Characterisation and conservation programme of the Alberes cattle breed in Catalonia (Spain)

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Summary

The Alberes cattle breed is a Catalonian autochthonous bovine population located in the Alberes Massif (north east of Spain), in the eastern extreme of the Pyrenees Mountains, and is well adapted to this zone in which it mainly makes use of forest resources. Cows are small sized and rustic, living under a semi-feral management system with minimal human contact. Traditionally, two coat colour varieties, Black and Fawn, have been described. Nevertheless, in both coat colour types the wild-type allele (E^+) of the extension locus predominates. The Alberes breed clusters within the Cantabrian trunk, although some other breeds may also have influenced the population during its history. All of the females are used for replacement and the surplus males are destined for fattening despite their low meat potential. Age at first calving ranges between 3 and 4 years. The 2007 census estimated the number of adult animals at 138 females and 9 males. The Alberes breed is considered as an *Endangered Breed* according to the FAO classification and intends to start an *in situ* minimum kinship conservation programme and also a cryoconservation scheme with embryos and semen.

Résumé

La race Alberes est une population bovine autochtone qui se trouve dans le Massif de Alberes (Nord-Est de l'Espagne), dans la zone de l'extrême Est des Pyrénées. Cette race est bien adaptée à la zone et elle est capable de bien valoriser ses ressources alimentaires, aussi bien herbacées que forestales. Il s'agit d'animaux de petite taille et rustiques qui vivent en liberté toute l'année avec un minimum de contact humain. Traditionnellement on décrit deux variétés de couleur du manteau : la variété noire et la Fagina, bien que dans les deux cas il existe une prédominance de l'allèle E+ brun dans le locus d'extension. La race Alberes fait partie du bloc Cantabrique, bien que d'autres races aient eu une influence sur cette population tout au long de l'histoire. Toutes les femelles sont tenues pour le replacement. Les veaux mâles son mis à l'engraissement malgré le faible potentiel de viande de cette race. L'âge à la première mise bas se situe entre 3 et 4 ans. Le dernier recensement des animaux adultes avec morphotype Alberes (2007) a montré un total de 138 femelles et 9 mâles, ce qui place la population dans la catégorie de race en danger de disparition d'après la classification de la FAO. Pour cette raison un programme formel de conservation a été mis en route qui comprend la conservation in situ à travers un programme de parentage minimum et in vitro à travers la cryoconservation d'embryons et de semence.

Resumen

La raza Alberes es una población bovina autóctona localizada en el Macizo de las Alberes (Noreste de España), en el extremo oriental de los Pirineos, y está bien adaptada a la zona siendo capaz de aprovechar los recursos alimenticios de la zona,

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tanto herbáceos como forestales. Son animales de pequeño formato y rústicos, que viven en libertad todo el año, con mínimos contactos con las personas. Tradicionalmente se han descrito dos variedades de color de capa, la variedad Negra y la *Fagina*, aunque en los dos tipos predomina el alelo castaño E^+ del locus de extensión. La raza Alberes se encuadra en el tronco Cantábrico, aunque otras razas han influido en esta población a lo largo de su historia. Todas las hembras se guardan para reposición. Los terneros machos son cebados a pesar del limitado potencial carnicero de esta raza. La edad al primer parto se sitúa entre los 3 y 4 años. El último censo (2007) de animales adultos con morfotipo Alberes ha arrojado un total de 138 hembras y 9 machos, lo cual sitúa a la población en la categoría de raza en peligro de extinción de acuerdo con la clasificación de la FAO. Por ello se ha iniciado recientemente un programa formal de conservación que incluye la conservación *in situ* mediante un programa de parentesco mínimo e *in vitro* a través de la crioconservación de embriones y semen.

***Key words**: Endangered population, Conservation programme, Production system, Physical characteristics, Genetic diversity.*

Introduction

The Alberes cattle are a semi-feral bovine Catalonian breed, located in the Natural Park of the Alberes Massif (200-1 100 m a.s.l.), in the eastern extreme of the Pyrenees (Figure 1). It is distributed between the *Alt Empordà* region (Spain) and the *Vallespir* region (France).

The first description of the Alberes cattle breed was carried out by Mascort (1957), who classified the Alberes population as having three main types:

1. Type A: the most abundant, being of small size with a black coat colour and degradations in the abdomen.
2. Type B: with two varieties, one with a toasted straw colour coat (it was assumed to have been genetically improved), and the other with a coat colour varying from white to light brown or fawn (called *"Fagina"*). It was also a cow with a small frame.
3. Type C: Brown Swiss crossbred animals.

Almost three decades later, Sánchez Belda (1984) wrote about an endangered small breed located in that region, with a chestnut brown coat that was darker in winter, and almost black in males. The calves were born with a light brown coat.

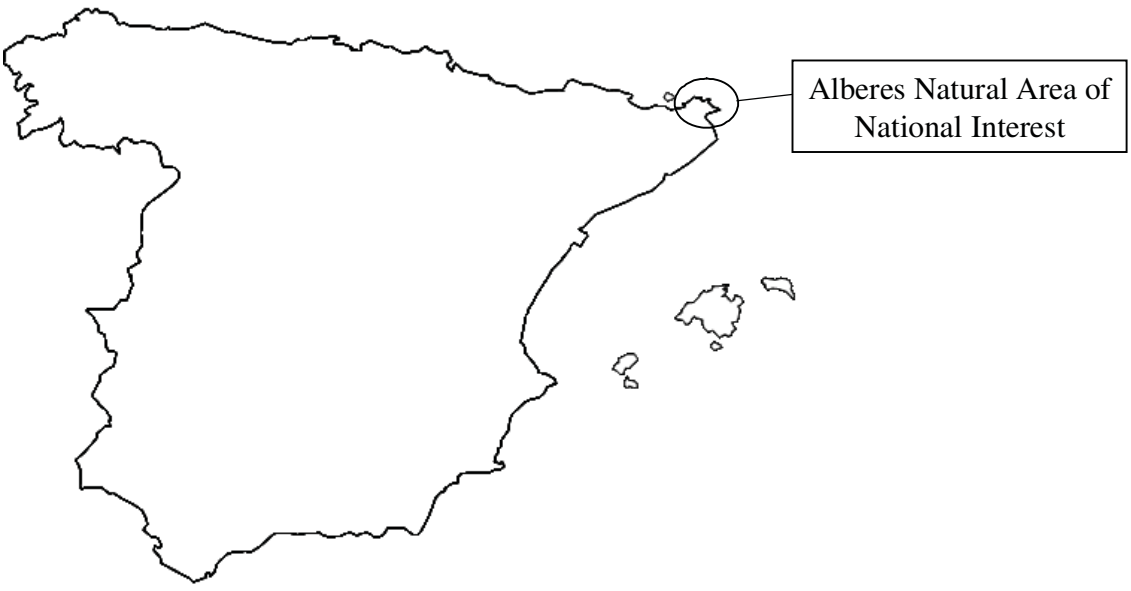

Figure 1. The Alberes cattle is located in the Natural Park of the Alberes Massif (200-1 100 m a.s.l.), in the eastern extreme of the Pyrenees (latitude: 42º 26' 07''N; longitude: 6º 39' 30'' W).

Nevertheless, he described a large variability of coat colour tonalities. A similar description was given by García-Dory *et al*. (1990), who suggested the inclusion of the Alberes breed within the Cantabrian trunk, which contains the *Asturianas*, *Monchina* and *Tudanca* breeds, among others. Subsequently, Martell (1991) and Jordana *et al*. (1999) took the terminology of the local caretakers and described two varieties: the Black Alberes, perhaps the oldest variety, and the *Fagina* or Fawn Alberes, this last name coming from the fruit of the beech tree (*Fagus sylvatica*), abundant in the Alberes region. According to these authors, the Black variety is the most numerous in the *Empordà* region (Catalonia, Spain), while the Fawn variety, also called *Massanessa*, a name derived form the *Massana* river, is predominant in the *Roussillon* region (France).

Since these preliminary descriptions were offered, no formal studies to characterise the current status of the breed have been done in order to start a conservation or improvement programme. For this reason, the *Departament d'Agricultura, Ramaderia i Pesca de la Generalitat de Catalunya* has promoted and funded several studies whose results are summarised in this paper.

Production System

This breed, characterised by small-sized animals with a straight cranial profile and short horns, lives free all year round in the *Baussitges* rangeland. This has a total area of 2 181 ha, consisting of 1 482 ha of forest and shrubland and 699 ha of grassland. Mediterranean oak woodlands, mainly holm oak (*Quercus ilex* L.), but also cork oak (*Quercus suber* L.) and pubescent oak (*Quercus humilis* Mill.) dominate the landscape on the slopes. Acidic grasslands, dominated by *Festuca ovina* and *Carex cariophyllea*, with dwarf shrubs of heather (*Calluna vulgaris* L.), are the common vegetation on the crests, above 900 m a.s.l. The animals are grouped in three herds, each of them grazing near an old farmhouse (called *Freixe*, *Castanyers* and *Roig*, respectively), where animals receive supplementary feed, such as alfalfa pellets, in adverse periods, mainly in winter. In general, individuals remain in the herd where they are born. Each herd consists of a group of cows with their calves, usually led by a female or a few dominant females. The males live more independently although they are also linked to a particular herd. When the environmental temperature increases, in spring and summer, the animals graze on grasslands of the crests and neighbouring forests (Figure 2).

Selection of the diet

With the aim of determining the natural diet composition of the Alberes cows, Bartolomé *et al*. (2004) collected faecal samples in two environments (woodlands and grasslands) of the *Baussitges* rangeland during two periods: spring and autumn. Using the methodology of microhistological analyses of faeces, two hundred fragments of leaf epidermis were identified from each sample. The results showed that ligneous components occur with most frequency (75% of the diet) in the samples collected in the forest throughout the year, whereas forbs and grasses represented the highest fraction of the diet (60%) only in the spring samples collected from grasslands.

These data suggest that the Alberes cow is a versatile animal in terms of diet selection, which varies depending on the vegetation available in each period. The large proportion of woody components allows us to consider the Alberes cattle population as a browser throughout the year and a grazer only in spring and summer, when the animals can graze on herbaceous pastures. The pressure that this bovine breed exerts in the Mediterranean forest mass suggests that it is a very interesting element in the management of the natural resources associated with the contingency of forest fire (Bartolomé *et al.*, 2004).

Reproductive and productive aspects

The age at first calving ranges from 3 to 4 years. Natural service is the only reproduction system used. Replacement is carried out with all of the heifers, because the percentage of mortality throughout the year is high, although difficult to assess. Despite this practice, the population has not increased in the last few years. The bulls are chosen according to their conformation, leg soundness, rusticity and their conformation to the breed profile.

Once a year, all of the animals are brought together in a ceremony called '*esquellada*' (*esquella* is '*bell*' in the Catalan language). The animals are restrained within small fences in order to worm them and to extract blood samples for the obligatory veterinarian control. On this day young animals are identified with a plastic numbered earring and with an electronic ruminal bolus, and the cowbells of the

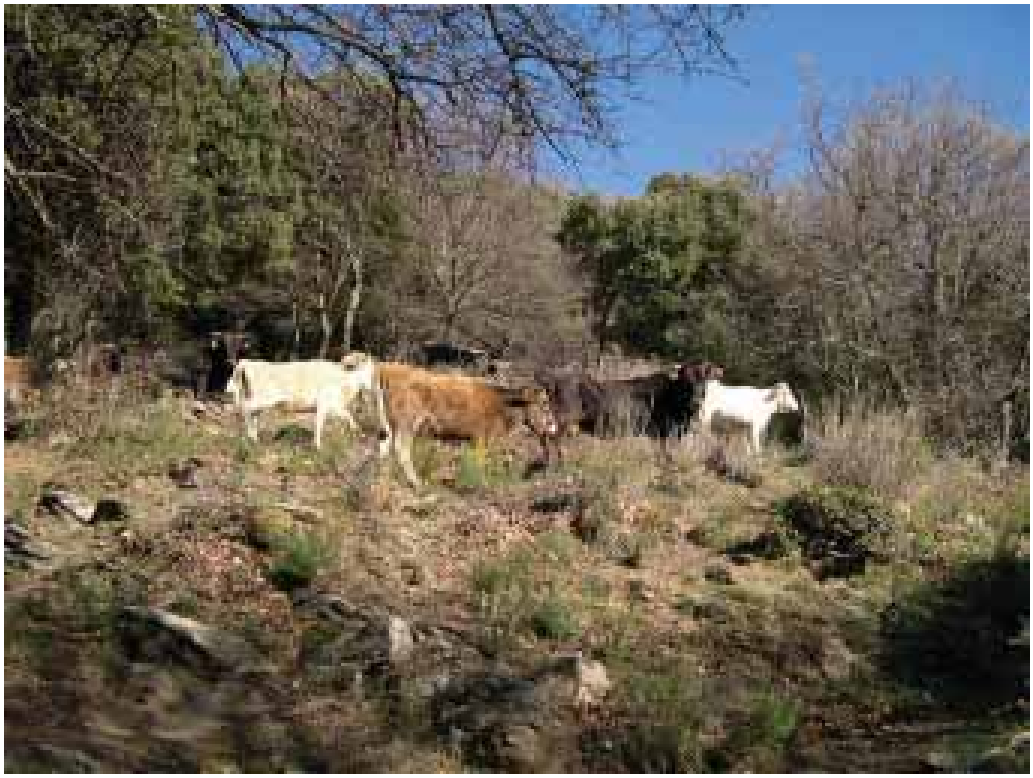

Figure 2. Alberes cattle in a woodland area.

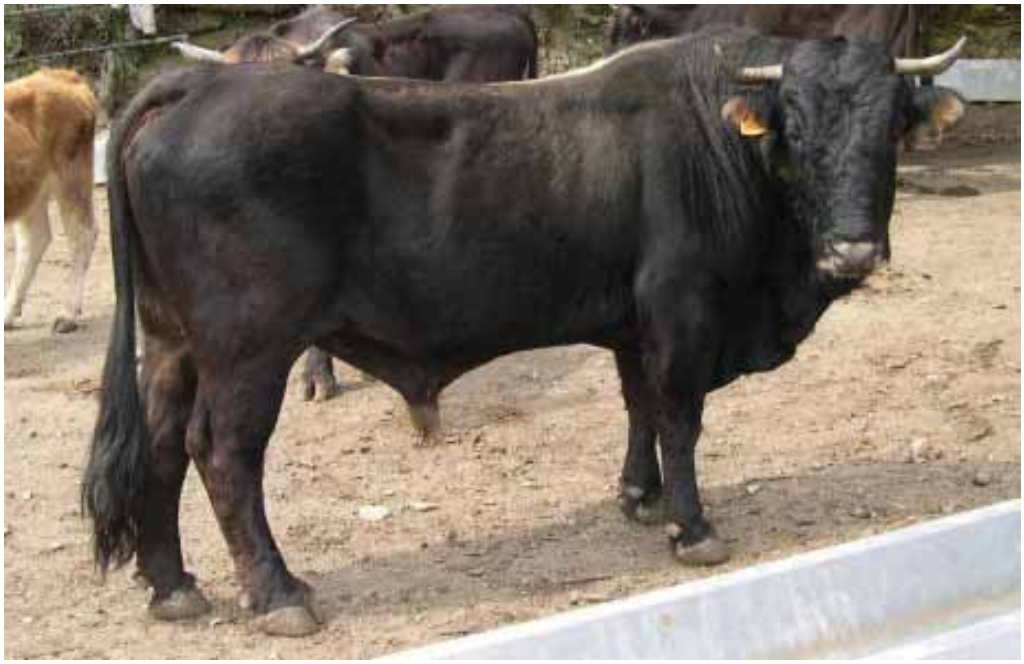

Figure 3. A typical Alberes Black bull.

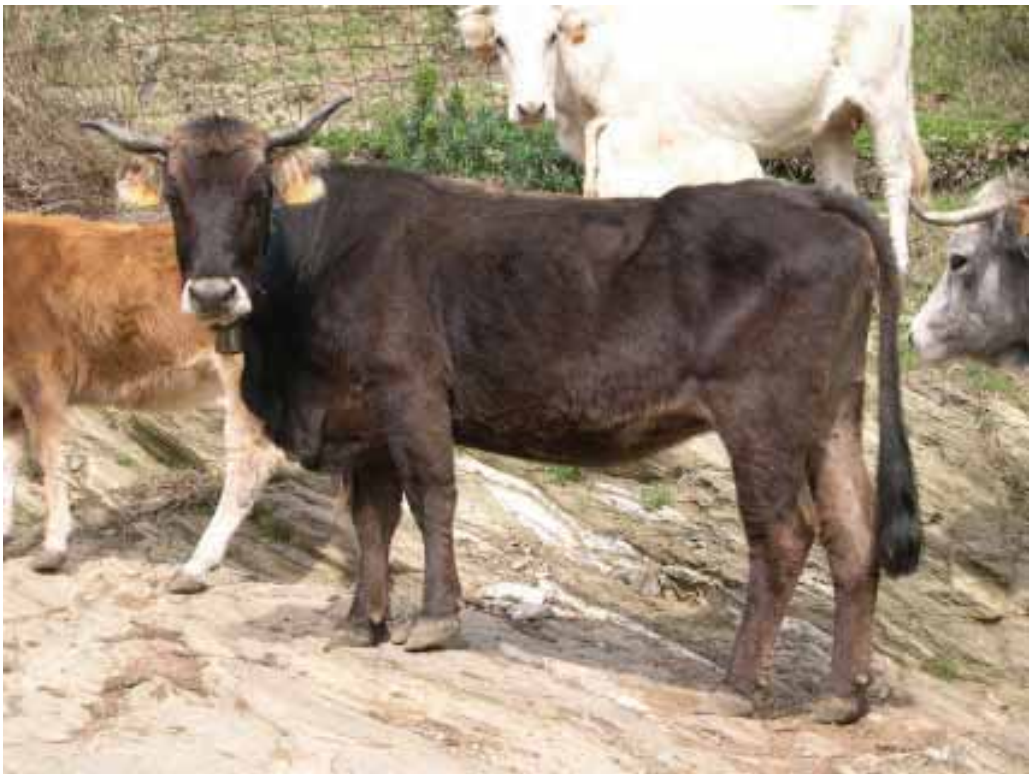

Figure 4. A typical Alberes Black cow.

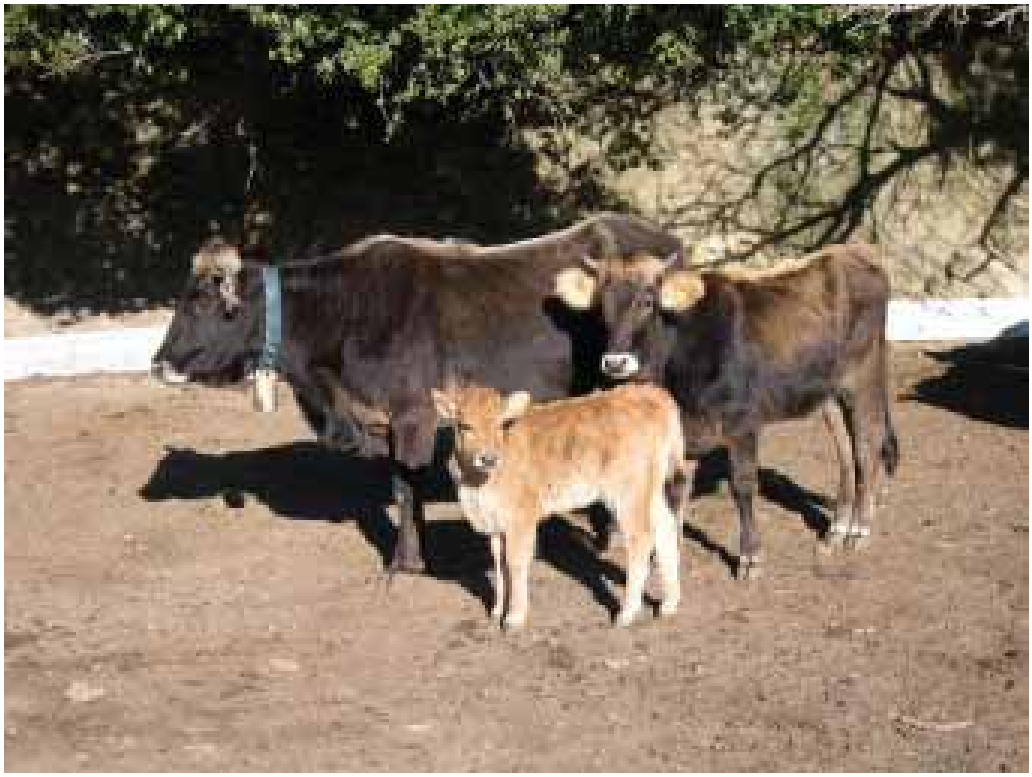

Figure 5. An Alberes cow with two daughters.

adult cows are checked and repaired, or changed if needed, in order to locate them across the range. Male calves not chosen for breeding are sent for fattening, whereas females go for herd replacement. The day ends with a lunch based on typical products of the region with the farmer, caretakers, family and friends.

Physical Characteristics of the Breed

The Alberes cattle are a small sized breed, with an average weight of 350 kg for the mature bulls and 275 kg for the mature cows (Mascort, 1957). The general aspect is of rustic animals without a defined productive aptitude (Figures 3 and 4).

The current animals have an elongated head of compact aspect, with an inter-horn diameter narrower than the inter eye-socket diameter. The forehead has a straight profile with a medium fringe, more pronounced in calves. The eyes are prominent and the facial area is elongated, with a light coloured muzzle-band. The horns are short and hook-shaped, with a circular section and are of medium size. The neck is long and flat with a dewlap of broken profile, larger in males than in females. The trunk is flat, deep and narrow, with a prominent and divided wither. The shoulders present low muscular development and are well attached to the trunk. The back and loin have poor muscular development. The abdomen is voluminous and the rump usually has a horizontal profile, with an elevated sacred crest and reduced muscular development of the rear region, which causes the consequent projection of the bones and an advanced tail-head. The mammary system is rudimentary and is covered by fine, long and generally lighter hair. The legs are of medium length, strong and with well defined joints, the rear ones usually not being correctly formed. The rump is straight or concave, with poor development. Pasterns are short, with small but strong and always pigmented toes.

The skin is abundant, with pigmented mucous membranes. The coat tonality can vary during the year: it is long and decoloured in winter, but a moult can give thin and brilliant hair if the spring has been favourable. It is possible to observe a wide variety of colours from almost matt black to fawn. There are also lighter colourings to a different extent in the lumbar line and at the bottom of the trunk (armpit, sternal region, mammary system, testicles, etc.).

Zoometric study

In order to characterise the size of the animals in the current population and to compare it with published data, 18 zoometric measurements were studied (Tables 1, 2 and 3) taken with a zoometric stick and a tape (Alderson, 1999; Aparicio, 1984; Sañudo, 1986). Body condition was evaluated according to Lowman *et al.* (1976). The score range is from 1 to 5. A score of 1 indicates a very poor body condition and 5 means an excellent body condition. These measurements allow us to calculate some morphologic, ethnologic and functional indexes (Tables 4 and 5). Only animals aged four years and older, with black, chestnut brown or fawn coat were included in the study, since other coat colours could indicate a crossbred origin.

Average measurements by sex, herd and coat colour are presented in tables 1, 2 and 3. The results indicate that, according to the classification of Felius (1995), the Alberes breed has a small size (115-125 cm height at withers). Males are around 6 cm taller (height at withers), longer (10.7 cm of length from shoulder to tuber ischii) and their chest is larger (the chest girth is 11.8 cm larger) than females. Body condition was also better in males than in females (3 vs 2.3). Alberes cattle have 10.4 cm less height at withers and 12.2 cm less at chest girth than the *Bruna dels Pirineus* breed, considered a medium sized breed. The results described in table 4 are related to the herd of origin. A clear grading of the size of animals appears. Animals from the *Freixe* herd are larger than the animals from the *Castanyers* herd (124.0 cm of height at withers in *Freixe* vs 117.2 cm in *Castanyers*), *Roig* animals being situated between these two herds. Nevertheless, some of the measurements presented a great variability and the differences did not always achieve statistical significance. The body condition score registered is poor, consistent with irregular oestrous. The consequences would be longer reproduction cycles and a low numeric productivity. Results shown in table 3 indicate no differences in size between the initial two coat colour varieties described which suggest that the differences in size among cows would have an environmental origin rather than a genetic basis.

The morphologic, ethnologic and functional indexes presented in tables 4 and 5 are calculated in order to determine the breed purpose or potential. The height slope shows that the Alberes cattle is 1.68 cm taller in the foreleg than in rear legs, similar to White Park animals. The length index (1) (Table 4) confirms that the Alberes cattle are taller

Table 1. Number of animals recorded (No), least squares means (LSM), standard error (S.E.), minimum (Min.) and maximum (Max.) of the morphological measures (cm) and body condition (according to Lowman et al., 1976) by sex.

	Males					Females				
	No	LSM	S.E.	Min.	Max.	No	LSM	S.E.	Min.	Max.
Height at withers	5	126.4[a]	2.6	118	133	84	120.6[b]	0.7	106	134
Height at medium back	5	123.1[a]	2.6	113	128	84	119.7[a]	0.7	102	134
Height at rump	5	127.2[a]	2.8	122	137	83	122.2[a]	0.7	108	136
Height at the tuber ischii	5	116.2[a]	2.5	114	119	84	113.4[a]	0.7	96	133
Depth of chest (thorax)	4	62.2[a]	2.1	58	68	76	59.9[a]	0.5	49	70
Chest circumference	4	187.6[a]	7.0	168	190	71	175.8[b]	3.1	138	200
Cannon perimeter	5	19.5[a]	0.5	19	20	71	17.8[b]	0.2	16	21
Length from shoulder to pins (tuber ischii)	5	157.2[a]	4.7	145	174	84	146.5[b]	1.2	124	176
Length from withers to pins (tuber ischii)	5	133.2[a]	3.5	125	140	85	124.9[b]	0.9	106	147
Rump length from hips (tuber coxae) to pins (tuber ischii)	5	51.9[a]	1.5	49	54	86	47.8[b]	0.4	41	58
Width of chest	4	38.2[a]	1.9	30	44	77	31.1[b]	0.5	23	40
Pelvic width	5	44.5[a]	1.4	39	51	84	43.8[b]	0.4	37	51
Intercoxae width	5	43.8[a]	1.5	39	48	84	40.7[b]	0.4	34	52
External interischii width	5	23.9[a]	1.1	22	27	84	23.3[a]	0.3	19	30
Internal interischii width	5	9.4[a]	0.5	8	11	83	11.8[b]	0.1	9	14
Head length	4	51.2[a]	1.8	51	53	78	48.1[a]	0.5	23	56
Head width	4	26.9[a]	1.7	23	31	78	23.4[b]	0.4	20	50
Body condition	3	3.0[a]	0.3	3	3	81	2.3[b]	0.1	1	3

Within a row, least squares means with the same superscript did not differ significantly ($P<0.05$).

Table 2. Number of animals recorded (No), least squares means (LSM), standard error (S.E.), minimum (Min.) and maximum (Max.) of the morphological measures, cm, and body condition (according to Lowman et al., 1976) by herds.

	Castanyers					Roig					Freixe				
	No	LSM	S.E.	Min.	Max.	No	LSM	S.E.	Min.	Max.	No	LSM	S.E.	Min.	Max.
Height at withers	30	117.2^{a}	1.1	106	134	15	120.5^{a}	1.5	108	129	39	124.0^{b}	0.9	113	134
Height at medium back	30	118.3^{a}	1.1	102	134	15	118.6$^{a.b}$	1.5	105	129	39	122.0^{b}	0.9	109	131
Height at rump	29	120.1^{a}	1.2	108	135	15	121.3^{a}	1.7	111	130	39	125.3^{b}	1.0	110	136
Height at the tuber ischii	30	110.1^{a}	1.0	96	123	15	113.6$^{a.b}$	1.5	106	121	39	116.0^{b}	1.0	102	133
Depth of chest (thorax)	28	59.5^{a}	0.8	50	70	12	59.3^{a}	1.2	49	65	36	60.9^{a}	0.7	53	68
Chest circumference	30	160.9^{a}	2.3	138	200	2	192.0^{b}	9.1	190	194	39	174.6^{b}	2.1	148	200
Cannon perimeter	30	17.5^{a}	0.2	16	21	5	18.0^{a}	0.5	17	19	36	17.8^{a}	0.2	16	20
Length from shoulder to pins (tuber ischii)	30	143.8^{a}	1.9	124	176	15	146.3$^{a.b}$	2.7	125	165	39	149.2^{b}	1.7	131	163
Length from withers to pins (tuber ischii)	29	123.6^{a}	1.5	110	147	17	124.8^{a}	1.9	106	136	39	126.3^{a}	1.3	108	144
Rump length from hips (tuber coxae) to pins (tuber ischii)	30	46.7^{a}	0.6	42	58	16	46.3^{a}	0.8	41	52	40	50.2^{b}	0.5	44	56
Width of chest	28	29.7^{a}	0.7	23	38	13	31.4$^{a.b}$	1.0	27	39	36	32.2^{b}	0.6	24	40
Pelvic width	30	41.7^{a}	0.6	37	51	15	45.0^{b}	0.8	38	51	39	44.8^{b}	0.5	38	50
Intercoxae width	30	39.2^{a}	0.6	34	52	15	41.4^{b}	0.9	34	47	39	41.5^{b}	0.5	35	48
External interischii width	30	22.9^{a}	0.5	19	30	15	22.7^{a}	0.7	20	27	39	24.3^{b}	0.4	20	29
Internal interischii width	29	11.6^{a}	0.2	8	13	15	11.5^{a}	0.3	10	13	39	12.2^{b}	0.2	11	14
Head length	28	48.0^{a}	0.5	40	56	13	48.6$^{a.b}$	0.4	44	51	37	49.9^{b}	0.4	46	54
Head width	28	22.1^{a}	0.3	20	27	13	22.6$^{a.b}$	0.4	20	24	37	23.4^{b}	0.2	21	28
Body condition	28	2.4^{a}	0.1	2	3	15	2.3^{a}	0.1	2	3	38	2.2^{a}	0.1	1	3

Within a row, least squares means with the same superscript did not differ significantly ($P<0.05$).

Table 3. Number of animals recorded (No), least squares means (LSM), standard error (S.E.), minimum (Min.) and maximum (Max.) of the morphological measures, cm, and body condition (according to Lowman et al., 1976) by coat colour.

	Black					Fawn				
	No	LSM	S.E.	Min.	Max.	No	LSM	S.E.	Min.	Max.
Height at withers	54	121.1[a]	0.9	107	134	20	121.1[a]	1.5	107	134
Height at medium back	54	119.7[a]	0.8	102	134	20	121.1[a]	1.4	109	134
Height at rump	54	123.2[a]	0.9	108	135	20	122.0[a]	1.5	110	134
Height at the tuber ischii	54	113.8[a]	0.9	96	133	20	113.3[a]	1.4	100	125
Depth of chest (thorax)	47	60.5[a]	0.6	49	70	20	60.0[a]	0.9	53	66
Chest circumference	46	170.8[a]	2.2	145	200	17	167.0[a]	3.6	138	200
Cannon perimeter	46	17.7[a]	0.2	16	21	17	17.5[a]	0.3	16	20
Length from shoulder to pins (tuber ischii)	54	146.3[a]	1.4	124	176	20	146.6[a]	2.4	131	167
Length from withers to pins (tuber ischii)	55	124.8[a]	1.1	106	147	21	125.1[a]	1.7	112	144
Rump length from hips (tuber coxae) to pins (tuber ischii)	56	48.4[a]	0.5	41	58	20	47.9[a]	0.9	41	56
Width of chest	48	31.8[a]	0.5	26	40	20	30.2[a]	0.8	23	39
Pelvic width	54	43.8[a]	0.5	37	51	20	43.3[a]	0.8	37	50
Intercoxae width	54	40.6[a]	0.5	34	52	20	41.1[a]	0.8	37	48
External interischii width	54	23.4[a]	0.4	20	30	20	23.7[a]	0.6	21	27
Internal interischii width	54	11.7[a]	0.1	9	14	20	12.2[a]	0.2	10	14
Head length	49	49.3[a]	0.4	44	56	20	48.4[a]	0.6	40	51
Head width	49	22.8[a]	0.2	20	28	20	23.0[a]	0.3	22	25
Body condition	52	2.4[a]	0.1	1	3	19	2.0[b]	0.1	1	3

Within a row, least squares means with the same superscript did not differ significantly ($P<0.05$).

Table 4. Average of eight morphological indexes of the Alberes cattle compared to Pirenaica and White Park breeds (according to Alderson, 1999).

	Alberes	Pirenaica	White Park
Height slope (cm)	1.68	7.00	2.07
Length index[1]	2.08	1.90	1.97
Length index ([2])	1.04	1.26	1.11
Rump length index	0.38	0.32	0.59
Balance	1.04	0.62	0.86
Width slope (cm)	9.61	-	-
Depth index	0.50	0.67	0.56
Foreleg length (cm)	60.65	44.00	56.31

Results of the calculations for individual animals indexed. Height slope: rump height - withers height; Length index

[1]Body length/chest (thorax) depth; Length index.

[2]Body length/withers height; Rump length index: rump length/withers to hip length; Balance: (hip width x rump length)/(chest depth x chest width); Width slope: hip width - chest width; Depth index: chest depth/withers height; Foreleg length: withers height - chest depth.

Table 5. Average of functional and ethnologic indexes of the Alberes cattle compared to the Pirenaica breed.

	Reference[1]	Alberes	Pirenaica[2]
Relative thorax depth index	More than 50	49.70	66.67
Transversal pelvic index	More than 33	33.76	41.67
Longitudinal pelvic index	No more than 37	39.57	40.15
Body index	83-90 medium	83.28	-

Note: All estimates are expressed in %.

[1]For beef cattle, by Sañudo (1986).

[2] Mendizábal *et al*. (1998).

than they are wide. The balance parameter indicates the slight development of the posterior third compared with the anterior part. The ethnologic and functional indexes (Table 5) show that the Alberes animals are low to medium sized animals with limited meat characteristics.

Genetic Diversity of the Alberes Cattle

The most important goal in the conservation of animal genetic resources is to maintain the variability of the population, assuming a correlation between genetic variation and the viability of the population. In recent years, FAO has proposed molecular methodologies based on the analysis of microsatellites loci as one of the most powerful tools for genetic-population studies (Goldstein and Schlotterer, 1999).

As a first step to establish a conservation programme it is advisable to determine if the Alberes cattle breed is composed of two clearly differentiated subpopulations or if it is of a unique genetic identity with a great chromatic diversity that we would have to maintain, as the zoometric study suggested. In this context, Casellas *et al.* (2004) have considered the genetic diversity of the Alberes cattle with the study of the relations between the Black and *Fagina* varieties, and classified this population in relation to other European cattle breeds. Casellas *et al.* (2004) studied 16 microsatellite loci, which are included in the AIRE2066 European Concerted Action list (FAO list). All microsatellites analysed were polymorphic in the Alberes population, as well as within-herd or within-colour variety. The number of alleles detected per locus fluctuated between 3 and 10, and average values were higher in the Black variety than in *Fagina* animals (5.9±0.4 vs 4.9±0.3), and similarly higher in the *Castanyers* herd (5.3±0.5) than in the *Roig* (5.0±0.4) or *Freixe* herds (4.7±0.3). The relative values of heterozygosity, both the observed heterozygosity (H_o) and the expected heterozygosity (H_e) values, were similar for each colour type variety, and fluctuated between 0.662 and 0.649 for total

Table 6. Growth, meat and carcass quality of the Alberes calves (Black and Fawn).

	No	Mean	Score
Growth, kg/d	91	1.11	
Carcass weight, kg	35	251.31	
Area of *longissimus thoracis* muscle, cm^2	8	39.76	
Conformation score	28	7.61	R- / R
Fatness score	28	4.93	2 / 2+
Intramuscular fat	22	1.41	Scarce
Meat colour	17	2.83	Light red
Fat colour	12	0.00	Light

animals. These results are comparable with those obtained in other European breeds (Kantanen *et al.*, 2000). The F-statistics showed a lack of genetic differentiation based on the coat colour (Black or Fawn) of the individuals. The non-significant F-statistics estimates in the Alberes breed indicate that there is no inbreeding in the population. These values could also be explained by the existence of gene flow with other populations (e.g., *Bruna dels Pirineus*, *Gasconne*, *Charolaise* …) as suggested by Mascort (1957), among others. The Alberes breed clusters within the Cantabrian trunk, which also suggests that although the Alberes population has felt the influence of some other breeds, the animals within the Cantabrian trunk may have contributed the most to the gene pool of the current population, coinciding with results previously reported by García-Dory *et al*. (1990) and Jordana *et al*. (1991).

Coat Colour

According to Klungland (1995), coat colour is governed by two main genes: the extension and agouti loci. The extension locus, identified as the Melanocyte Stimulating Hormone Receptor Gene (MC1R), and located at the 18th chromosome (Werth *et al.*, 1996), has three common alleles: E^D (dominant black), E^+ (chestnut, also called "wild type") and *e* (recessive red or brown). A fourth allele, E^1, was also described (Rouzaud *et al.*, 2000), which is the allele responsible for the brown phenotype coat colour of the *Gasconne* breed, also described in the Brown Swiss breed. Phenotypically, the Alberes population has been divided into two coat colour varieties, Black and Fawn, with intermediate tonalities. This observation suggested the presence of the E^+ allele with a probable intervention of the agouti allele (Figure 5). Allele frequencies were calculated to determine the distribution of the extension alleles in the Alberes population. The results confirm the predominance of the E^+ allele in the two varieties (Table 7). This allele is also observed predominantly in other Spanish breeds from the Cantabrian Trunk like the *Asturiana de los Valles* and *Asturiana de la Montaña* (Royo *et al.*, 2004). In summary, from a genetic point of view, Black and Fawn varieties are predominantly chestnut brown and the preservation of this identity must be a future objective. We propose selecting for breeding animals with the E^+ allele in homozygosis whenever possible.

Evaluation of Growth and Carcass Quality

To establish the quantitative and qualitative meat production potential of the Alberes calves, a fattening trial was carried out. The age of calves at the beginning of the study fluctuated between six and nine months although we did not know the precise age of each animal because the birth date is not usually recorded in the management system of the Alberes breed. Individuals were housed in barns in reduced groups (an average of 10 young bulls per group) where they were fed *ad libitum* with a specific diet based on standard concentrate meal (crude protein around 14% or slightly higher; energy of 1 UFC kg^{-1}; and balanced for Ca and P) and straw for the maintenance of ruminant ability. No special management or treatment was given to the animals. At the end of the fattening period, calves were slaughtered. Twenty four hours after slaughter, standard quality carcass measurements were taken on the left half-carcass, according to the methodology described by De Boer *et al.* (1974) and Piedrafita *et al.* (2003). Meat quality evaluation was done subjectively to appreciate the intramuscular fat content (Australian system, scale 1-6), as well as

fat and meat colour (this last factor is an indicative measurement of the pH which allows for the identification of possible dark meat). The reduced daily gain meant a reduced slaughter weight (Table 6). Carcass muscular development was also limited, as is indicated by a small rib eye area and a small conformation score. On the whole, the results indicate a low meat production potential of Alberes calves.

Temperament Evolution of Semi-feral Alberes Calves

A study on the temperament evolution of beef calves coming from extensive management systems was carried out on 84 entire male Alberes calves (Fina *et al.*, 2006). After weaning, male calves from two consecutive years were reared in feedlot barns during the fattening period, weighed and graded for a temperament score once a month (Grandin *et al.*, 1993). Behavioural records were analysed under a repeated measures model, testing the influence of several systematic sources of variation.

Three systematic effects reached statistical significance:

1. weight of the calf at the beginning of the fattening period;
2. initial temperament score, and
3. restraint session within the initial temperament score.

Calves with moderate and high temperament scores at the beginning of the fattening period tended to moderate their temperament, whereas calm calves did not show a significant trend. These results suggest that behavioural agitation decreases over time in excitable calves, reaching an acceptable level of tameness for these animals. The effect of the initial weight could be related to calf age, suggesting that older calves were less adaptable to intensive fattening systems (Fina *et al.*, 2006)

Census

The census was updated every year during the *'esquellada'*. In the year 2007, a total of 425 animals were counted, comprising 273 Freixe animals, 97 *Castanyers* animals and 55 Roig animals. This census includes animals of all ages and types (Black, Fawn and crossbred animals). Given the absence of birth records, the estimation of the age of the animals has been inferred both from the observation of the teeth and the horn rings. Both methods can have limited reliability because the erosion degree used to determine the age can follow a different pattern in other reference populations. In turn, a ring usually appears every year on the horn, but a horn ring can also appear in cases of suboptimal nutrition. Despite these limitations, these procedures allowed us to distribute the animals among the categories presented in table 8.

Table 7. Allele frequencies by coat colour for the MC1R.

	Allele			
Variety	E^D	E^+	E^1	*e*
Black	0.02	0.72	0.12	0.14
Fawn	--	0.55	0.06	0.39

Table 8. Census of the Alberes population registered at the last count (2006). An adult individual is 3 or more years old.

	Males		Females	
	Young	Adults	Young	Adults
Black	15	9	30	106
Fawn	2	0	14	32
Crossbred origin	40	1	57	119
Total	57	10	101	257
Total	67		358	

It is also interesting to report that from the last three restraints, all of the animals older than 6 months were identified with a ruminal transponder according to the methodology of the "Report from the Commission to the Council and the European for Parliament on the possibility of introduction of electronic identification bovine animals", dated 25 January 2005.

Conservation Programme

As stated previously, the last count gave a population size of 425 animals, but only 138 adult females and 9 adult males had the Black or Fawn coat colour and were considered as having the Alberes morphotype. The current population size fits the category of Endangered Breed proposed by the FAO (Scherf, 2000) and the Critically Endangered category (less than 100 breeding cows) according to the EAAP classification (*www.tiho-hannover.de/einricht/zucht/eaap/factors.htm*).

The low effective population size has created a dramatic situation, and starting a conservation programme has become vital. The combination of live and cryoconservation can result in very potent conservation strategies because it can achieve all of the objectives for conservation, can reduce the genetic drift substantially and the population can still evolve and adapt to its environmental circumstances (Meuwissen *et al.*, 1994). The effectiveness of live conservation schemes depends on the effective population size and the management of genetic variance through effective selection and mating of the animals.

For these reasons, a Minimum Kinship Conservation Programme has recently started. To carry out this programme it is necessary to register the individual pedigrees of the potential replacement males and females in order to be able to maintain maximum genetic variability. This effort would be completed by microsatellite analyses to fully assign the parents of the calves. Furthermore, an in vitro conservation programme of semen and embryos representing the genetic variability of this population has recently been started.

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