Morena Gallega cattle breeds with limited numbers: origin, productive characteristics and conservation programmes

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Resumen

En los últimos años las poblaciones autóctonas de bovinos gallegos han disminuido hasta alcanzar una situacion de vulnerabilidad, que va de un estado crítico de menos de 100 hembras de raza con una variabilidad genética muy reducida, y un estado de peligro con 100 a 1 000 hembras de raza que no bastan para la supervivencia. Al objeto de prevenir una eventual extinción, se estableció un Programa Operativo para el mantenimiento de un banco de germoplasma (semen y embriones) y de animales *in situ* (explotaciones y reservas naturales) con el fin de asegurar la preservación y facilitar los estudios etnológicos, productivos y reproductivos. Cinco rebaños pertenecientes a las razas Cachena, Caldelana, Frieiresa, Limiana y Vianesa fueron estudiados para ser censados tomando en consideración el habitat, la selección animal, los caracteres morfológicos y productivos, la calidad del semen de los toros y su rendimiento de reproducción.

Summary

In recent years, Galician autochthonous cattle populations have declined to a situation of vulnerability, between the critical status (less than 100 breeding females, very reduced genetic variability) and the endangered status (from 100 to 1 000 breeding females, which is not sufficient to survive). In order to prevent eventual extinction, an Operative Programme to maintain a germplasm bank (semen and embryos) and animals *in situ* (cattle farms and natural reserves) has been established to ensure preservation and facilitate study from the ethnological, productive and reproductive point of view. Five herds of Cachena, Caldelana, Frieiresa, Limiana and Vianesa breeds, have been studied for census, habitat, morphological characters, animal breeding, productive character, seminal quality of bulls and reproductive performances.

Key words: *Cachena, Caldelana, Frieiresa, Limiana, Vianesa,* In situ, Ex situ

Introduction

The Morena Gallega cattle breeds are formed by several racial groups which belong to the racial taxonomy of the Spanish cattle. Although they occupy a common geographic place in Galicia they show enough characteristics on their own to be studied separately: Cachena, Caldelana, Frieiresa, Limiana and Vianesa (Sanchez Garcia *et al.*, 1992). These five breeds, together with three more, form a complex group that first appeared in the Spanish Official Census of cattle breeds in 1970 with the generic denomination of “Morenas del Noroeste” (Sanchez Belda, 1984).

Table 1. Census of the Morena Gallega cattle breeds (Vallejo, 1992)

Breed	1986[1]	1991[2]		Breeding organization
		Females	Males	
Cachena	30	220	40	Xunta de Galicia
Caldelana	4 827	2 000	29	idem
Frieiresa	1 152	400	14	idem
Limiana	7 961	200	10	idem
Vianesa	3 817	2 000	14	idem

[1]Yearbook of Agrarian Statistics (only comprises females older than two years) Ministry of Agriculture, Fisheries and Food. 1989.
[2]Spanish Society for Animal Genetic Resources (S.E.R.G.A.)

They are breeds of meat and work aptitude, perfectly fitted to their environment and placed in specific geographic areas from which they have taken their name. Because of their limited numbers they can be included in the vulnerability grades[1] (Vallejo, 1992), Caldelana and Vianesa being vulnerable, and Cachena, Frieiresa and Limiana, endangered. As far as their philogenetics is concerned, Vallejo *et al*. (1990) consider that they come from *Bos taurus ibericus* or *Bos primigenius estreptsicerus*. However the Cachena breed has been considered by the same authors to be influenced by the *Bos brachicerus africanus*, contradicting the influence attributed to the *Bos desertorum* until now by the ethnologists.

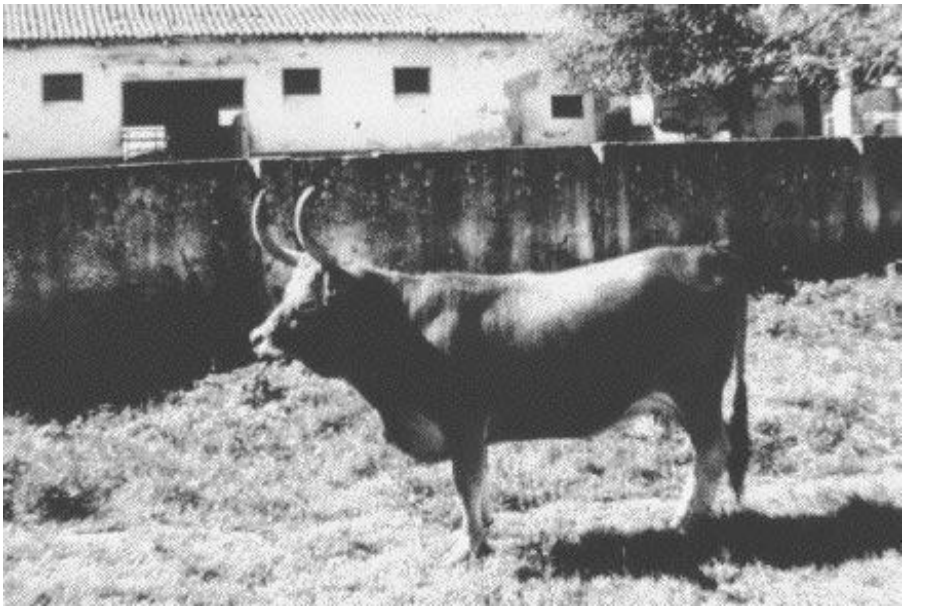

Figure 1. Cachena breed

[1]According to FAO Expert Consultation on Management of Global Animal Genetic Resources: Vulnerable, from 1 000 to 5 000 breeding females; endangered from 100 to 1 000 breeding females.

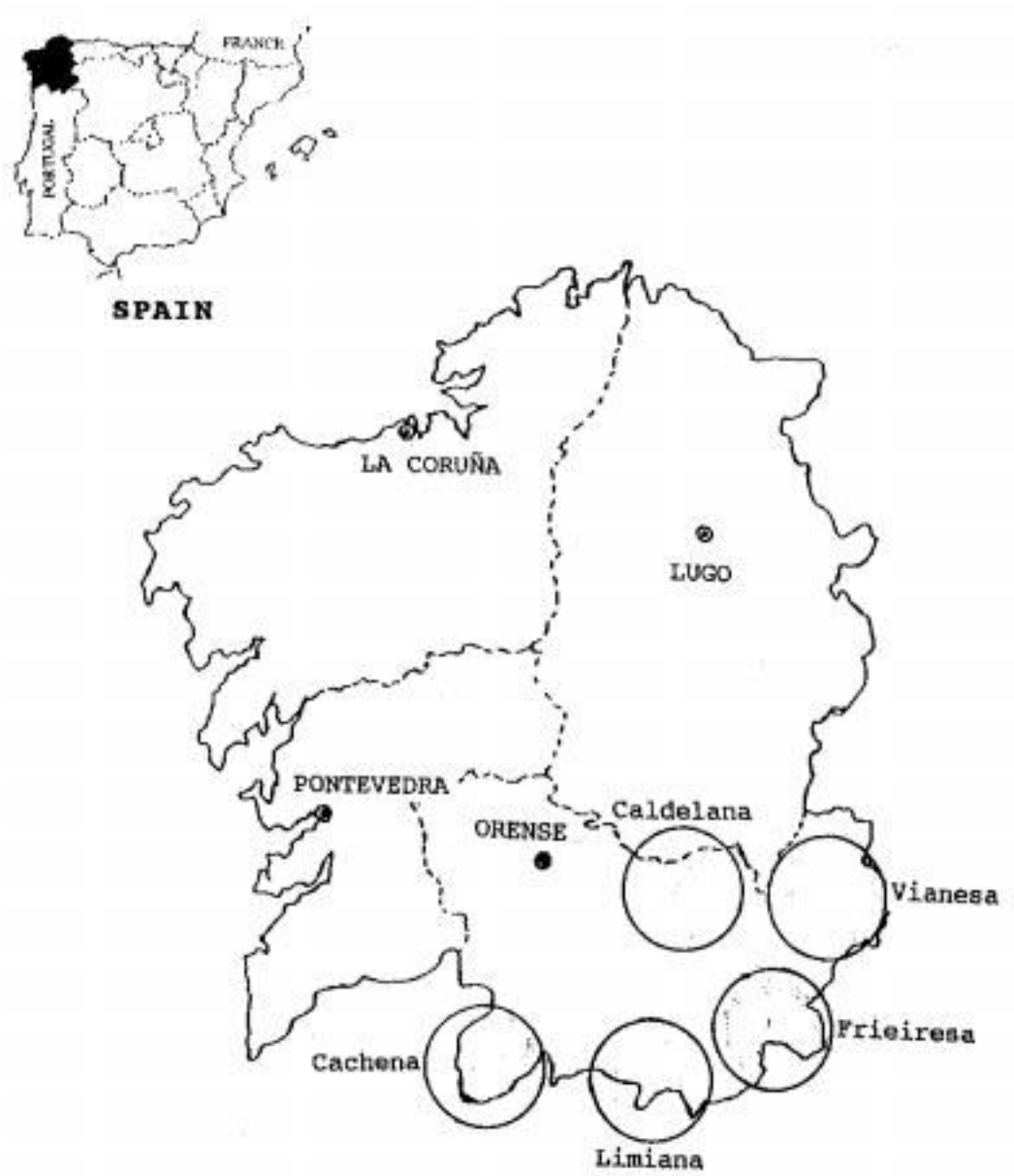

Figure 2: Geographic distribution of Morena Gallega cattle breeds

Census, Distribution and Habitat

The last official census provided by the Ministry of Agriculture, Fisheries and Food in 1986 and published in 1989 is completely different from the one made by Vallejo (1992). Vallejo's census is based on the inventory carried out and sent by the Spanish Society for Animal Genetic Resources to an E.U. Programme in order to work on the European Inventory of Animal Genetic Resources. These two different censuses are summarized in table 1.

These breeds are placed in specific geographic areas, mainly in Orense (in southern Galicia, north-western Spain), a region which belongs to the Comunidad Autónoma de Galicia. They are shown in figure 2. The land in which these breeds are raised is very acid, with very high level of organic content, a mud-sandy texture and therefore with a net deficiency of assimilated elements. Botanical study shows that the flora

Figure 3. Caldelana breed

composition is quite uniform due to the low cattle stocking rate, and is mainly composed of grasses, legumes, compound leaf plants and cystacae. The chemical analysis reflects the low summer rainfall through the low humidity contents and high variability in protein and crude fibre levels.

Morphological Characters and Breeding

Cachena breed

Concerning their general conformation, Cachena cattle have a body with a dished profile, small-framed with very harmonious proportions. They have a small head, with a white border on the snout, and with large high lyre-shaped horns. The coat is bright brown, darker in the neck area; the mucous membranes, the hoofs and the distal part of the horns are black; they have a fringe on the nape of the neck; the outer ear and the tail are bushy.

The cows have good maternal attributes: easy calving, partly because of the light weight of the calf at birth, a good milk production which allows the calves to be fed until six months of age; maternal instinct, protecting the progeny from the possible wolf attacks, by leading the calves to the centre of a fence formed by the heads and horns.

This breed was used for a time to do farming work (oxen), though its main aptitude is quality meat production.

Caldelana breed

The Caldelana breed is formed by a group of animals with a straight profile, medium-weight and medium-framed. Their head is closely proportional to the body size, with a flat forehead and long wide face, mainly the females usually show a silvery border on their snout and slate mucous membranes. They generally have hooked horns, slightly straightened outside in females; the horns are thick, with a circular section, and white with a darker distal part. Their ears are medium-sized, horizontal and bushy with bright hair.

The blonde colour with black switch,

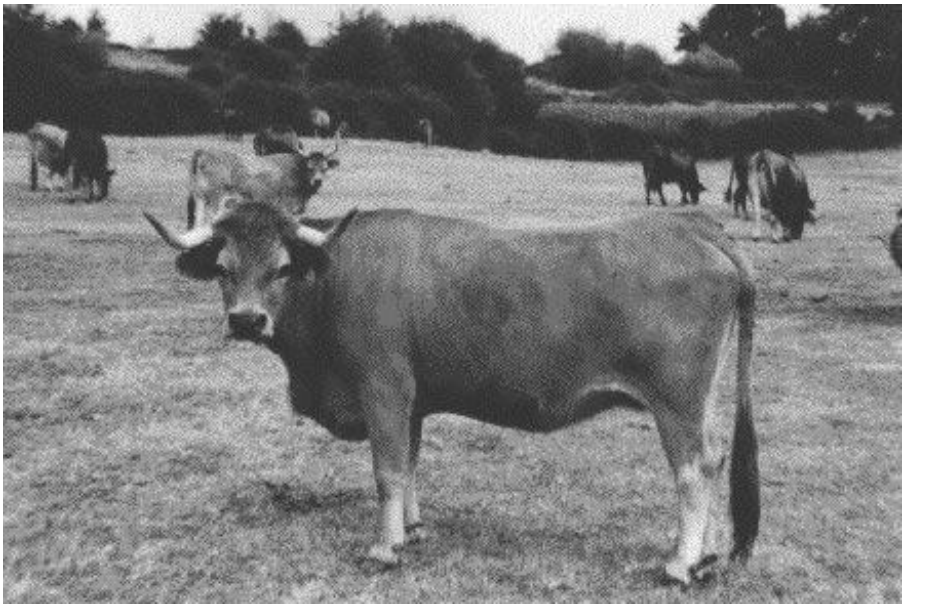

Figure 4. Frieiresa breed

Figure 5. Limiana breed

present at birth, changes with age into its characteristic steel black coat, with a bright-reddish back line (ribbon) which is sometimes wide, forming a band to the flanks, with red insertions around the edges and outer ear. Colour degradation exists fundamentally in the armpits and crotch.

The quiet nature of this breed makes them suitable for work.

Frieiresa breed

They are animals with a sub-dished profile, large to medium size and with long proportions. The head is small and short with long horns which are darker in their distal part. The horns go forward and down, the tips pointing slightly outwards.

The coat is light brown, darker in males and lighter in calves; it is generally dark in the face, neck, double chin, foreleg and lower abdomen. The long hair which forms a gold-blonde fringe on the frontal region is a dominant character present in all their crossbreeding.

The farming system is mixed, using communal pastures of local hills from June to November; or grazing for part of the day and remaining indoors at night. The breed shows good rustic qualities, such as tameness and easy handling, so it is optimum for farming work. However, its main aptitude is meat production (calves weaned at 4-6 months old).

Limiana breed

They are large-framed animals in the valley and medium-framed in the mountains, with medium proportions and a sub-dished profile. It is considered one of the best breeds for meat production, without forgetting their good aptitude for work, proof of which being that they are still used by the small local farmers.

The head is of a medium proportion and the nape of the neck is straight. The horns are short-hooked in bulls; large, long and spiral turning outwards in cows; the section is circular and the colour is light with a darker distal part. The ears are large and bushy.

The coat colour is usually brown, darker in

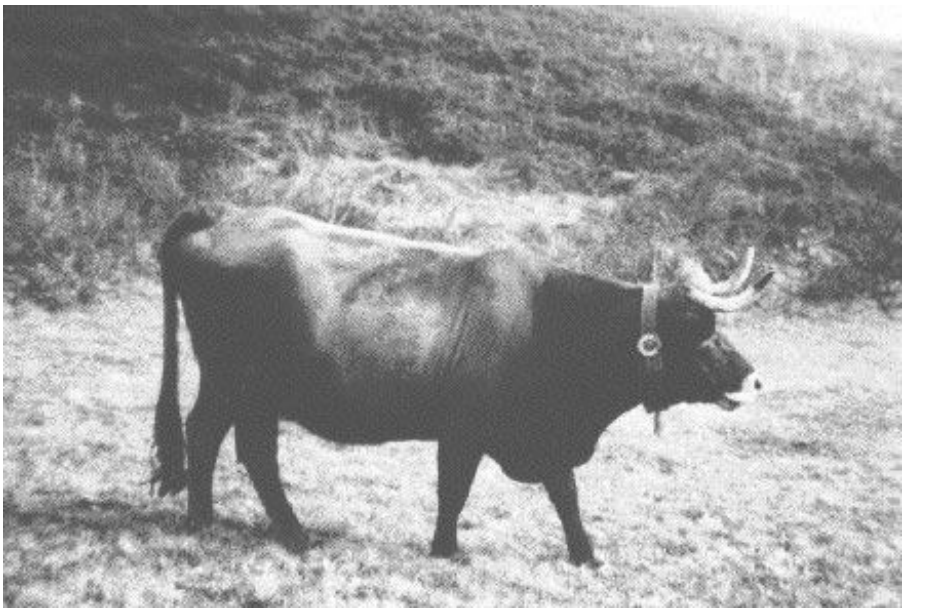

Figure 6. Vianesa breed

the front part; with a whitish border around the snout. The farming system is mixed with stabling and grazing which provides excellent calves. Cows have a high index of fertility and easy calving. Milk production is good and maternal attributes are important.

Vianesa breed

These animals show well-balanced corporal proportions and medium size. The head is small with a dished profile and horns are short-hooked or half-mooned in males and distanced in females. In the females, the horns come from the prolongation line of the nape of the neck, continue laterally and upwards in a wide spiral which points backwards; the horns are pearly except the tips which are black. The ears are large and bushy.

The coat is brown, with darker areas in bulls and lighter or blonde in calves. The extremities are always darker as well as other areas in several corporal regions giving a wide variety of particular features ("caras ahumadas", "ojalado", "listón", "lombardo", "alabardo", "aldinegro"). The heavy lighter hair falling over the forehead, "fringe" and in the outer ear, "earrings" are particular characteristics. Pigmented mucous membranes and a black snout with a white border are present.

The rustic attribute is the most valued one allowing perfect adaptation of the animals in the mountain area where they live. Good milk production aids rapid growth in calves. On the other hand, besides high fertility and easy calving, the quiet nature of the breed allows good handling.

The farming system is a traditional one, with a mixed formula of livestock housing during the period of bad weather, and grazing in the meadows, pastures, forests and moorlands.

Morphometric Characters

Table 2 shows the zoometric parameters in male and female adults in the different Morena breeds. Two very important pieces of data can be obtained merely from the study of their height. On one hand, the slight hollow back, that it is not as pronounced as could be expected in a breed in which only natural selection has been involved; this is interesting as a special sign or tendency to meat or work aptitudes. On the other hand, a clear range of heights has been established which goes from the short Cachena which must be considered one of the smallest breeds in the world, to the large Limiana. Heights of the Frieiresa, Vianesa and Caldelana breeds descend respectively between those of Limiana and Cachena. The dimensions of length and width and the perimeters have the same tendency following a descending range from Limiana to Frieiresa, Vianesa, Caldelana and Cachena.

Production Characters

The growth evolution has been obtained from the live weight, considering different ages: at birth in order to determine the medium size of the calves which is very important for delivery; at 6 months when calves are weaned; at 12 and 24 months old, around the onset of puberty and at three years which is considered intermediate data to adult age. The phenotypic values obtained are shown in table 3 and correspond to the late maturing breeds.

Semen Quality of Bulls

Information on the factors that influence semen production is important in establishing genome banks to allow *ex situ* conservation of the indigenous Galician breeds.

A study has been made using the records concerning the quality on 1984 ejaculates from 50 bulls: Cachena breed (6), Caldelana (5), Limiana (5), Vianesa (5) and Frieiresa (29). These ejaculates were used in the Selection and Reproduction Animal Center in Fontefiz (Orense) for semen production during the years 1985 to 1989 (Sanchez Garcia *et al.*, 1990). Means of volume (VEM), sperm concentration (CEM), average number of spermatozoa per ejaculate (NESPM), mass motility (MEM) and individual progressive motility at collection (MPI), after a balancing period 4-6 hours (MPPH) and after freezing-

Table 2. Zoometric parameters (cm) of the Morena Gallega adults

Body measurement(cm)	Cachena		Caldelana		Frieiresa		Limiana		Vianesa	
	M	F	M	F	M	F	M	F	M	F
Height at withers	122	117	132	128	141	131	143	137	138	132
Height of back	118	114	127	125	133	128	132	135	133	128
Height of rump	122	118	134	131	146	132	144	139	144	132
Depth of chest	72	65	75	69	77	72	79	74	76	69
Width of chest	48	44	49	42	53	47	54	46	52	45
Width of hips	48	45	51	51	56	54	56	55	55	51
Width of stifle joint	42	37	49	46	55	47	55	51	51	44
Body length	167	148	170	156	195	164	197	164	186	163
Pelvis length	50	48	55	52	66	55	65	56	63	52
Circumference of chest	196	176	200	184	216	196	227	200	219	190
Circumference of cannon bone	19	16	21	19	23	20	24	20	20	19

M=males F=females

Table 3. Evolution of growth (live weight in kg) in the Morena Gallega cattle breeds

Breeds	Sex	Birth m ± S.D.	6 months m ± S.D.	12 months m ± S.D.	24 months m ± S.D.	36 months m ± S.D.	Adult m ± S.D.
Cachena	M	20.2±2.0	158.3±21.8	187.2±28.4	322.1±12.2	421.6±59.8	586.4±24.1
	F	19.3±2.3	146.6±26.2	170.1±37.7	250.0±27.4	296.3±37.3	390.7±35.4
Caldelana	M	28.7±3.4	162.6±35.8	265.3±41.8	331.4±56.1	652.8±62.7	931.6±65.5
	F	25.8±4.1	129.9±20.1	216.6±40.4	-	378.3±47.5	467.6±56.3
Frieiresa	M	36.0±1.7	206.6±34.4	272.5±46.1	430.0±29.4	680.0±40.4	865.0±10.4
	F	30.0±4.3	205.0±49.5	252.5±24.7	315.0±49.5	-	492.8±60.0
Limiana	M	35.3±4.1	200.0±14.1	339.5±42.5	492.8±63.8	721.6±62.7	925.8±86.4
	F	34.0±3.5	177.5±53.0	237.5±31.8	360.0±84.8	450.0±20.0	492.1±75.9
Vianesa	M	33.4±4.3	193.7±35.4	272.3±62.3	554.1±54.9	750.0±69.8	912.5±120
	F	31.8±3.6	185.4±36.0	259.1±27.8	371.0±31.9	463.7±71.6	592.5±52.5

M=Male F=Female m ± S.D.=Arithmetic mean ± Standard Deviation

Table 4. Semen characteristics of the Morena Gallega bulls (Sánchez García and Vallejo, 1990)

Breed	AV (ml)		AEC[1]		ANE[2]		AMM[3]		IPM[4]		IPMH[4]		IPMFD[4]	
	n	m	n	m	n	m	n	m	n	m	n	m	n	m
Frieiresa	323	5.19	284	1.12	284	5.80	264	2.38	275	74.20	268	70.81	266	60.00
Vianesa	110	5.49	102	1.19	102	6.43	100	2.57	98	79.67	94	74.59	94	60.28
Cachena	70	4.95	64	0.87	64	4.47	60	2.34	63	74.20	59	70.81	59	58.38
Caldelana	260	4.62	224	1.35	224	6.43	228	2.46	242	76.77	229	71.96	228	61.94
Limiana	230	6.34	216	1.14	216	7.50	204	2.44	215	75.84	209	71.08	209	61.70

[1](Spermatozoa / mm3) x 106
[2]Spermatozoa x 109
[3]Scale 1 to 5
[4]Proportion of alive spermatozoa

AV: Average volume / ejaculate
AEC: Average sperm concentration / ejaculate
ANE: Average number of spermatozoa / ejaculate
AMM: Average mass motility / ejaculate
IPM: Individual progressive motility at collection
IPMH: Individual progressive motility after a balancing period 4-6 hours
IPMFD: Individual progressive motility after freezing-defreezing

Table 5. Estimates of reproductive traits of Morena Gallega breeds

Breed	Puberty		Length of pregnancy	First calving	
	Age (months) m ± S.D.	Weight (kg) m ± S.D.	(days) m ± S.D.	Age (months) m ± S.D.	Weight (kg) m ± S.D.
Cachena	20.0±4.0	222.5±40.8	284.7±7.1	33.9±5.3	331.4±36.3
Caldelana	22.6±4.1	280.0±14.1	287.4±5.8	30.3±4.9	327.0±152.8
Frieiresa	18[1]	250[1]	287.2±3.9	25[1]	400[1]
Limiana	16.2±5.8	346.6±40.7	293.2±3.5	37.0±1.4	460.0±21.2
Vianesa	28.0±1.4	425.0±63.6	286.7±9.9	37.5±0.7	517.5±60.1

[1]Data belong to only one female due to impossibility of obtaining more information
m ± S.D.=Arithmetic mean ± Standard Deviation

Table 6. Nucleus herds of the Morena Gallega breeds

Nucleus herd	Number of females	Number of males	Total number
Cachena	89	25	114
Caldelana	52	19	71
Frieiresa	24	6	30
Limiana	24	6	30
Vianesa	24	6	30

(MPHH) and after freezing-defreezing (MPPCD) are shown in table 4.

Reproductive Performances in Females

Estimates of reproductive parameters in cows at the age of first oestrus and first calving with their respective weights, and length of pregnancy are summarized in table 5.

a) Pubertal oestrus. The age at pubertal oestrus for each population could not be established accurately due to the small number of observed females (from 1 in the Frieiresa population to 21 in the Cachena). However, the information obtained is indicated in table 5, and this at puberty shows the tendency to an older age at puberty as compared with other meat breeds.

b) Pregnancy length. This is within the normal range as far as the meat breeds are concerned, extreme cases of >300 days not observed. The Caldelana, Frieiresa and Vianesa breeds have almost the same gestation length. The shortest gestation is (284.72 ± 7.16 days) for the smallest breed (Cachena) and the longest (293.20 ± 3.56 days) for the biggest breed (Limiana).

c) Age and live weight at first calving. This is one of the most frequently used parameters in beef cattle. It is important because of its influence on the economic results of the general farming management. Replacement or increment of cattle numbers should not take too long since this would have a repercussion on the rearing cost. The age at first calving ranges from 2 years 6 months and 1 day for the Caldelana breed to 3 years 1 month and 25 days in the Vianesa breed.

This data are similar to that found previously in the bibliography two decades ago, although there are individual differences.

The average weights at the first calving indicate good development, with the exception of Cachena and Caldelana breeds which are light.

Protection-Conservation Programme

The two commnly-used protection-conservation methods for cattle under threat of extinction have been established: the *in situ* method based on the maintenance of live cattle in their natural environment, and the *ex situ* method (gene bank) including the cryogenic conservation both of semen, ova and embryos, in order to preserve the widest genetic variety of these breeds.

It has been necessary to intensify and adapt the old centres that are still taking part in these activities and to incorporate new units into these programmes. The major unit is the Animal Selection and Reproduction Centre in Fontefiz (Orense) where some of the herds which give rise to all the Morena Gallega breeds are found, as well as the germplasm bank. There are other three sites holding the rest of the herds.

Table 7. Cryogenic semen and embryo bank

Breed	Number of semen doses	Number of frozen embryos
Cachena	63 134	67
Caldelana	113 626	29
Frieiresa	60 457	25
Limiana	68 511	15
Vianesa	61 791	34

In situ conservation

The nucleus herds placed in suitable locations have been obtained from a small number of individuals. From these herds the "reproduction groups" have been formed with a male and four females each (six per herd). The animals mate according to suitable combinations in order to avoid inbreeding in the herd, following a fixed plan of rotational matings (Rochambeau and Chevalet, 1990). The groups of live animals that have formed the nucleus herds are summarized in table 6.

Ex situ conservation

This option is based on the services of freezing semen and embryo transfer that have allowed the institution of frozen semen and embryos which are shown in table 7.

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Phenotypic characterization of the Saudi Arabian Hassawi cattle breed

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Summary

Hassawi cattle breed is a mix of *Bos indicus* and *Bos taurus*. The cattle are raised in the Eastern province of the country by farming families in mixed farming system. The breed numbers are declining very fast, from 10 449 head in 1986 to an estimated maximum of 4 500 head at present.

The decrease is mainly due to replacement by exotic breeds, the indiscriminate crossing with these exotics, particularly in view of the scarcity of the Hassawi bulls for mating. Animals are small in size, mature body weight 210-270 kg for bulls and 150-200 kg for cows, quite uniform in colour (light red) and body conformation have conspicuously reduced dewlap and umbilical folds and relatively large hump. Animals are heat tolerant, sustain high feed intake under ambient temperature, resistant to many diseases prevailing in the region and cows have good mothering ability. Productivity of the breed in terms of meat and milk is low when compared to that of exotics in high input production environments, but reproduction performance excels that of temperate breeds and zebu cattle.

Efforts should be made to stop the decline in the breed numbers and to conserve the breed as an asset for production under harsh environment.

Resumen

La raza bovina Hassawi es una mezcla entre *Bos indicus* y *Bos taurus*. Estos bovinos se crían en la provicia oriental del país en explotaciones familiares con sistema mixto de producción. El número de animales está decayendo a gran velocidad, pasando de 10 449 cabezas en 1986 a un máximo estimado en 4 500 cabezas en la actualidad.

El decrecimiento se debe principalmente a la sustitución por razas exóticas y al cruce indiscriminado con estas razas exóticas, en particular debido a la escasez de toros Hassawi para la monta. Estos animales son de talla pequeña, con un peso corporal en edad madura que va de 210 a 270 kg para los toros y de 150 a 200 kg para las hembras. El color es relativamente uniforme (rojizo) y la conformación corporal ha reducido de forma importante el desarrollo y los pliegues umbilicales y ha dado lugar a una joroba. Los animales son tolerante al calor, mantienen una ingestión alimentaria elevada en temperatura ambiente, son resistentes a las principales enfermedades presentes en la región y las hembras resultan buenas madres. La productividad de la raza en cuanto a carne y leche es baja, comparada con la de razas exóticas en medios de alta producción, pero la tasa de reproducción supera la de otros bovinos y zebús de zonas templadas.

Es necesario realizar esfuerzos para impedir el declino del número de animales y conservar la raza como recurso para la producción en medios difíciles.

Key words: *Hassawi, Al-Quatif district, Ecology, Physical characteristics, Production systems*

Introduction

Population size, species and breed diversity of the indigenous domestic livestock in the

Middle East and the Arabian peninsula are declining at an ever accelerating rate. Some of the 171 breeds of the domestic species existing in the region are endangered or at risk of becoming extinct. Species and breeds with low production potential are the most endangered. Indigenous cattle of the Arabian peninsula are on top of this list. The Hassawi cattle breed of Saudi Arabia is one such example.

Typical Hassawi cattle are kept in small numbers on some small-scale traditional farms in the Eastern province of the Kingdom of Saudi Arabia. The breed has neither been described in the literature nor inventoried in Masons' World Dictionary of Livestock Breeds (Mason, 1996) or the FAO/UNEP World Watch List for Domestic Livestock Diversity (Scherf, 1995). In the absence of a systemic and coherent institutional policy to improve and conserve them, the Hassawi cattle will become extinct and, a potentially valuable genetic material will be lost forever.

The objective of this manuscript is to characterize the Hassawi breed by providing basic information on its origin, population statistics, ecology, production system, utilisation, physical and adaptive features and production characteristics .

Origin and Population Statistics

Present-day Saudi Arabian indigenous cattle can be classified into three categories: the humped *Bos indicus* (Zebu) distributed widely in the Southern provinces of the Kingdom along the Red Sea coast; *Bos indicus* x *Bos taurus* derivatives (Sanga), found mainly in the Central and Eastern provinces along the Arabian Gulf coast and the stabilized Zebu x Sanga types scattered in the Eastern, Western and Central provinces.

The origin of Saudi Arabian cattle dates back to around 7500 B.C. Epistein (1971) suggesting that cattle were brought into the Arabian peninsula, from their centres of domestication in the Indian sub-continent, well before their introduction into other parts of the world. According to Payne (1964, 1970), Rouse (1970) and Smith (1980), the Samitic tribes of southern Arabia were the first to introduce zebu and *Bos taurus* cattle into Eastern, Southern and Northern Africa and probably, Europe.

It is most likely that the humped Asiatic zebu and the humpless *Bos taurus* cattle types once occupied extensive areas of the peninsula, interbred with each other or evolved independently into several distinct breeds or strains. One of these breeds is the present Hassawi (synonyms: *Dirbani*, *Baladi*) as it is named in Saudi Arabia, bred by farming families in numerous villages of the Eastern province of the Kingdom.

The breed population was large and its ownership was most common prior to the 1970's. Since then, however, the breed numbers have declined markedly. According to the Ministry of Agriculture (Year Book, 1990) the numbers of the breed decreased from 10 449 head in 1986 to 6 815 head in 1990. This leads one to extrapolate that present population size stands at about 3 500-4 500 head, making the breed a "minor", needing watching as "endangered" or "vulnerable" (Hall and Raune, 1993).

The reasons behind the diminishing breed numbers are many and relate to environmental, socioeconomic and technical aspects. It is common knowledge that Saudi Arabia has witnessed an accelerated form of agricultural development and human population and urbanization increases during the past three decades. To meet and sustain the increased demand for fluid milk, the government of the Kingdom implemented a policy, encouraging and financing importation of exotic temperate zone dairy cattle. This placed an excessive selection pressure against indigenous cattle and promoted an irresistible tendency to abandon them in favour of exotic breeds, and or to indiscriminately crossbreed them. In remote areas, away from the development focus, inbreeding and scarcity of feed and water were, probably, the reasons behind degradation of the breed.

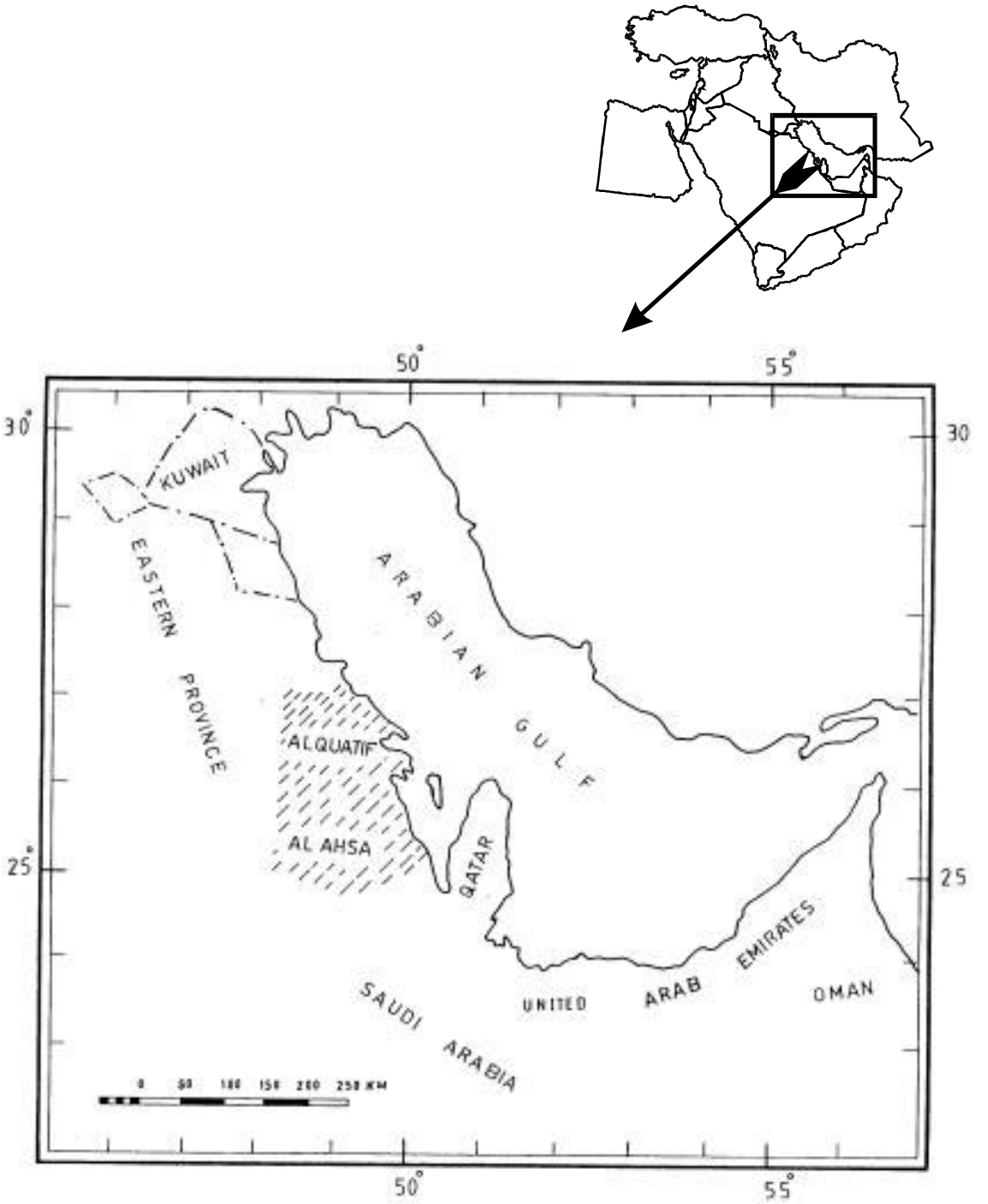

Figure 1. Location of the Hassawi breeding area

Figure 2. A herd of Hassawi cattle

Ecology, Use and Production System

In the Eastern province the habitat of the Hassawi cattle is limited to the farming areas in the Al-Qatif district on the Arabian Gulf and Al-Ahsa Oasis to the southwest (Figure1). The ecology of the habitat is arid and desert-like. Away from the coast extends an undulating poorly vegetated terrain 100-500 meters above sea level, hosting the largest crude oil reserves in the world.

The climate is characterized by extreme diurnal and seasonal variations in temperature, humidity and sunshine. The year is, however, divided into two distinct seasons:

1) a 7-month long (April-October) rainless and very hot but humid summer with 10 hrs of sunshine, and
2) a 5-month (November-March) warm and rainy winter season with 7 hours of sunshine.

Long term maximum and minimum temperatures recorded were 44.7°C and 25°C in July and 25°C and 9°C in January. Rainfall is low and amounts to 60-70 mm. Most of the precipitation is received in December and January. The distribution of cultivatable lands and water resources is very limited and localized, hence the intensity and distribution of human population and agricultural activities.

The Hassawi cattle are kept in small herds of 2-5 head by small scale farmers. The bulk of the 0.5-5.0 ha family farm is occupied with date palm trees under which high value crops such as vegetable and fodder crops are cultivated using pump irrigation from underground water basins. Occasionally citrus fruit trees are planted.

The main purpose of keeping the cattle on the farm is the provision of milk for household consumption. The milk yield of these cattle, however, is too low to warrant marketing without adverse effects on the growth and well being of the calf. The breed has reasonable conformation for meat production and yields good beef carcass. Heifer calf meat, however, is preferred by the inhabitants to bull calf meat, a habit which

may have contributed to the reduction in breed numbers. Cattle manure is extensively used for soil conditioning and fertilization. Because of their small size, the Hassawi cattle are not used for work on or off-farm.

The mixed crop-livestock production system practised, and the scarcity of grazing and labour deemed that the cattle be managed under a zero-grazing system. They are usually kept in permanent confinement with a shed and stall feeding. The majority of the herds tend to have no breeding bulls, however, and breeding is a problem. The cattle are fed green fodder (*Medicago sativa*) and purchased hay (Rhodes grass) as base diet, supplemented with underquality dates. Calves are kept in separate stalls and are allowed to suckle their mothers twice at the morning and evening milkings. Hassawi cows do not let milk down if their calves are not under them at the time of milking.

Physical Characteristics

The Hassawi breed is uniform and homogenous and exhibits least variations in size, conformation and colour. The breed is of medium size and has a reasonable general conformation. The small size may have resulted from natural selection under harsh environment al conditions and reduced feed availability.

The body is of fair depth, although inclined to lack width at the chest and flanks and to be flat over the ribs. The legs are long with light and fine bones, suggesting that the animals could be trekked for long distances.

The coat colour is invariably light red and has short and glossy hair and pigmented skin. The knees, fetlock, hooves, eyelids and tailswitch are either black or brown, in harmony with the muzzle colour.

The head is long and proportionately small compared to the body. The face is long, triangular and slightly concave in profile with a flat and wide forehead. The nose is straight and the muzzle is large and is either black or brown. The eyes are often surrounded with black areas and prominent supraorbital bones. The ears are large and comparable to those of Indian breeds. They are laterally located and horizontally oriented. The horns are rudimentary in females and very short in

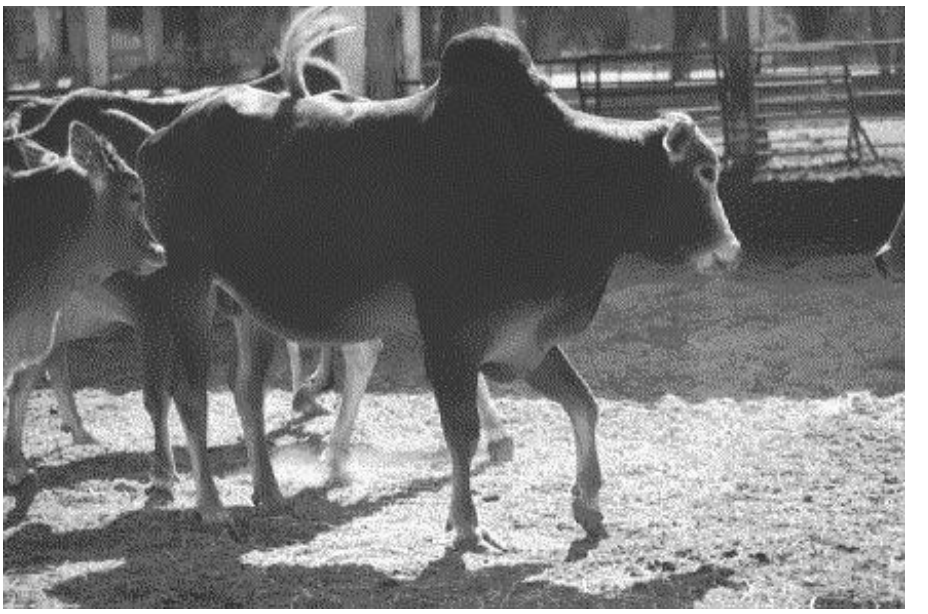

Figure 3. A Hassawi bull

Figure 4. A Hassawi cow with her calf

the males. Polled animals are rare.

The neck is short and thick in the male and thin in the female. The breed have a conspicuously reduced dewlap and umbilical folds, typical of *Bos taurus* breeds. The hump is large and well defined, especially in the male, typical of zebu cattle. It stands upright and is cervicothoracically positioned.

The hind quarters of the Hassawi are not well developed, with the thighs lacking in width and fullness. The ischial arch and sacroiliac articulation bones are very prominent and the buttocks are lean with conspicuous pinbones. The tail is long extending below the hocks with its base (Sacrocoxygeal junction) set markedly advanced on the back.

The udders and teats are retracted and degenerate, pointing to the poor dairy potential of the breed. Figures 2, 3 and 4 show a herd of Hassawi cattle, a bull and a cow with her calf, respectively.

Adaptation Characteristics

The Hassawi cattle are evidently low-producing animals, nonetheless, their owners believe that they are endowed with the following valuable attributes:

a) heat tolerance: the Hassawi cattle are hardy and adapt well to the hot and humid environment in which they live. They may have, through time, developed mechanisms giving them a high degree of heat tolerance. These mechanisms comprise dark skin pigmentation protecting against sunburns and a shiny coat capable of reflecting a high proportion of solar energy;
b) feeding behaviour: the Hassawi cattle are capable of sustaining a good apetite, unimpaired by high ambient temperature. They are capable of feeding well during seasons and hours of high temperature;
c) water and feed economy: the relatively small size, coupled with the remarkable heat tolerance of the Hassawi cattle, reduces the amounts of water and feed they require for their body maintenance and condition;
d) mothering ability and herd instinct: the Hassawi cow is an excellent mother. She is reluctant to let milk down if her calf is not under her when milked. She feeds and protects it well against potential predators. In addition, the cattle have a well developed herd instinct, a characteristic

making them tractable and easy to herd. However, they are difficult to milk and to handle as individuals;

e) disease resistance: in comparison with other cattle breeds, living on the same premises, the Hassawi cattle are resilient and have a high degree of resistance to the few endemic diseases prevailing in their habitat, such as rinderpest, foot and mouth disease and femoral fever. They are also resistant to tick infestation and tickborne diseases. Mortality rates among suckling calves and mature animals are relatively low and are respectively less than 6 and 2%.

Production Characteristics

Information on the production performance of the Hassawi cattle is seriously lacking. The results included hereunder were derived from data of unreported experimental work undertaken by the Ministry of Agriculture at Al-Hofuf research station during the period 1973-1978. The research focussed on the Hassawi cattle growth performance, reproductive abilities and milk production potential. However, the research used a limited number of animals (16 head) and its results are, therefore, not as conclusive.

Birth weight of Hassawi cattle ranged from 12-14 kg for male and 9-11 kg for female calves depending on whether the calves were born to heifers or multiparous cows. Pre and post weaning rates of daily growth averaged 293 and 512 g, respectively. Live body weight of males was 178 kg at 400 days. Pubertal body weight of bull and heifer calves ranged from 130 to 160 kg and 90 to 120 kg, respectively. The respective mature body weights of bulls and cows were 210 to 270 kg and 150-200 kg.

The Hassawi females are early maturing and fertile, capable of giving a calf every year. They attain puberty at as early as 263 days of age. Age at first calving ranged between 332 to 624 days. Mean intervals between consecutive calvings was as short as 290 days and as long as 783 days.

The milk yield of the Hassawi cows is not known as the amounts of milk suckled by the calves during the milking operation was not determined. Recorded milk off-take, however, could be as little as 180 l or as large as 570 l during a lactation period ranging from 150 to 230 days. Butter fat content of the Hassawi milk ranged from 5.0 to 6.5%, higher than that of temperate dairy breeds and zebu cattle presently raised in the Kingdom.

Conclusions

To fully describe the Hassawi cattle, there is dire need for comparative quantitative data to substantiate some of the information on their physical, adaptive and special genetic attributes. The beef and dairy production potentials of the breed are relatively low and evidently the cattle could not, without improvement, compete with more productive breeds in high input production environment

The reproductive performance of the Hassawi cattle excels that of temperate and zebu cattle. It is often characterized by early puberty, early maturity and short calving interval resulting in high fecundity rates. In addition, the breed may be considered one of the few capable of surviving under the very hot environment of maritime deserts and to produce under limited levels of feed and water resources.

Population statistics of the breed indicate that it is endangered and on the verge of extinction. There is, therefore, an urgent need that measures be taken to prevent the loss of this potentially valuable genetic material. The status of other indigenous cattle in Saudi Arabia and other Gulf States requires study.

Acknowledgements

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Establishment of a breeding season and evaluation of the reproductive performance of the Pantaneira horse in Mato Grosso do Sul, Brazil

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Summary

The objective of this study was to establish a breeding season and to evaluate the reproductive performance of a horse herd of the Pantaneira breed from Nhumirim Ranch in the lowlands of Mato Grosso do Sul, Brazil. During the period 1990/91, the stallion was kept year-round with 17 mares. In the following year (91/92) a breeding season of seven months (Sept. 91 to Mar. 92) was established, in which the stallion and 15 mares were used. In the first period (90/91), the concentration of births occurred from September to December of 1991. The percentage of pregnancy and parturition observed in 90/91 and 91/92 for the male:female proportions of 1:17 and 1:15 were: 82.3, 100 and 86.7, 100%, respectively. In the breeding season from Oct. 91 to Feb. 92 with male/female ratios of A-1:11, B-1:10 and C-1:10, it was observed that the percentage of pregnancy was 90.9, 100 and 100%, respectively, with 100% parturition in the 3 groups. Independently of the number of females used (A-1:10, B-1:08, C-1:12), the rate of pregnancy obtained from the breeding season from Oct. 92 to Feb. 93 was 100%.

Resumen

Este trabajo fue realizado con el objetivo de evaluar el desempeño reproductivo y estabelecer la mejor época de la estación de monta para el plantel de caballos de la raza Pantaneira, pertenecientes a la hacienda Nhumirim, Pantanal Mato-Grossense, Brasil. Para la determinación de la estación de monta el padrillo permaneció durante el año entero (90/91) con las 17 yeguas. En el año siguiente (91/92) fue establecido un período de monta fijo con una duración inicial de siete meses (set./91 hasta mar./92), utilizando el mismo reproductor y 15 yeguas. En la ocasión en que el padrillo permaneció durante todo el año con las yeguas (90/91), los nacimientos ocurrieron de setiembre hasta diciembre de 1991. Las tasas de preñez y parición obtenidas en los períodos de monta 90/91 y 91/92 fueron de 82,3, 100 y 86,7, 100%, respectivamente. Se observó para la estación de monta de oct./91 hasta feb./92, cuando la proporción macho:hembra era: padrillo A-1:11, B-1:10 y C-1:10, que las tasas de preñez eran respectivamente, 90,9, 100 y 100%, con una tasa de parición para los tres grupos del 100%. La tasa de preñez durante la estación de monta de oct./92 hasta feb./93 fue del 100% para las tres proporciones sexuales adoptadas: padrillos A-1:10, B-1:08 y C-1:12.

Key words: *Pantaneira, Horse, Brazil, Reproduction, Conservation, Breeding season*

Introduction

The Pantaneiro horse (figure 1), a result of natural selection over the last three centuries, is characterized by its rusticity and adaptation to the environmental conditions of the Pantanal (seasonally flooded lowlands) (figures 2 and 3). Its economic and social importance supports meat production and contributes to the stability of the region. After

1900, indiscriminate crossbreeding and the spread of diseases such as trypanosomiasis and, recently, infectious equine anemia (IEA), contributed to its decrease in number. The incidence of IEA, which ranges from 30 to 80%, is endemic to the region, and is one of the main factors that have reduced equine breeding in the Pantanal.

The Brazilian Association of Pantaneiro Horse Breeders (ABCCP), created in 1972, and government institutions have taken on the task of preserving the Pantaneiro horse. In 1988, the Brazilian Corporation for Agricultural Research (EMBRAPA), through the Pantanal Agricultural Research Center (CPAP), established a nucleus of equine production at Nhumirim Ranch, located in the Nhecolândia region of the southern Pantanal, whose objective was to conserve the genetic material, well adapted to the wetlands (hoofs are more resistant to flooded soils) and environmental conditions of the region, and to investigate reproduction, nutrition and genetic improvement of the breed. In the future, EMBRAPA-CPAP will direct programs for genetic improvement of the breed, taking into account the economic and zootechnical characteristics, in order to maintain the genes and genetic combinations that are potentially important for survival in the ecotype.

The mare is a seasonal breeder with physiological anoestrus taking place during the shortening of day-lengths (Scraba & Ginther, 1985; Nequin *et al* al., 1990). A successful program of equine reproduction should have higher production and productivity, as well as an on-farm management practice using an established breeding season (BS). The adoption of a BS is a management practice that allows selection, birth concentration that can facilitate the management of foals, the use of appropriate ages and seasons to apply vaccinations and parasite control chronograms, organizing activity schedules (hooving, weaning, castration) and sales in homogeneous lots.

In contrast with other species, there are few field studies on the reproductive efficiency of domestic equines. Therefore, supplementary studies in this area are very important for the region in order to provide information which can increase the reproductive efficiency of breeding herds.

Figure 1. Pantaneira mare and foals

Table 1. Annual weather data at Nhumirim Ranch in the Pantanal (latitude 18º59'O"S, longitude 56º39'O"W and altitude 98 m) from 1989-92

Year	Average temperature (ºC)	Average relative humidity (%)	Precipitation (mm)
1989	24.9	83.3	1317.7
1990	24.8	81.7	822.2
1991	25.1	83.1	1267.8
1992	24.6	84.1	1387.0

Source: AGROCLIMATOLOGIC station at Nhumirim Ranch, property of EMBRAPA-CPAP, region of Nhecolândia, Pantanal Mato-Grossense, Brazil

Table 2. Estimated incidence of light for Corumbá - MS (Southern Pantanal, latitude 19º01S and longitude 57º40'W)

Day	Sunrise (h) ±S.D.	Sunset (h)	Hours light/day
31 January	5:29±0.05	18:29±0.00	13:00
29 February	5:46±0.03	18:22±0.05	13:16
31 March	6:03±0.16	18:26±0.26	12:23
30 April	6:04±0.02	17:37±0.06	11:33
31 May	6:14±0.03	17:20±0.03	11:06
30 June	6:24±0.02	17:17±0.01	11:33
31 July	6:26±0.01	17:25±0.03	11:39
31 August	6:14±0.06	17:35±0.02	11:21
30 September	6:14±0.06	17:41±0.01	11:27
31 October	5:25±0.06	17:48±0.02	12:23
30 November	5:09±0.01	18:28±0.27	13:19
31 December	5:12±0.03	18:19±0.05	13:07

(h) ±S.D.= Hours ±Standard Deviation

The objective of this study was to evaluate the reproductive performance of the Pantaneira breed under natural conditions and to verify the viability of the establishment of a 4-5 month BS , during the highest conception concentration season in the Pantanal, Brazil.

Materials and Methods

Reproductive evaluation was conducted at Nhumirim Ranch, operated by EMBRAPA-CPAP, located in the Nhecolândia region of the Pantanal in the state of Mato Grosso do Sul, Brazil. The climate of the region is hot and rainy in the summer and dry and mild in the winter, with average temperatures of 32ºC and 12ºC, respectively. Yearly precipitation ranged from 900 to 1400 mm between 1989 and 1992 (Table 1), with maximum rainfall between December and March. The sunshine in the region was estimated (Table 2) from sunrise to sunset according to the method followed by Brasil (1987).

From 1990 to 1991 and 1991 to 1992 a 6-year-old stud stallion, with known fertility and 2 female groups of 17 and 15 mares, of undefined breed (UB), with ages varying from 8.7 to 9.1 years old, respectively, were used. The stallion stayed with the mares for the whole year (90/91) and in the following year (91/92), a breeding season was established with an initial duration of seven months (Sept. 91 to March 92). This was reduced over the years to four months.

The experiment went through two breeding seasons from Oct. 91 to Feb. 92 and Oct. 92 to Feb. 93, using three stud horses (A,B,C) with known fertility and 31 Pantaneira mares. For the first mating cycle, animals were distributed onto different paddocks with 175 to 200 ha of native grass, in a rotating system. Mares were previously selected, based on body conformation, breed characteristics and temperament. Horse:mare ratios were A (1:11), B (1:10) and C (1:10) with average ages of the horses and mares as 13.7 and 6.0; 8.0 and 5.1, 8.0 and 6.3 years , respectively. After parturition and full recovery from the colt's umbilicus, three distinct groups of mares were used for the second mating cycle with each of the three stud horses. All animals were in good body condition.

Pregnancy rate was analysed by χ^2 test (Statistical Analysis Systems Institute Inc., 1989).

Results

When the stud horses were kept for the whole year with the mares (90/91), births concentrated from September to December of 1991. The rates of pregnancy and parturition observed in the breeding season 90/91 and 91/92, for the male:female proportions 1:17 and 1:15 were 82.3, 100 and 86.7, 100% respectively (Table 3).

In the breeding season from October 91 to February 92, with horse:mare ratio of: A-1:11, B-1:10 and C-1:10, pregnancy rates were, respectively, 90.9, 100 and 100% with 100% of parturition rate in the three groups. The pregnancy rate was 100% during the breeding season from October 92 to February 93 for the three male:female ratios adopted: A-1:10, B-1:08 and C-1:12. The ratio between number of mares getting pregnant in different male:female ratios did not differ (c^2; P>0.05) from one year to another (Table 4).

Discussion

Although it is difficult to demonstrate that light is a primary regulator of the reproductive activity of seasonal breeding, a variety of studies have suggested that the primary response to photostimulation is increased pituitary secretion of LH and FSH. The hypothalamus contains a pulse generator which regulates the discharge of GnRH from the median eminence (Karsch, 1988). The photoperiod may alter the frequency of the pulse generator. In this study it was possible to characterize the Pantaneiro horse as long-day breeder since births concentrated from September to December 91, even though the females had remained with the stud horse all year round.

Table 3. Breeding season, sex ratio, pregnancy and parturition rate, during the periods of 1990/92 at Nhumirim Ranch (EMBRAPA-CPAP), region of Nhecolândia, Pantanal Mato-Grossense, Brazil

Breeding Station	1990/91	1991/92
Period	Whole year	Sept./March
Male:female ratio	1:17	1:15
Pregnancy rate(%)	82.3	86.7
Parturition rate (%)	100	100

Table 4. Male:female ratio, pregnancy and parturition rate of the Pantaneira mares breed in the region of Nhecolândia, Pantanal Mato-Grossense, Brazil

Breeding season	Oct.-91/Feb.-92			Oct.-92/Feb.-93		
Stud Horses	A	B	C	A	B	C
Male:female ratio	1:11	1:10	1:10	1:10	1:08	1:12
Pregnancy rate (%)	90.9	100	100	100	100	100
Parturition rate(%)	100	100	100	100	100	100

Figure 2. Pantaneira horses in their natural environment

Berger (1983) reported a pregnancy rate of 95% for 38 oestrus cycles for wild horses. Similar results were obtained by Gibbs & Davison (1992) with 97% pregnancy for mares kept on native pasture. However, when the females were stabled with the stud horse for 30 days, the pregnancy rate was 71% (Ginther, 1983). Ginther *et al.* (1983) observed for a period of 48 days of breeding season, in different male:female ratios, pregnancy rates of 1:60 in pasture, 42%, 1:20 in pasture, 51% and 1:20 when the stud horse was introduced to the herds on alternate days for 3 hours, 54%.

Bristol (1982), using 20 synchronized mares with one stud horse, observed pregnancy in

Figure 3. A group of Pantaneira horses

85% of the mares. A later study (from 1983 to 1985) with male:female ratio of 1:15 to 1:21 reported pregnancy rates of 87.7, 93.7 and 97.15, respectively (Bristol, 1987).

The results obtained in this study suggest that pregnancy rates (82.3 to 100%) observed for Pantaneiro horses were satisfactory and similar to those reported in the literature. Nevertheless the percentage of parturition for the Pantaneiro horse was higher than that observed for wild horses (23% to 82%) and for domestic horses (76 to 84%) (Ginther, 1992). Based on this information and on results obtained in the present study, a breeding season of five months is suggested for equines in the lowlands. The range of male:female ratios used in this study was from 1:10 to 1:17. Since the area designed for the herds was sufficient (175 to 200 ha/herd) not only for the interaction between stud horses and mares, but also for feeding the herds, the proportion of males to females could be widened or increased.

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The Hungarian Grey cattle: a traditional European breed

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Summary

In this paper, the Hungarian Grey, a traditional draught and beef cattle was studied. This breed was threatened by extinction due to the mechanization of agriculture and propagation of upgraded breeds which had almost completely replaced it. Following a crisis in the 1960's (in 1966 only 470 dams were registered) a pioneering conservation scheme was introduced. Thanks to scientific breeding, the number of cows increased to approximately 1 600 and the risk of inbreeding has been avoided. In addition to a historical review, body conformation, production characteristics and modern forms of exploitation for this rare but genetically valuable breed are discussed.

Resumen

Se ha estudiado el Gris Húngaro, una raza bovina tradicional de tiro y carne. Este tipo de ganado fue amenazado por extinción debido a la propagación de motocultura y razas mejoradas desplazando casi su población entera. A partir de la crisis de los años 60 (470 vacas fueron registradas en 1966) se implantó un plan piloto de protección. Gracias a la cría científica existen aproximadamente 1 600 vacas se ha evitado el riesgo de consanguinidad. Además de una revista histórica se trata la conformación, características de producción y posibilidades de explotación moderna de esta raza rara y de gran valor genético.

Key words: *Hungarian Grey cattle, Conservation, Mechanization, Domestication*

Introduction

The *Podolian* type of grey cattle was widely distributed in Eastern and Southeastern Europe between the Ukraine and Italy. The Hungarian Grey (HG) has emerged as a highly bred form that dominated stocks in the Carpathian Basin during the last centuries. Its dramatic decline and successful conservation is not only an object lesson in the management of gene reserves. It also illustrates the impact of history and economy on general attitudes toward domesticates.

Breed History

Several factors interacted during the evolution of this breed, although the extent and probabilities of their contributions differ. Speculations may be sub-divided into two main groups.

Local domestication

The idea that this cattle descended directly from aurochs (*Bos primigenius* Boj, 1827) was raised by, among others, Charles Darwin (1959). The ancient breeds Heinz Heck chosen for his reconstruction of aurochs included HG (Heck, 1952). Jankovich (1967) hypothesized that it was domesticated in medieval Hungary by '*venatores bubalinorum*' known from 13th century documents. He interpreted this term as meaning catchers of 'bubalus-calves', i. e. the offspring of aurochs. By that time, however, aurochs remains were rare at archaeological sites in Hungary (Bartosiewicz, 1996). Consonant osteometric data (Matolcsi, 1970; Bökönyi, 1974) show that

most 10-13th century cattle in Hungary were small, brachyceros type animals (withers height ca. 110 cm) with no transitional forms indicative of ongoing local domestication. The medieval impact of aurochs genes, however, cannot be entirely ruled out.

Migrations and trade

It has been suggested that the ancestors of HG cattle were brought by conquering Hungarians from the areas northeast of the Carpathians during the 9th century (Tormay, 1901; Hankó, 1936) or during the latest, 13th century waves of eastern migrations (Matolcsi, 1975) or, actually, anytime in between. Tenth century Hungarians regularly raided areas in Italy as well as Germany and may have brought such animals from the southwest (Ferencz, 1976). Commercial imports of such cattle from Italy during the 14th century Anjou rule in Hungary have also been hypothesized. Finally, the question must also be raised whether it was HG which was exported to Italy within the framework of envigorated trade links giving rise to similar breeds there.

A 1526 document mentions Hungarian cattle as having been introduced (*sic!*) to the Augsburg market (Takáts, 1927), although written evidence for westward exports is known from the mid-14th century (Miskulin, 1905). Explicit reference to long-horned, '*magnus cornuotes boves Hungaricos*', however, first appears only in a 16th century document (Milhoffer, 1904) when exports indeed culminated (Bartosiewicz, 1995b).

Huge late medieval stocks, potentially originating from all the aforementioned sources, provided an excellent basis for selection. Market driven, target-oriented breeding possibly played a decisive role in consolidating a trademark appearance which became *de facto* common by the 17-18th century (Bartosiewicz, 1996). Prior to World War I, breeding stock was exported to the Balkans where it was used in upgrading local grey cattle (Mattesz, 1927).

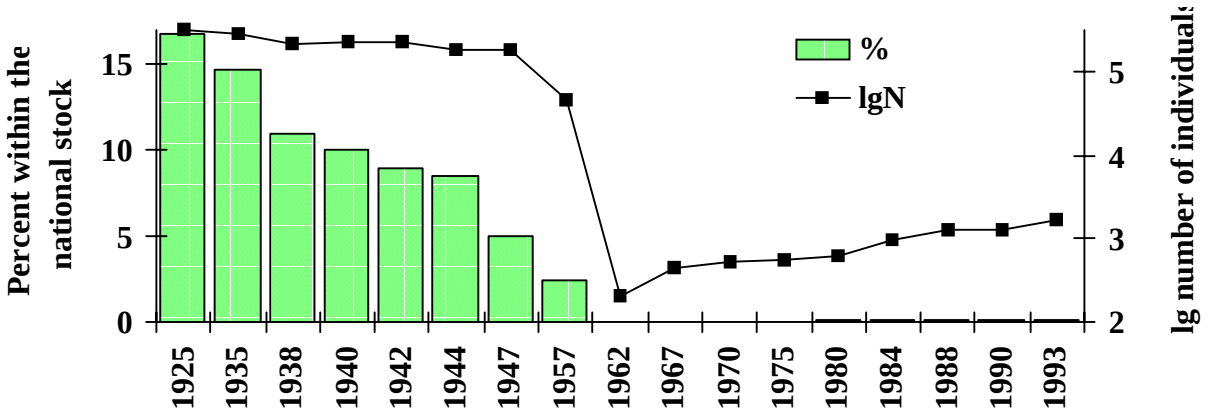
Population Statistics

While in 1884, 78 % of the 4.9 million cattle in Hungary were registered as HG (Mattesz, 1927), exactly half of the 6.7 million stock belonged to this breed at the turn of the century (Tormay, 1901). By 1911, this proportion fell back to 30 % (Bodó, 1987) due to the introduction of industrial crop-rotation that outcompeted extensive pasturing and to urbanization that increased demand for milk (Szöllõsy, 1994), better satisfied by Fleckvieh.

Following World War I, Hungary lost two thirds of its territory which makes the precise appraisal of the contribution of this breed difficult. Figure 1 shows that the radical decline in the remaining, central area continued. By 1925, the 321 000 HG cattle represented only 16.8 % of the national stock. Transylvania, an important breeding region, lay way beyond the new borders. Thus, the renowned Hortobágy plains became of pivotal importance. After World War II a radical decline followed (see the logarithmic tranformations in figure 1).

The 'elbow' seen in the 1947-1967 interval indicates near-extinction. The mechanization of tillage was inevitable in large, centrally established cooperatives. Draught exploitation, became irrelevant. Most HG cattle were slaughtered. During the late 1950's, some 1 800 of the 2 000-3 000 cows were mated with sires of the Kostroma dairy breed (Schandl, 1962). According to a 1962 central resolution only 200 purebred HG cows and 6 bulls were saved (Bodó *et al.*, 1996). In the face of this official initiative there were brave grass-roots efforts to save animals from culling or crossing, often illegally. Although the 1962 numbers would have been insufficient for maintaining genetic diversity, Hungary won an internationally acclaimed pioneering position in the conservation of ancient breeds (Alderson, 1989; Grünenfelder 1994). The scientific evaluation of conformation and performance was begun by Imre Bodó (1968). Inbreeding was avoided by using a rotational mating scheme of originally inbred lines (Bodó, 1990) based on six local HG sires, two imports of the same breed and three Maremman sires introduced during the

Figure 1. Changes in the contribution of Hungarian Grey to the cattle stock after World War I



early 1970's. After 7-9 generations, the initial lines became completely randomized (Bodó, 1996). Quantitative recovery is shown in official statistics (Table 1).

HG bones (including 18 complete skeletons) kept in the Hungarian Agricultural Museum (HAM) originate from 74 individuals, mostly slaughtered in 1963. This unique collection is an important source of osteological information (e. g. Matolcsi, 1970; Bartosiewicz, 1984; Bartosiewicz *et al*., n. d.) and often includes complementary data on the animals.

Table 1. The recovery of Hungarian Grey breeding stock relative to the 1962 official figures. (Raw data: Bodó et al.*, 1996:)*

Year	Dam	Sire	Increase (%)	Cumulative (%)
1962*	200	6	0	100.0
1966	470	12	133.9	233.9
1970	500	19	7.6	251.9
1975	550	20	9.8	276.7
1980	600	25	7.8	303.4
1982	800	30	32.8	402.9
1984	900	35	12.7	453.9
1986	1 000	40	11.2	504.9
1988	1 200	50	20.1	606.8
1990	1 200	55	> 0.1	609.2
1992	1 500	60	24.3	757.3
1994	1 600	70	7.1	810.7

* Official directive

Physical Characteristics

In rare breeds, special attention is paid to stabilizing external traits which are manifestations of the traditional form targeted by conservation efforts.

Colour and horns

This breed has alternately been called 'Hungarian White / Silver' or referred to by the vernacular term '*crane-coloured*' (Tormay 1901). While light coats are not preferred by modern breeders, animals occur in all shades of grey. Bulls have dark, 'smokey' markings especially in the front quarters and around the eyes. In adults the horns' tips are black, their lower portions white. The muzzle, eyelashes and claws are black. Calves are born reddish and turn grey at six months.

The present horn conformation probably resulted from long and meticulous selection. The attention devoted to the impressive horns is reflected by a complex terminology.

One hundred and seventy-two such expressions recorded by Herman (1914)

include *shacko*, *tulip* and *forked*, to name only a few descriptive ones. Long and slender, symmetric horns separated by a broad intercornual ridge are traditionally considered a sign of good constitution (Tormay, 1901). While shapes may vary (Bodó ed. 1991), horns must be at least as long as the head in bulls. In cows, a minimum of 1.5x skull length is required. Horn dimensions taken in the HAM collections are summarized in table 2.

Horn cores provide the only osteological evidence for early HG cattle. While Matolcsi (1975) made a passing reference to early medieval cattle finds of comparable, *primigenius* cranial type from the area of the former Soviet Union, to date the longest intact horn core of relevance in Hungary is known from the excavations of 17th-19th century Kecskemét (Table 2; Bökönyi 1974). The horn sheath measured almost 60 cm along its lateral curvature.

Body conformation

Traditionally, emphasis was laid on draught exploitation (Bodó 1990). Large size and long legs have been a priority over early maturation in the selection for draught cattle (Wijngaarden-Bakker 1979). As is often the case with traditional breeds, sexual dimorphism is pronounced in both size and body proportions (Figure 2). Bulls have stronger forequarters, larger dewlaps and more robust horns than cows. Oxen are more gracile than bulls and have longer horns.

Bodó (1987) distinguished four types within this breed. Their basic body dimensions are summarized in table 3. The small 'primitive' and 'fine' types have been most endangered. Following World War II the so-called 'large estate' type has been most widely distributed and is best represented by the HAM sample (originating mostly from the Hortobágy and Ohat state farms; cf. table 6). The museum sample of horns must be somewhat biased by selection for 'trophies': several skulls were collected for the sake of well, developed, spectacular horns.

Exploitation

Between the world wars, a widely advocated way of modernizing HG was the development of a triple-purpose breed. There was not, however, enough time for combining three differing sets of traits within a homogeneous, purebred population. First draught exploitation disappeared, then even dual-purpose Fleckvieh lost ground to specialized breeds.

Draught

Traditionally, HG yearlings designated for draught were castrated during the spring

Table 2. Means and standard errors (cm) of measurements taken on complete horns in the collections of the Hungarian Agricultural Museum and the 17th-19th century horn core from Kecskemét

	Cow (n = 16)	Bull (n = 4)	Ox (n = 7)	Kecskemét (17th-19th century)
Horn core				
Lateral length	51.9±1.6	42.0±4.4	64.1±2.6	42.7
Base circumference	21.6±0.4	23.9±0.5	27.8±1.2	26.6
Distance between tips	83.5±3.6	86.8±4.1	102.5±6.2	-
Horn sheath				
Lateral length	68.4±1.9	50.3±5.5	82.3±3.2	59.2*
Base circumference	24.7±0.4	26.9±0.4	31.4±1.2	-
Distance between tips	97.5±6.3	95.3±4.8	117.7±9.6	-

* Estimated on the base horn core lengths (r = 0.844***; Bartosiewicz 1995a)

Figure 2. A high degree of sexual dimorphism is characteristic of the Hungarian Grey cattle (After Bökönyi, 1974)

(Nagyváthy, 1821-1822). Typically, oxen worked between the 4-14th years of their lives (Schandl, 1962). HG oxen, however, could be used for longer than other breeds even on a meager forage (Bodó, 1973).

The 4.8-5.1 km/h speed cited for HG draught oxen was a normal speed for humans who often walked in front of the oxen when there was no marked way ahead (Viires, 1973). Ploughing 14 cm deep 23 cm wide furrows was possible at a speed of 2.8-3.3 km/h (Tormay, 1901). Depending on soil quality, the *per diem* areal performance reported for HG oxen ranged between ploughing 0.28 and 0.43 hectares (Varga, 1872). HG draught oxen often worked 270 days a year (French *et al*., 1967) in contrast to the 60-70 days recorded in Russia at the turn of this century (Langdon, 1986).

Beef

HG cattle mature late and deposit relatively little fat. Only sporadic data are available on fattening characteristics. The 1526 Augsburg document praised Hungarian beasts as '*die pesten Ochsen*' (Takáts, 1927), but objective grading of beef has yet to be carried out. Some lines in modern HG cattle certainly show potentials of superior beef production (Figure 3). Visual inspection shows that the meat itself is dark and not particularly marbled since most of the suet forms subcutaneous and intestinal fat deposits.

Traditionally, beef production could be combined with draught exploitation by fattening working oxen at a relatively young age. At the end of the last century, ADG values recorded for such oxen ranged between 650-1 100 g (Tormay 1901). The lack of consistent recording, however, limits compatibility even between existing data. This would be all the more important, because the culling of draught oxen has been replaced by fattening young steers. Table 4 shows sporadic data (Tormay 1901; Schandl, 1962; Bodó *et al*. 1996) complemented with data for the closely related Maremman cattle (Lucifero *et al*., 1977). Although this latter is a larger and more robust breed than HG, its data clearly illustrate the differences between fattening animals of comparable type but different ages. While dressing percentages are in practice missing, the weights of six skeletons were recorded in the HAM (Table 5). On average, they weigh less than 7 % of the live weight illustrating a fine skeletal make-up.

In 14 herds published by Wellmann (1926), weaning weight averaged 132.5±11.6 for 6.5 month calves of HG dams of a mean live weight of 549.4±12.2 kg. These relatively small figures should be seen in the light of

Table 3. Body dimensions of mature Hungarian Grey cattle. Shading indicates correspondence between production types and the parameters museum sample (After Tormay, 1901; Schandl, 1962; Bodó, 1987).

Measurement	19th century range	Modern standard	Main Types				Hungarian Agricult. Museum*
			Primitive	Heavy draught	Fine ("dairy")	Large estate	
Cow							n = 51
Live weight, kg	-	540	300-400	600-700	400-500	500-600	413±8.9
Horn circumference, cm	-	-	16.5-17.5	19-21	17-18	18-20	21.6±0.4
Head length, cm	50-54	52	-	-	-	-	50.8±0.5**
Frontal breadth, cm	21.2-23	24	-	-	-	-	24.5±0.3**
Heart girth, cm	171-218	196	175-190	210-230	185-195	195-210	184±1.2
Chest width, cm	36-47	41	-	-	-	-	-
Chest depth, cm	-	72	-	-	-	-	-
Withers height, cm	127-155	135	120-125	145-155	125-130	135-140	135±0.7
Trunk length, cm	153-165	161	140-150	160-180	140-150	150-170	153±0.9
Rump width, cm	39-48.5	46	-	-	-	-	44.6±0.3**
Rump length, cm	-	52	-	-	-	-	-
Shank circumference, cm	-	19	-	-	-	-	19.7±0.1
Bull							n = 2
Live weight, kg	-	800	600-700	950-1050	700-800	800-950	829-835
Horn circumference, cm	-	-	19-21	23-25	21-20	22-23	26.9±0.4
Head length, cm	52-57	56	-	-	-	-	-
Frontal breadth, cm	25-33	31	-	-	-	-	-
Heart girth, cm	170-230	214	200-220	230-250	200-220	220-230	229-232
Chest width, cm	40-54.5	48	-	-	-	-	-
Chest depth, cm	-	77	-	-	-	-	-
Withers height, cm	130-158	146	130-140	155-170	135-145	145-155	151-154
Trunk length, cm	151-183	179	150-160	180-190	155-165	175-185	179-185
Rump width, cm	42-52	48	-	-	-	-	-
Rump length, cm	-	56	-	-	-	-	-
Shank circumference, cm	-	23	-	-	-	-	21-25

*Mean±SE for horns and cow dimensions in the Hungarian Agricultural Museum
** n = 35

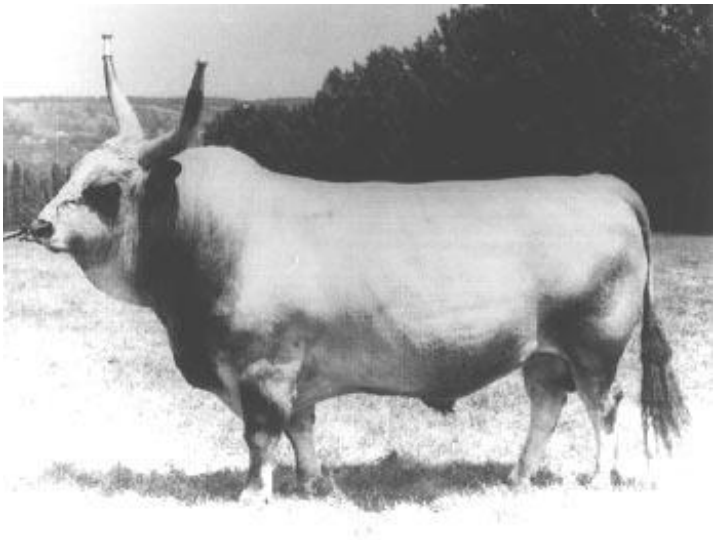


Figure 3. The 'Mérges' bull showing that genetic diversity within the Hungarian Grey breed can even be a basis for developing a beef population

easy calving. More recent birth weights of some HAM specimens (1950's) averaged 38 kg for male calves and 35 kg for females. These relatively high values may result from the non-random nature of the museum sample. Easy calving is combined with usually favourable fertility parameters and longevity of cows (9-10 calves in 10-12 breeding years). The record dam lived for 32 years (Bodó *et al.*, 1996).

Dairy

Data on systematically milking HG cows were already recorded at the beginning of the last century (Bodó *et al.* 1996). The small and hairy, '*range*' udders of cows, however, show that in spite of renewed efforts, the average breeder has not assertively improved dairy production. This traditional breed usually

Table 4. Compilation of fattening data for Hungarian Grey and Maremman steers

Breed / source	n	Initial (kg)	Final (kg)	Interval (days)	ADG (g)	Dressing (%)
Draught oxen (Tormay)	300	554	680	148	810	-
Draught oxen* (Tormay)	204	533	646	143	790	-
Oxen (Tormay)	533	-	-	237	630	-
"Young" oxen (Tormay)	-	630	726	130	740	-
"Old" oxen (Schandl)	-	-	-	270	700-900	
Bulls (Bodó *et al.*)	7	269	536	300	891	(58.0)
Maremman Group AI	-	295	546	238	1 056	57.3
Maremman Group AII	-	281	506	236	954	56.8
Maremman Group BI	-	280	546	273	974	57.0
Maremman Group BII	-	224	476	307	821	56.4

*"in sandy regions"

Table 5. The absolute and relative weight of bones in some adult Hungarian Grey cows and bulls in the collections of the Hungarian Agricultural Museum (Hortobágy State Farm)

Name	Age (years)	Live weight (kg)	Skeletal weight (kg)	Bone (%)
Cow				
Meggyes	7	360	20.6	5.7
Arany	6	500	32.7	6.5
Szemes 2	9	430	33.0	7.7
Táncos	15	544	35.6	6.5
Mean±SE	9.3 ± 2.0	454.5 ± 40.4	30.5 ± 3.4	(6.6)
Bull				
Buda	12	-	64.5	-
Anonym	2	560	32.1	5.7

produces 800-1 000 kg milk annually (Schandl 1962). Improving milk production was regarded as the key to the last-minute modernization of this breed.

The average milk production of almost 700 cows presented in table 6, was 1 762±0.3 kg during 232±0.2 days of lactation. The amount of butterfat produced during this period corresponds to 4.5-4.6 %. Even better results are shown by some individuals in the HAM (Table 7).

Other

One more traditional form of direct exploitation is worth mentioning: the manufacturing of large horn sheaths into

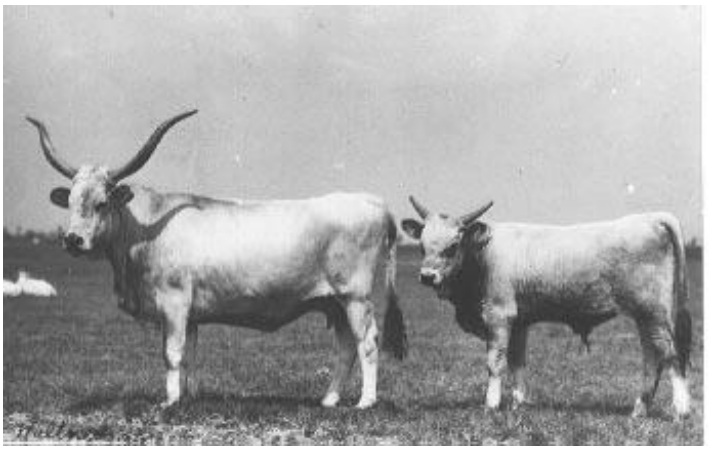


Figure 4. Hungarian Grey dam and bull calf (Photo B. Waltner)

Table 6. Milk production statistics of Hungarian Grey cows at the Hortobágy (I) and Hosszúhát (II) State Farms (Raw data: Bodó et al *1996)*

	n	n	Days of lactation		Milk (kg)		Fat (kg)	
State farm	I	II	I	II	I	II	I	II
1952-1953	64	-	227	-	1 530	-	71.2	-
1953-1954	128	50	231	189	1 600	1 611	72.6	70.4
1954-1955	126	49	239	232	1 893	1 733	83.3	81.3
1955-1956	117	60	247	247	1 929	1 963	86.0	93.0
1956-1957	102	-	228	-	1 730	-	78.8	-
Weighted means±SE	537	159	235 ± 0.3	224 ± 1.9	1 757 ± 7	1 781 ± 12	79 ± 0.2	82 ± 0.7

decorative objects. The removal of large horns by craftspeople may have reduced the survival rate of large horn cores in archaeological deposits. Given a reasonable market demand, artisans could make use of this exquisite raw material even today (Chartier *et al*. 1986).

Cattle were prominent symbols of status, affluence and even masculinity throughout the history of civilization (Bartosiewicz, 1996). Recently, the HG breed has been exploited for this most ancient product, image, for commercial and even ideological purposes. Preoccupation with the breed's origins shows that this animal has remained strongly bonded with cultural identity in Hungary, fostering an attitude that has helped its survival in modern times.

The conservation of HG cattle contributes to the maintenance of genetic diversity in domesticates. Its long-term impact on sustaining productivity in animal husbandry is a crucial point that needs no special emphasis in this publication.

Conclusions

This century witnessed a sharp decline and rather spectacular recovery in HG cattle. The increasing popularity of Fleckvieh, the geopolitical isolation of breeding stocks and the mechanization of agriculture each undermined the dominant position of this breed.

Conservation and crossings

HG provided a maternal line in several crossings. Upgrading efforts frequently involved dairy breeds such as Montafon and Kostroma cattle (Zólyomi 1931; Magyari 1958). The creation of Hungarian Fleckvieh was the only lasting success along this line. While further eroding the purebred stock, most crosses were no match for single purpose dairy breeds that produce quantities of low fat consumers' milk. The rich milk of HG dams, however, should be regarded as an asset in range farming. Other merits of this breed are also related to reproduction. They include easy calving, good maternal behaviour and the resistance of animals to disease that make extensive management with minimal human assistance cost-efficient (Figure 4).

The extinct Transylvanian form of this breed was stockier and thus better suited for beef production. The first importation of Maremman sires in 1934 was also inspired by the recognition that the merits of HG cattle can be best exploited in range management (Bodó *et al*., 1996) and that the breed's traditional characteristics should be upgraded. Genetic effects of the next wave of Maremman crossings during the 1970's were slowly eliminated as the risks of inbreeding declined and purebred conservation became a priority. Following a genetic bottleneck, the

Table 7 - Milk production statistics of individual Hungarian Grey cows in the collections of the Hungarian Agricultural Museum (Hortobágy State Farm)

Name	Age (years)	Live weight (kg)	Meat weight (kg)	Days of lactation	Milk (kg)	Fat (%)
Pöszi	11	475	204	201	1 176	5.0
Csendes	15	393	161	205	1 205	4.4
Boglár	9	350	146	126	1 301	4.3
Páva	9	386	163	300	1 736	5.0
Lárvás	11	492	242	236	1 896	4.2
Csibi	10	495	-	262	2 470	4.2
Amália	-	486	215	222	2 138	4.3
Szárcsa	10	400	-	300	2 168	4.9
Szajkó	12	443	-	300	3 215	4.5
Mean±SE	10.9 ±0.7	435.6 ±18.1	188.5 ±15.3	239.1 ±19.4	1 922.8 ±222.7	-
Adó*	-	650	-	300	3155	5.0

*Ohat State Farm (Schandl 1962)

present population is stable and inbreeding can be avoided. The HG breed has become an adequate genetic reservoir for the future.

Future perspectives

In addition to the breeders' culturally idiosyncratic concept of how animals 'should look' (Kroeber and Richardson 1940), stocks are continuously adapted to changes in historical and economic situations. As Györffy (1983) wrote at the turn of the century: "The types of people and animals that were destroyed by river regulations will never be brought back. The fiery herdsmen and fiery [grey] cattle will never return!"

However, there are new perspectives in marketing that improve the economic viability of the breed beyond its mere survival as a gene reserve. When appropriately promoted, the rich, venison-type meat of HG cattle (specially grown 'organically') could become a sought after upmarket product. While demand for such delicacies will probably shrink in present day Hungary, supervised commercial crossings may increase the efficiency of beef production as is the case with, for example, Texas Longhorn sires in crossings aimed at lowering the incidence of dystocia (Garrett *et al.* 1982). In this regard, commercial crossings between HG and Charolais cattle have proven to be most promising.

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