids in order to take the required steps to preserve genetic diversity, on more solid grounds.

Alpaca x Vicuña (Peru)

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THE GERMAN COACH HORSE "SAXONY WARMBLOOD"

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SUMMARY

The author gives information on the phenotypic and genetic characteristics, the history and the present state of the endangered breed German Coach Horse

Key words: Genetic Resources, Horse, Germany

RESUME

L'auteur donne des informations sur les caractéristiques phénotypiques et génétiques, I'historique et 1'état actuel de la race dénomée cheval de trait allemande race en voie d'extinction.

Paroles clés : Ressources génétiques, cheval, Allemagne

1.0 HISTORY

The German Coach Horse, which is also called Schweres Warmblut, Old-Oldenburger, Heavy Warmblood or Saxony Warmblood, developed in the last century and filled the requirement for a horse between the heavy draught horse used in agriculture on heavy soils and the light riding horse used by cavalry individually. The region of origin was the area of Oldenburg/Ostfriesland in the north of Germany, a region with old traditions in animal breeding. The first register was established in 1861. The German Coach Horse had great importance in agriculture on small farms, in transport and in artillery movement. As a result of the reduction of the importance of horses in agriculture and army after the second world war the stock of this breed decreased rapidly. There was a marked increase in demand for a light horse suitable for riding sport. Therefore the heavy mares were mated with Thoroughbred stallions to produce a sport horse. At the end of the sixties the number of heavy stallions decreased and in the years 1975 and 1976 no breeding took place. It is a curiosity that in the region of Saxony and Thuringia 12 heavy stallions of the National Stallion centre in Mofitzburg (Saxony) were not castrated and worked as coach horses. They became the basis of the reactivation of the breed “Saxony Warmblood”. Now in Saxony and Thuringia there exists a small population of about 600 mares and 20 stallions. Related breeds exist in Oldenburg/Ostffiesland, Denmark, Poland (Slansk), the Netherlands (Groninger), Bavaria (Rottaler) and Baden-Wiirttemberg (Alt@rttemberger).

2.0 CHARACTERISTIC OF THE BREED

The Saxony Warmblood is a very typical elegant german coach horse. Its body is broad and deep, the neck and the croup are muscular. The two pictures show a representative from the historical and the existing population. Very typical compared with other breeds is the swinging trot with a high action. This breed is precocious, sociable and has a quiet temperament. About 90% of the population are brown or black horses (Table 1). The important data of body measures are shown in table 2.

TABLE 1

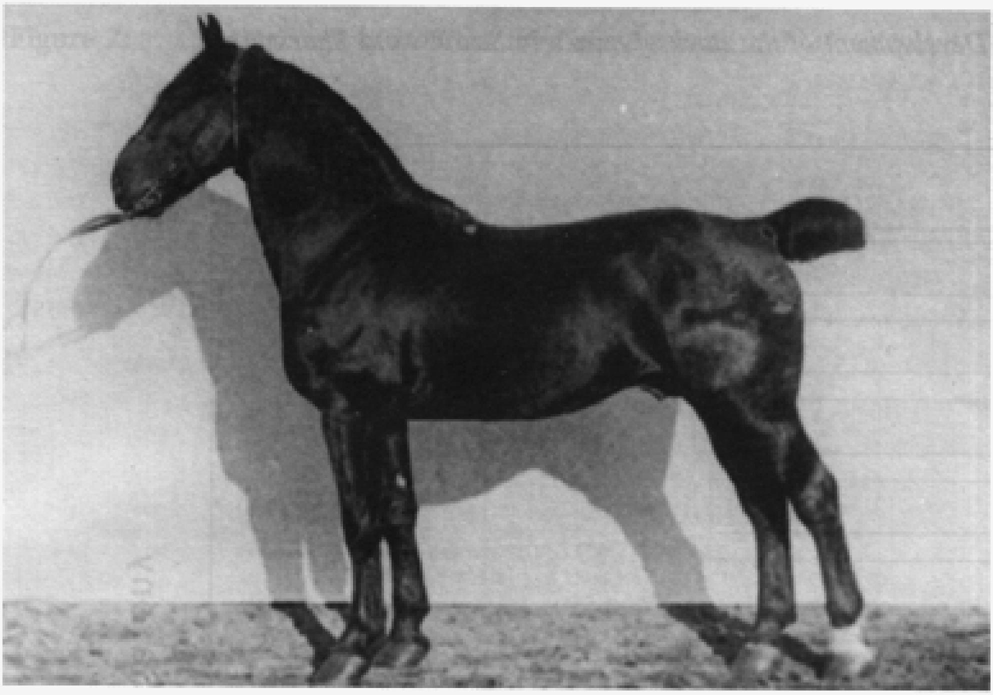
Distribution of coat color in the popiilation of mares of Saxony Warniblood (Wiesner 1989)

Color	absolute (n)	relative (%)
Brown	298	58
Black	173	34
Chestnut	30	6
White	8	2
total	509	100

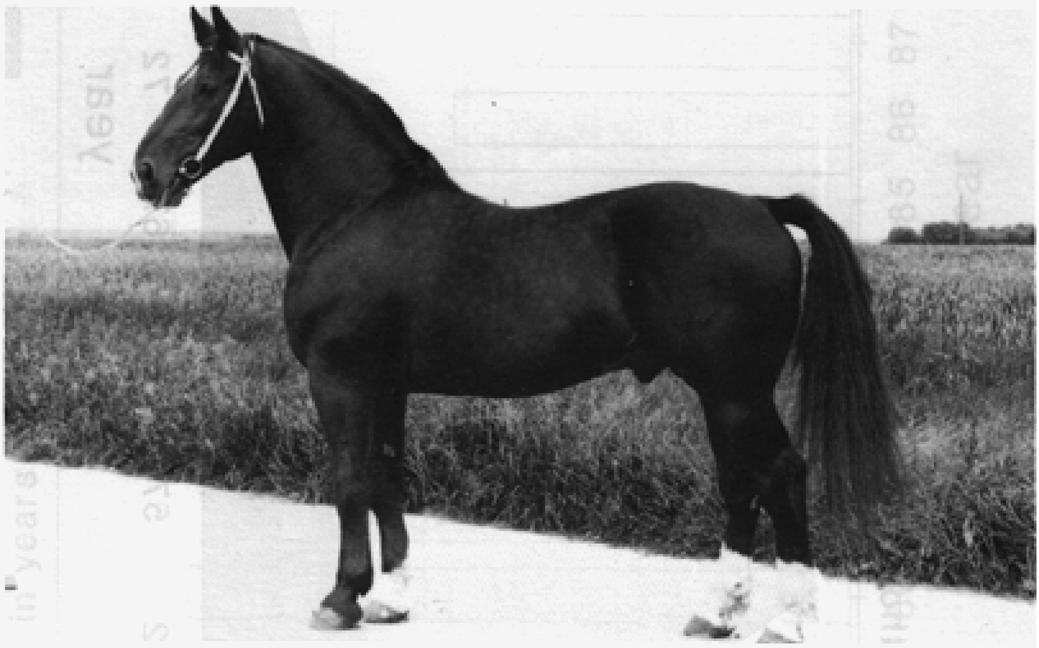
TABLE 2

Measurement of Saxony Warmblood (cm)

height of withers	158...165
length of body	163...170
girth	196...203
cannon	22...24
live weight	600...700



Stallion "Augustus" born 1898



Stallion "Lord II" born 1984

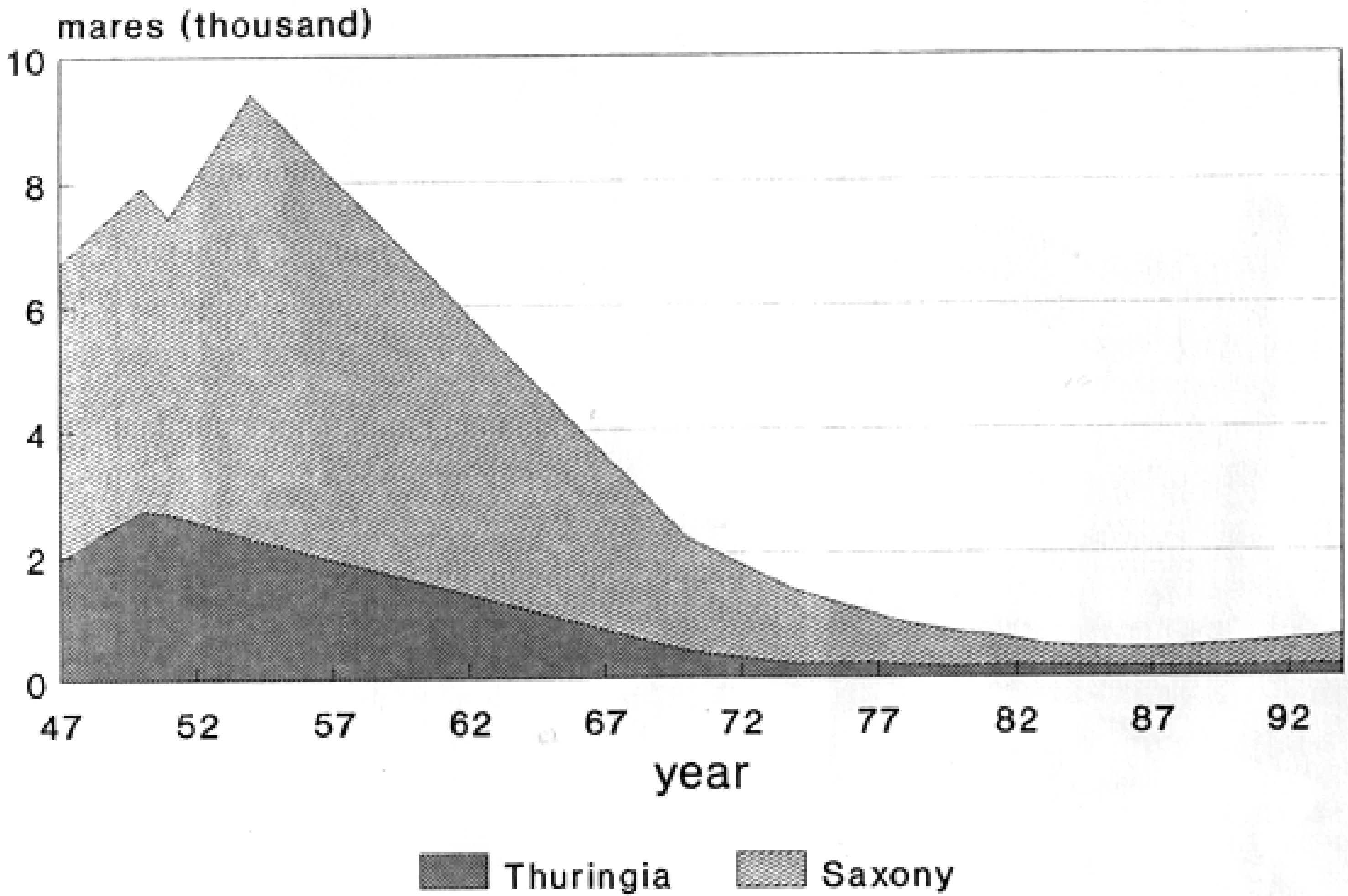


Figure 1: *Development of the stock of mares in Saxony and Thuringia.*

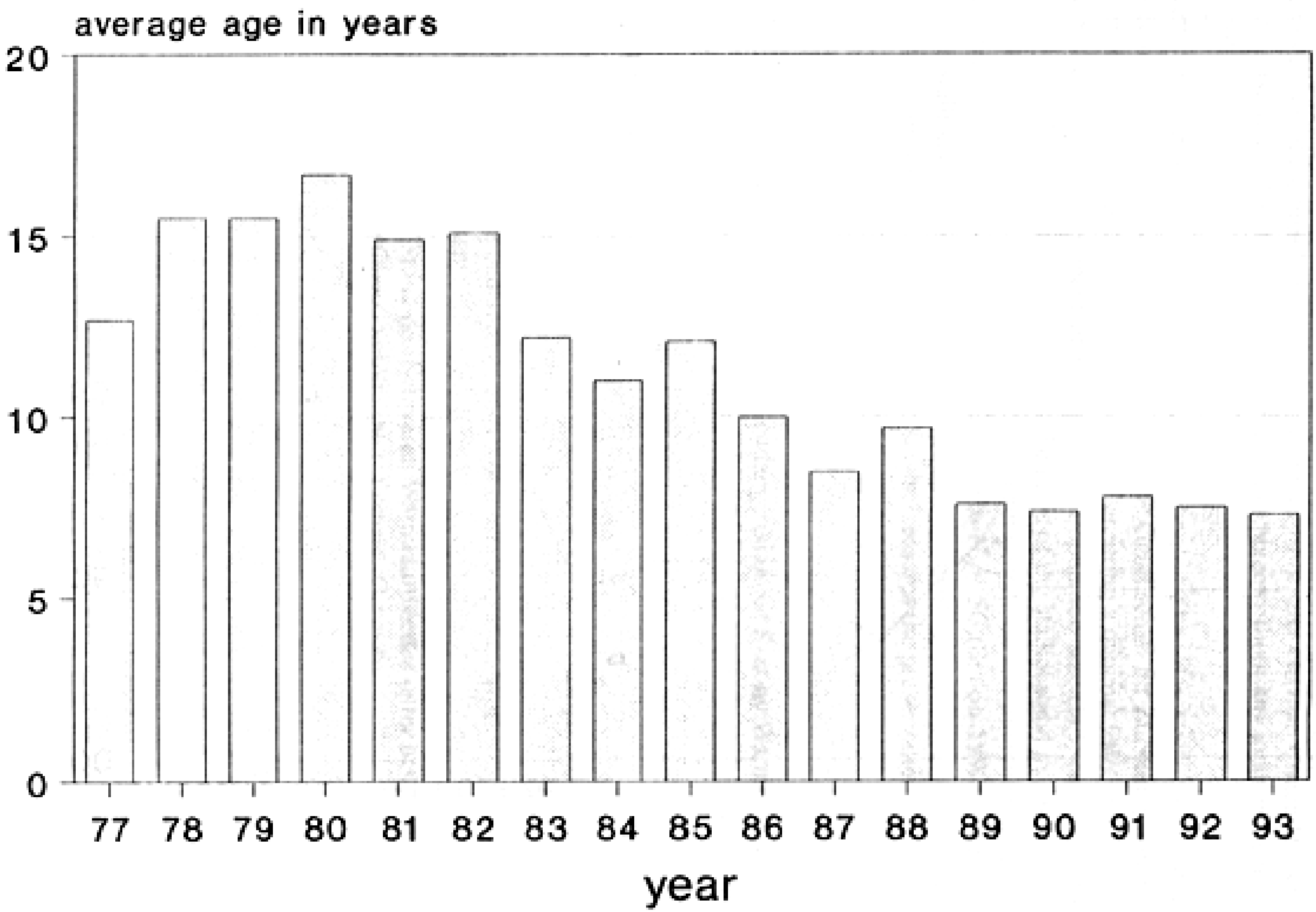


Figure 2: *Average age of stallions used since reactivation of the breed.*

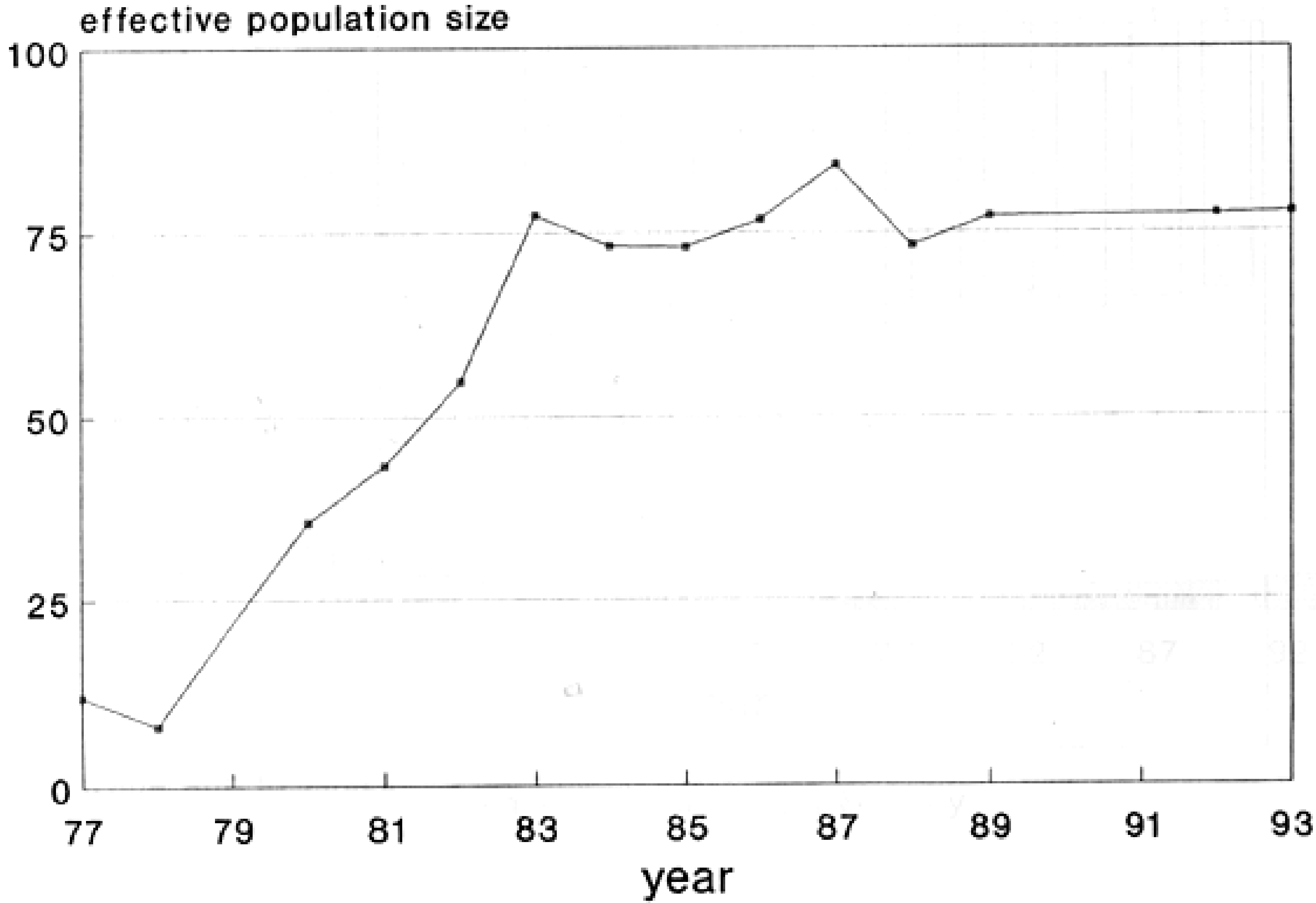


Figure 3: *Development of the effective population size, calculated on the basis of stallions and mares used.*

3.0 DATA OF THE POPULATION

The existing stock of mares descends from the population in Saxony and Thuringia. Figure I shows the development of the stock of mares in these two regions. The breed was reactivated by old individuals. Figure 2 shows the average age of the stallions used since 1977. Since the end of the eighties the population has stabilized, and a large generation gap has developed. The survival of the breed seems to be ensured. In 1992, 287 German Coach Horse foals were bom and registered in Germany. The breeding takes place without any input of genes from other populations.

However the status of endangerment of a breed should be based not only on the absolute number of breeding animals. A proposal of the “Deutsche Gesellschaft flir Zijchtungskunde”, the German branch of EAAP, concentrates on the concept of ensuring a minimal Effective Population size. Picture 5 shows the development of the Effective Population size (N.), calculated by the formula N. = 4 N@./(Nf+N.) (Falconer 1969) on the basis of the stallions and mares which were used for mating. If we want to keep inbreeding below 1% per generation and minimize genetic drift, the Effective Population size should not be smaller than N. = 50 (Simon 1992). The formula assumes unrelated stallions and random mating. Therefore the existing population with about 600 mares and 20 stallions seems to be a practical solution which ensures the preservation of the genetic resource and allows a minimum of selection on type and conformation.

4.0 CONCLUSIONS

With the help of breeders and officials the endangered breed Saxony Warmblood could be maintained in a small population. This would also be an important genetic pool for the related breeds outside Germany.

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