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PHYSICAL DEVELOPMENT OF WILD BOAR IN THE CANTABRIC MOUNTAINS, ÁLAVA, NORTHERN SPAIN

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ABSTRACT

The study of the morphological characteristics of an animal population reveals the state of the relationship between the species and its environment. For adequate management, it is necessary to evaluate the health, physical condition and productivity of wild populations and their habitats (Kirkpatrick 1980). In this study, we examined a sample of 673 wild boars (*Sus scrofa,* L.) that were captured between 1992 and 1997 in Álava province, Spain. We characterized the morphometrics (e.g., weigh, body size) of wild boar in the Cantabrian population. To determinate a boar's age, we used tooth reinstatement tables (for individuals younger than 24 months) and a count of the cement lines of incisor I_1, which allowed us to establish a mathematical growth model for the Cantabrian population of wild boar. Of all of the measurements we recorded, body-head length and length of the jaw are the parameters that have the strongest correlation with age. With both variables, the correlation is expressed a logarithmic equation ($y=a \ln x + b$). The mean body weight of mature males and females were 74.27±3.34 kg and 55.30±1.15 kg, respectively. The mean body-head lengths of males and females were 154.37±3.24 cm and 142.23±1.06 cm, respectively. In both sexes, body size was similar to wild boar in a population in France, but they were smaller than those in other Spanish populations in the Demanda Mountains, Burgos, northern Spain, which might be due to differences in population density. In both sexes, growth rates follow the typical pattern: wild boar exhibit strong incremental growth in the first year, but continue to grow, albeit more slowly, throughout the animal's life.

Key words: northern Spain, physical development, *Sus scrofa,* Wild boar.

DESCRIPTION OF THE STUDY AREA

The historical territory of Álava is part of the Autonomous Community of the Basque Country, northern Spain, and borders the provinces of Vizcaya and Guipúzcoa to the north, Navarra to the east, La Rioja to the south, and Burgos to the west (Figure 1).

Álava has an area 3.047 km^2, approximately 43% (1.320 km^2) of which is forest and bush areas, where wild boar can grow and develop. Álava is at the northeast end

Figure 1. Location of the study area within Spain.

of the Iberian Peninsula and is an area of transition between the Pyrenees, the Cantabrian Mountains, the Castillian region, and the Ebro Valley. Due to the area's position between the Atlantic and the Mediterranean, it has highly peculiar characteristics of vegetation. In addition, the east-west orientation of the mountain ranges produces important botanical differences between areas of shade and sun. The vegetation on the northern side of the ranges is predominantly beech forest (*Fagus sylvatica*) and oak (*Quercus robur* and *Q. pyrenaica*.). On the southern hillsides, there are evergreen-oak groves and small holm oak groves (*Quercus ilex ssp ilex* and *Q. ilex* ssp *rotundifolia*).

To analyse the community of ungulates in the region, we divided the study area into seven Management Units and grouped the different subpopulations into sectors that have common botanical characteristics. Other limits we taken into consideration, which obviously prevented the natural movements of wildlife (e.g., highroads, railways, and heavily used country roads).

MATERIALS AND METHODS

In vertebrates, there are many density-dependent factors that contribute directly to the natural regulation of populations, including intraspecific and interspecific competition, factors related to food availability (Begon et al. 1988). Furthermore, some species exhibit territorial behaviour by establishing a social hierarchy that contributes to the self-regulation of the population, which influence directly the dispersal of juveniles (Prior 1995). Those phenomena can be studied using a series of steps taken on the animals under study, which allows us to assess the state of the animal population and its environment (Navarre 1993). Furthermore, the analysis of

body growth should be considered with respect to sex and age class of the individuals because of differences in the size and physical condition of the animals (Dzieciolowski 1970, Aumaitre et al. 1982).

In our study, measurements (see Figures 2 and 3) are based on a sample of 673 wild boars (*Sus scrofa* L.) captured between 1992 and 1997 in the province of Álava, northern Spain. We did not consider the possible inter-annual differences in food availability because we did not find significant differences in climatological variables in the years of this study. Additionally, the high botanical diversity of Álava attenuates the effects of possible annual food shortages (Markina 1998).

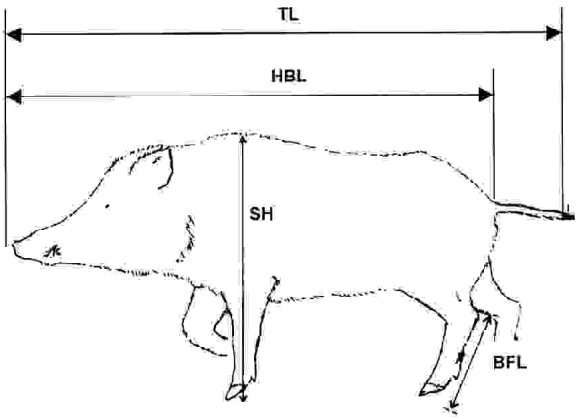

Figure 2. Body measurements take on wild boar from a population in the Historical Territory of Álava, Spain.

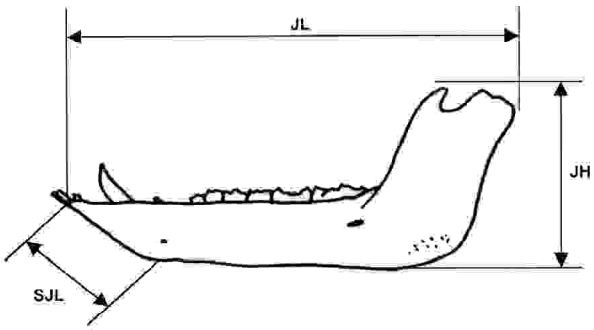

Figure 3. Jaw measurements take on wild boar from a population in the Historical Territory of Álava, Spain.

To assess the degree of sexual dimorphism and the relationship between growth parameters and age (Table 1), we performed regression analyses in which x = age and y = the dependent variable in question, and correlation coefficients (r) were calculated (Sokal and Rohlf 1986).

TABLE 1
Measurements taken on specimens of wild boar from a population in the Historical Territory of Álava, Spain.

MEASUREMENTS	DESCRIPTION
LW	Total live weight
EWS	Eviscerated weight with skin
EW	Eviscerated weight without skin
TL	Total length
HBL	Head-body length
SH	Shoulder height
BFL	Back foot length
JL	Jaw length
JH	Jaw height
SJL	Suture jaw length

Weights were recorded using a steelyard scale (precision = 100 g). Body measurements were made using a cloth tape measure (precision = 1 mm), and jaw measurements were made using a cranium meter, (precision = 1 mm).

RESULTS

Ponderal growth

The relationship between body size and age seems clear, although in wild boars this relationship is masked in some age groups because body weight is affected by environmental factors. In the lower age groups, the weight of specimens can vary considerably, even within an individual age class from year to year, depending on the productivity of the environment.

Using the age data from 396 specimens from the wild boar population in Álava that were estimated by counting the cementum layers of sectioned incisors, and 277 specimens that were estimated using tooth reinstatement tables (for animals < 26 months old), we found highly significant correlations (Figure 4) between age and live weight in males ($r = 0.870$, $n = 199$, $p<0.01$) and females ($r = 0.8566$, $n = 197$, $p<0.01$. Mean total live weight was 74.27±3.34 kg in adult males and 55.30±1.15 in adult females. The mean total live weight achieved by first-year animals was 33.67±1.02 kg in females and 34.22±0.78 kg in males.

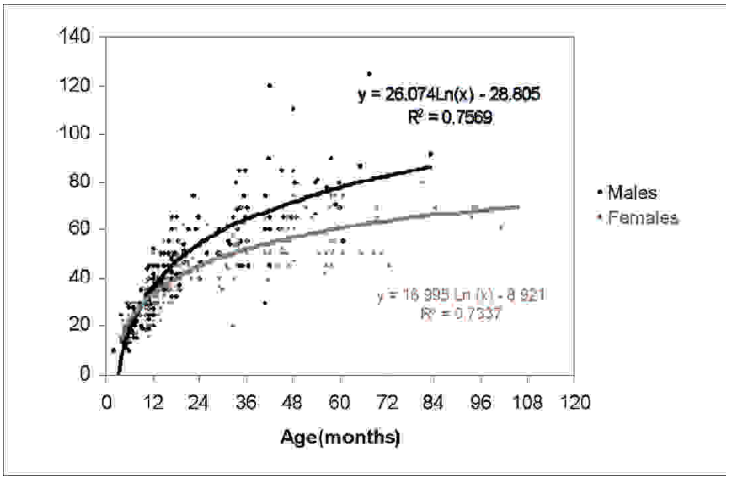

Figure 4. Ponderal growth of wild boar from a population in the Historical Territory of Álava, Spain.

In the beating survey, weight refers to the whole animal and, in many instances, the specimens were eviscerated in the field and the dressed carcass weighed along with the skin. We calculated the relationship using both measurements, as well as the dressed carcass weight without the skin, which we frequently found at the location where the quartering of boars took place.

As we expected, there is a linear correlation among the three measurements, and we obtained the following conversion equations:

EWS (kg) = 0.8076 LW (kg) – 1.9675
(r = 0.9853; n = 38; p<0.01)

EW (kg) = 0.6768 LW (kg) – 1.0084
(r = 0.9796; n = 107; p<0.01)

EW(kg) = 0.7915 EWS (kg) + 0.948
(r = 0.993; n = 60; p<0.01)

Body growth

The mean total body-length of adult boars was 154.37±3.24 cm in males, and 142.23±1.06 cm in females, and there was less variation in both sexes among youngest age groups.

Table 2 shows the results of the correlations between body parameters and age, all of which demonstrate significant logarithmic relationships (y = a lnx + b). Note that female growth is below the values observed in males for all of the measurements. HBL is the parameter that has a stronger correlation with age in both sexes, compared to BFL, which had higher variability among the specimens we examined (Figures 5 and 6).

TABLE 2
Measurements of wild boar body growth from a population in the Historical Territory of Álava, Spain. Samples sizes are given in parentheses.

MEASUREMENTS	MALES	FEMALES
TL	0.8819 (103)	0.7691 (115)
HBL	0.9055 (103)	0.8855 (115)
SH	0.808 (153)	0.8153 (168)
BFL	0.7131 (156)	0.5963 (174)

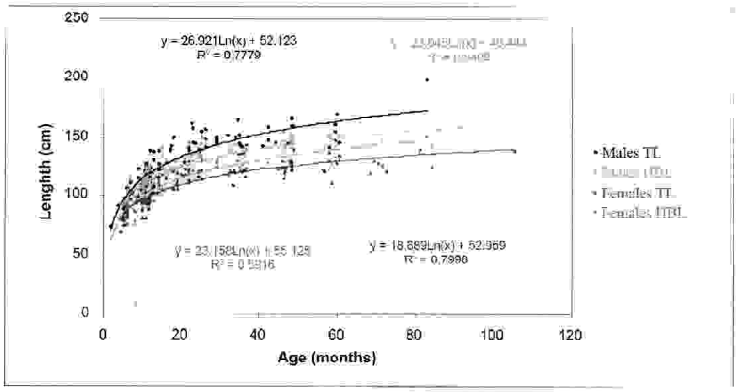

Figure 5. Total length growth of wild boar from a population in the Historical Territory of Álava, Spain.

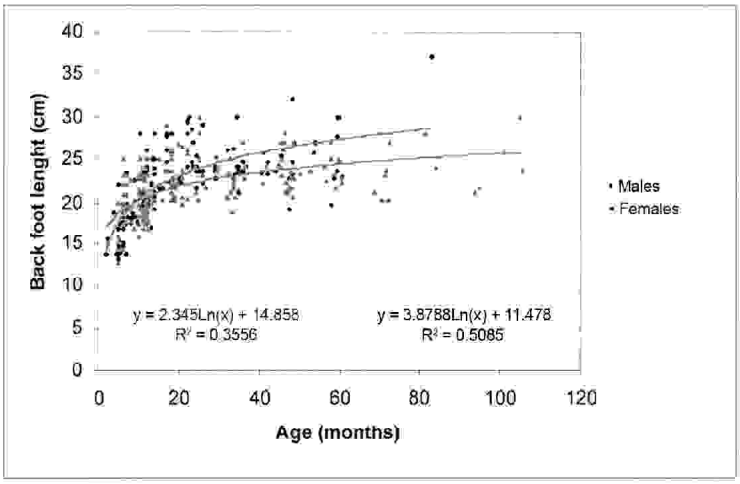

Figure 6. Back foot length growth in wild boar from a population in the Historical Territory of Álava, Spain.

Jaw growth

Among adult wild boars, mean jaw length was 26.63±0.40 cm in males, and 24.42±0.10 cm in females, which is representative of the small differences between the sexes in other jaw measurements.

Table 3 shows the correlations between the three jaw measurements and age, all of which were statistically significant and logarithmic ($y = a \ln x + b$). JL is the measurement that produces the highest correlation coefficient in both sexes and, as with body measurements, females show proportionally smaller growth (Figures 7 and 8).

TABLE 3
Correlation coefficients for jaw growth in wild boar from a population in the Historical Territory of Álava, Spain. Samples sizes are given in parentheses.

MEASUREMENTS	MALES	FEMALES
JL	0.9269 (215)	0.9234 (224)
JH	0.8954 (212)	0.8564 (218)
SJL	0.8899 (240)	0.8674 (255)

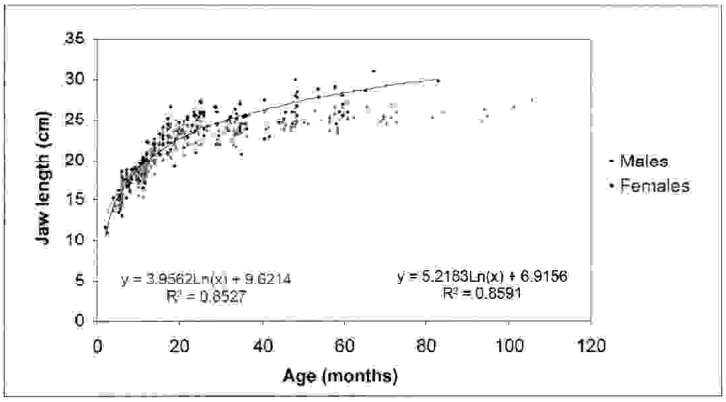

Figure 7. Jaw length growth in wild boar from a population in the Historical Territory of Álava, Spain.

DISCUSSION

As in other Eurasian mammals, wild boars have an average height and weight that increases from the Atlantic Ocean to central Europe and Asia (Marion 1982). For instance, wild boars in the Russian Republics, especially on the Asian side, can reach weights of up to 300 kg (Varin 1980). Furthermore, polygamous species, such as wild boar, in which males compete for females, there is strong selection for large

size. In females, although sufficient weight is important in reproduction (Aumaitre et al. 1982, Aumaitre et al. 1984, Sáez-Royuela and Tellería 1987), selection pressure for large size is less than in males, growth stops at an earlier age (Bouldoire and Vassant 1988). Additionally, the early age at which female wild boars reproduce results in a reduction in growth rate due to an inhibitory effect caused by the burden of carrying young, and the subsequent breeding of the young wild boars (Briedermann 1970, Fernández-Llario and Mateos-Quesada 1998).

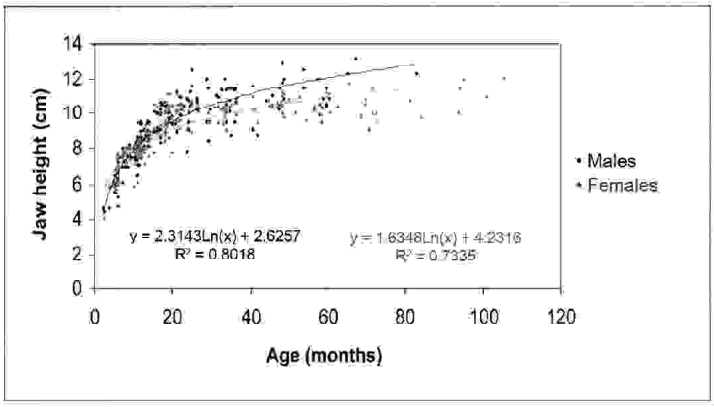

Figure 8. Jaw height growth in wild boar from a population in the Historical Territory of Álava, Spain.

TABLE 4
Mean size of wild boars from a population in the Historical Territory of Álava, Spain.
(Males>36 months; Females >24 months).

MEASUREMENT	MALES	RANGE	FEMALES	RANGE
LW (kg)	74.27±3.34	30-125	55.3±1.15	20-80
TL (cm)	154.37±3.24	140-198	142.23±1.06	126.7-160
HBL (cm)	132.37±1.88	120-151	123.22±1.05	108.2-140
SH (cm)	76.84±2.2	46.2-95	71.37±0.64	58.7-81.2
BFL (cm)	25.53±0.86	19.2-37	23.32±0.45	18.7-30
JL (cm)	26.63±0.40	22.5-31	24.42±0.1	21.8-27.4
JH (cm)	10.78±0.44	8.8-13.2	10.1±0.24	9.0-21.0
SJL (cm)	7.24±0.19	5.7-9.5	6.03±0.1	4.5-7.5

If we recognize that wild boars in the historical territory of Álava exhibit growth patterns similar to other wild boar populations in the Cantabric Mountains, and have determined that animals reach adult size at about two years of age in females and

three years of age in males (Sáez-Royuela 1987), we note that our specimens were slightly smaller than the wild boar from adjacent populations in Sierra de la Demanda, Burgos province, which are similar to animals in French populations (Klein 1984). That pattern is evident in both sexes and it might be due more to the ability of wild boars to adapt to local food resources, modifications to the rate and intensity of reproduction, as well as body development (Pepin et al. 1987), than to inherent differences between the typical subspecies. On the other hand, the stress on wild boar caused by the pressure of excessive hunting, which can force animals to travel long distances, thereby breaking the group's social structure and its natural nourishment life-cycle, can strongly affect the physical quality of the population (Mauget 1980; Vassant et al. 1988). That phenomenon, however, does not seem to affect the population's demographic growth in Álava and the dilation of the reproductive cycle (Markina et al. 2003).

With respect to the average weight of first-year animals, the trend toward smaller size is also more pronounced in males than in females, neither of which exceed 40 kg at 12 months of age, which is the value cited as a discriminant among subadult wild boar in France (Klein 1984). Thus, population-related physical differences are already apparent in the early age groups.

All of the body parameters examined in our study were correlated with age and confirmed the differential growth of the sexes, so we have demonstrated that a biometrical study can be of great use when estimating the age of wild boar specimens and can replace other, more complex aging techniques. Among the measurements we recorded, HBL and JL provide the strongest correlation coefficients in both sexes of wild boar in Álava, Spain.

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