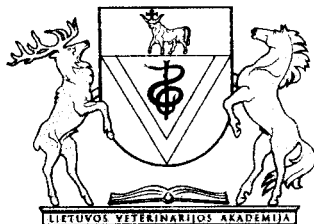


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**Abstracts**  
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## Cephalic skull measurements to differentiate male and female bovine skulls

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**Abstract.** A sample of near 799 bovine fresh adult skulls (distributed among 117 males and 682 females) belonging to 10 different domestic cattle breeds from Spain and France was examined. The studied breeds (Aubrac, Bruna dels Pirineus, Friesian, Red Friesian, Limousin, Brown Swiss, Pyrenean, Blonde d'Aquitanie, Salers and Charolais) descend from different European ancestor trunks. The heads were obtained from slaughtered animals and at all events were from absolute pure animals according to the racial standard. A total of 9 cephalic lineal measurements and 7 derived indexes were obtained on each skull. Some original aurochs skulls are used, too. The values between sexes were individually compared to discriminate measures to differentiate male and female skulls were found in each breed and globally.

Given their number-based nature, cephalic measurements and indexes allow comparisons between breeds from very different geographical areas as well as permitting the development of research into breeds using exclusively bone material. Moreover, our presented numbers could act as reference values for further morphometrical craneological studies on sexual dimorphism.

# ZOOMETRIC MEASUREMENTS OF CEPHALIC CONFORMATION IN ADULT BOVINE MALES AND FEMALES (*Bos taurus*)



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## INTRODUCTION

After the initiation of domestication, not only did cattle body size decrease but also the difference in size between genders. Nevertheless, in modern domestic cattle, sexual dimorphism between bulls and cows still exists. Such difference in size is not just confined to certain parts of the body, it can rather be present in any bone, such in the horns and in the head.

The goals of this research are:

- 1) to obtain some values (lineal measurements and indexes) of the skull of some domestic bovine breeds; these values are normally used in veterinary ethnology, easily taken *in vivo*, and they allow the comparison with extinct breeds or species (such *Bos primigenius*). We think our results will be particularly useful to determine variation range of a given breed. These values are not presented here.
- 2) to determine the cephalic values that are more discriminant to differentiate sexes in modern cattle.

Given their number-based nature, these cephalic measurements and indexes allow comparisons between breeds from very distant geographical areas, and permit to carry out research on breeds using exclusively bone material. In addition, our results could be used as reference values for further morphometrical craneological studies on sexual dimorphism.

## MATERIAL AND METHODS

### Skull material

A total of 578 fresh complete skulls from 76 adult males and 502 adult females (>2,5 yr), belonging to 16 modern domestic breeds, was used. According to the racial standard, all material was from absolute pure animals.

### Obtained measurements

### Indexes

Cephalic length	CefL	Cephalic index (CefI): (CefW/CefL) x 100
Cranial length	CrL	Cranial index (CrI): (CrW/CrL) x 100
Facial length	FacL	Facial index (FacI): (FacW/FacL) x 100
Cephalic width	CefW	Depth index (DI): (CefL/CefD) x 100
Cranial width	CrW	Skorkowski's W1 index (W1) = (CefW/FacL) x 100
Facial width	FacW	Skorkowski's W2 index (W2) = (FacL/CrL) x 100
Horn perimeter	HP	Horn length : horn perimeter = (HL/HP) x 100.
Cephalic depth	CefD	
Horn length	HL (along the outer curvature).	

### Software

HAMMER, Ø.; D.A.T. HARPER; P.D. RYAN. 2001. PAST: Paleontological Statistics Software Package for Education and Data Analysis. *Palaeontologia Electronica*. 4 (1) [on line] [http://palaeo-electronica.org/2001\\_1/past/issue1\\_01.html](http://palaeo-electronica.org/2001_1/past/issue1_01.html)

## RESULTS AND DISCUSSION

Overall, lineal measurements are statistically larger in males, except for LH (table 1). The female skulls are always shorter and narrower than those from males, their orbits are less protruding and the horns are reduced in their perimeter, although the horn length in both sexes is similar. The fairly high variation in CefL could be explained by the protruding occipital part of the head, specially in males.

Indexes are all statistically different, except for FacI and W2, therefore indicating a similar conformation on facial region between sexes (table 1).

The most discriminant variables include CefW, CrW and CrI (figure 1).

In summary, the lineal measurements related to cephalic width and length show statistically significant differences between sexes, independently of the breed. Also, most indexes present differences between sexes, and this could allow the evaluation of skulls of different sizes.

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Bruna dels Pirineus (bull)



Gasconne (bull)



Aubrac (cow)

### Studied breeds

Breed	Females	Males	Breed	Females	Males
Asturiana de los Valles	17	0	Gasconne	7	0
Aubrac	9	1	Limousin	9	10
Avileña	9	0	Pardo Alpina	19	1
Blanca del Pallars	10	0	Parde de Montaña	19	0
Bruna dels Pirineus	260	20	Pyrenean	17	1
Fleckvieh	5	0	Blonde d'Aquitanie	7	3
Friesian (black and white)	38	24	Salers	34	1
Friesian (red and white)	16	1	Charollais	26	14

These studied breeds descend from different European ancestor trunks.

	Males	Females
CefL	57,91±4,92***	53,30±3,71
CrL	17,02±2,62***	15,28±1,79
FacL	40,89±4,27***	38,01±3,81
CefW	27,25±1,68***	23,53±1,42
CrW	23,10±1,61***	18,64±1,16
FacW	18,64±1,54***	17,04±1,12
HP	22,67±2,36***	17,28±2,68
CefD	40,44±3,15***	36,17±2,76
HL	30,13±7,61	30,26±8,30
CefI	47,27±3,67***	44,30±3,61
CrI	138,69±21,27***	123,59±15,33
FacI	46,11±6,50	45,29±5,49
DI	143,80±13,69***	148,06±13,56
W1	67,25±7,43***	62,52±7,53
W2	245,68±43,39	252,63±42,05
HL/HP	134,18±34,73***	175,46±38,27

TABLE 1. Obtained measures (X±d.e.)

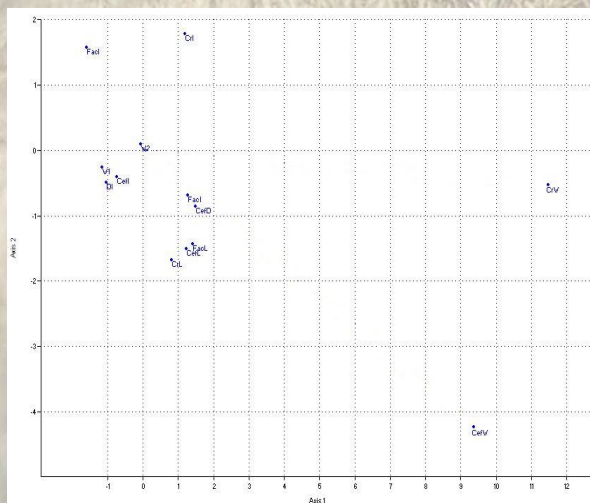


FIGURE 1. PCA Analysis