PREDICTION OF LIVE WEIGHT BY MORPHOMETRIC MEASUREMENTS IN FEMALES AND MALES OF CRIOLLO SHEEP OF THE OAXACAN MIXTECA, MEXICO †

[PREDICCIÓN DEL PESO VIVO MEDIANTE MEDIDAS MORFOMÉTRICAS EN HEMBRAS Y MACHOS DE OVINOS CRIOLLOS DE LA MIXTECA OAXAQUEÑA, MÉXICO]

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SUMMARY

Background. The live weight (LW) and morphometric variables of sheep are useful characteristics to generate adequate criteria for genetic improvement and conservation of Creole animal resources. **Objective**. To establish morphological relationships and through them predict LW of females and males in Creole sheep of the Oaxacan Mixteca, Mexico. **Methodology**. LW, thoracic perimeter (TP), height at withers (HW), back length (BL), cane perimeter (CP), head length (HL), neck length (NL), abdominal perimeter (AP) and rump width (RW) were recorded in 720 Creole sheep in 24 production units, measured in animals of both sexes. First, they were analyzed using general linear model procedures to determine the effect of sex on the variables of interest, and then, they were analyzed using discriminant analysis. Simple correlations between morphometric variables were calculated and step-by-step multiple linear regression equations were generated to predict LW. **Results.** Differences were found between sexes for LW and morphometric measures, which were correlated ($p \leq 0.05$). The variables TP, AP and BL had the highest correlations (0.92, 0.90 and 0.89, respectively) and the variables CP, NL and RW, the lowest (0.75, 0.82 and 0.83, respectively). The statistical models explained a large proportion of the total variability (R^2 from 85 to 91 %). According to sex, males had R^2 (0.90 to 0.94) higher than females (0.83 to 0.89). In both cases TP and HW were the most important characteristics for predicting LW. **Conclusions**. Under the conditions of this work, the model that included TP and HW was the one that best predicted the LW of the Creole sheep of the Oaxacan Mixteca. It is recommended to use different equations for each sex and training of sheep producers in the use of those equations.
Key words: discriminant analysis; multiple regression; body weight; genetic resources.

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RESUMEN

Antecedentes. El peso vivo (PV) y las variables morfométricas de los ovinos, son características útiles para generar criterios adecuados de mejoramiento genético y conservación de recursos animales criollos**. Objetivo**. Establecer relaciones morfológicas y a través de ellas predecir el PV de hembras y machos en ovinos criollos de la Mixteca Oaxaqueña, México. **Metodología**. En 720 ovinos criollos de 24 unidades de producción, se registraron el PV, perímetro torácico (PT), altura a la cruz (AC), largo del dorso (LD), circunferencia de la caña (CC), largo de la cabeza (LC), longitud del cuello (LCu), perímetro abdominal (PA) y ancho de la grupa (AG), en animales de ambos sexos. Primero, se analizaron mediante análisis de varianza, para determinar el efecto de sexo sobre las variables de interés y después, se analizaron utilizando análisis discriminante. Se calcularon las correlaciones simples entre las variables morfométricas y se generaron ecuaciones de regresión lineal múltiple paso a paso para predecir PV. **Resultados**. Se encontró diferencia entre sexos para PV y medidas morfométricas, las cuales estuvieron correlacionadas ($p \leq 0.05$). Las variables PT, PA y LD tuvieron las correlaciones más altas (0.92, 0.90 y 0.89, respectivamente) y las variables CC, LCu y AG, las más bajas (0.75, 0.82 y 0.83, respectivamente). Los modelos estadísticos utilizado explicaron una gran proporción de la variabilidad total (R^2 de 85 a 91 %). De acuerdo con el sexo, los machos presentaron R^2 (0.90 a 0.94) más altos que las hembras (0.83 a 0.89). En ambos casos PT y AC fueron las características más importantes para predecir PV. **Conclusiones**. Bajo las condiciones de este trabajo, el modelo que incluyó PT y AC fue el que mejor predijo el PV de los ovinos criollos de la Mixteca oaxaqueña. Se recomienda utilizar ecuaciones distintas para cada sexo, y entrenar a los productores de ovinos en el uso de esas ecuaciones.

Palabras clave: análisis discriminante; regresión múltiple; peso corporal; recursos genéticos.

INTRODUCTION

The recording of live weight is an important practice, since knowledge of this would help to predict the productive performance of an animal (Chacón and Boschini, 2017) and for decision-making in management practices, with special importance in reproduction, genetic selection, feeding and sanitary management (Raji *et al*., 2008). However, this practice is not common among producers, among other things, due to the absence of scales in the production units and the time spent in the weighing process.

In developing countries, sheep play an important role in the economy and feeding of smallholders, who are commonly raised and produced under extensive management systems (Ojonegecha *et al*., 2020). In Mexico, Oaxaca there are approximatelly 400,000 sheep, much of them of the Creole type, which production supports many rural families with limited economic resources. This sheep biotype and the form of production have been generally carried out with a low use of technology and scarce infrastructure for its production (Martínez-Peña *et al*., 2018). Frequently, in the marginalized regions of Oaxaca, live weight is subjectively estimated and is based mainly on the observational skill of the producer, buyer or technician. Therefore, it is necessary to find a technically based tool to reduce handling errors caused by the lack of precision when estimating live weight (Resende *et al*., 2001). Ribeiro *et al*. (2004a) mentioned that morphometric variables are used in the estimation of live weight in various species and breeds of domestic animals. In turn, Cam *et al*. (2010) considered that the prediction of live weight from morphometric variables represents a practical method. In addition, multivariate techniques, such as principal component analysis, have been used for the prediction of live weight (Ojonegecha *et al.*, 2020). Factor analysis provides the tools for analysing the structure of the interrelationships (correlations) among a large number of variables by defining sets of variables that are highly interrelated (Salako, 2006). Ojonegecha *et al.* (2020) revealed through Pearson correlation coefficients that great and predictive degree of relationship existed amongst body measurements in Yankasa Sheep, and the highest singular pair was the association between body weight and chest girth. They found that chest girth and PC1 were the major predictors of BW when original body measurements and principal components, respectively, were used as predictors in Yankasa Sheep.

To date, no information has been reported on morphometric measurements and prediction of live weight of the Creole sheep of the Oaxacan Mixteca. This is a need of significant importance since these animals are a genetic resource adapted to the climatic and management conditions of the region. Thus, the objective of this study was to establish the relationships between morphometric traits and live weight of sheep of both sexes, as well as to generate a predictive model based on the live weight of Creole sheep of the Oaxacan Mixteca in Mexico.

METHODOLOGY

Study site

The study was conducted in 24 sheep production units from 17 municipalities of the Oaxacan Mixteca, Mexico. The area is characterized by altitudes of 1,200 to 2,300 meters above sea level, with mainly mountainous relief (81.6%). The climate varies from warm-semi-dry to temperate-humid, but there are also extremely dry places, except during summer rains

(June to October). The average rainfall in the region ranges between 400 and 800 mm per year (CONAGUA, 2022).

Animals

We evaluated 720 female (n = 481) and male (n = 239) Creole sheep from one to 60 months of age that we had access to. The sheep were raised in extensive management systems, with grazing during the day and enclosure at night. In general, there were no regular health control practices and the main objective of the production units was the sale of live animals for meat supply.

Characteristics measured

The live weight of each animal was measured in kilograms, with a Rhino® digital scale with capacity for 100 kg and 0.05 kg precision, in the morning and before grazing, to avoid bias due to feed consumption. Morphometric variables were measured in centimeters and taken with a flexible tape. Eight body measurements were obtained from each animal (Table 1), following FAO recommendations (2013) and other studies (Chacón *et al*., 2011). To minimize assessment biases, all measurements were taken by a researcher and a trained field assistant.

Data analysis

Descriptive statistics for body measurements were obtained by the UNIVARIATE procedure and comparison between sexes was carried out by the lsmeans option of the general linear procedure (PROC GLM). The data obtained were used to estimate simple correlations between morphometric variables and live weight (LW) through the calculation of Pearson correlation coefficients. LW was predicted from body measurements with the step-by-step multiple linear regression procedure generating an equation for data as a whole, for females and males. A stepwise discriminant analysis was performed using PROC STEPDISC to identify the most useful morphometric traits and morphological indices for further discriminant analyses. The relative discriminatory ability of a quantitative variable was assessed using the partial R^2, F value, and level of significance (p > F). Then, the canonical discriminant analysis function (PROC CANDISC) was used to perform univariate and multivariate one-way analyses, derive canonical functions and linear combinations of the quantitative variables that summarize variation between sexes, and calculate the associated Mahalanobis distances. All statistical analyses were performed using SAS version 9.3 (SAS Institute Inc., 2014).

Table 1. Description of body measurements taken from 720 Creole sheep from the Oaxacan Mixteca, Mexico.

Morphometric measurement	Description
Height of wither (HW)	The height (vertical) from the bottom of the front foot to the highest point of the shoulder between the withers.
Cane perimeter (CP)	The circumference of the reed bone of a front leg below the bottom of the knee joint.
Head length (HL)	Distance from the nape of the neck to the alveolar edge of the incisors of the upper jaw.
Neck length (NL)	Distance from the nape of the neck to the center of the withers with the head of the sheep held approximately 90 degrees from its body.
Back length (BL)	Horizontal distance from the scapula to the rump.
Thoracic perimeter (TP)	Circumference of the body immediately behind the shoulder blades in a vertical plane, perpendicular to the longitudinal axis of the body.
Abdominal perimeter (AP)	Circumference of the body that passes immediately behind the sacrum and at the level of the udder.
Rump width (RW)	Distance between the two rump tips.

RESULTS AND DISCUSSION

Analysis of morphometric variables

The mean morphometric variables evaluated were higher in females than in males ($p \leq 0.05$), except for the cane perimeter (Table 2). The average LW was 6% higher in females than in males. In this regard, Falcón *et al*. (2020) also reported higher weights in females of sheep of the AsBlack breed of Peru. Similarly, Ávalos *et al*. (2022), when estimating the mature weight of Creole sheep of the Mixteca, found LW of 27 and 35 kg in males and females, respectively. In studies on Creole sheep in Mexico, Jaramillo *et al*. (2009) observed LW of 20.26 ± 2.98 kg in Tarahumara Creole sheep, in Chihuahua, Mexico, which is similar to those in the present study; while in Chiapas Creole sheep, Perezgrovas and Castro (2000) reported in average higher LW, from 25 to 28 kg, in animals from birth to 4.5 years of age and Méndez–Gómez *et al*. (2014) recorded LW of 23 to 25 kg in adult sheep.

Table 2. Descriptive statistics of nine morphometric variables of the Creole sheep of the Oaxacan Mixteca (n = 720).

Variable	Female (n=481)	Male (n=239)	MSD	Mean	SE	CV
LW (kg)	21.83 a	20.44 b	0.78	21.36	0.36	45.93
HW (cm)	58.11 a	56.30 b	0.75	57.43	0.36	17.10
CP (cm)	10.44 b	10.86 a	0.13	10.57	0.04	10.59
HL (cm)	18.64 a	17.91b	0.24	18.40	0.12	16.90
NL (cm)	26.82 a	25.65 b	0.56	26.43	0.23	22.16
BL (cm)	53.07 a	51.36 b	0.83	52.50	0.39	19.82
TP (cm)	67.28 a	62.85 b	1.12	65.81	0.51	20.89
AP (cm)	77.34 a	71.16 b	1.50	75.29	0.66	23.56
RW (cm)	15.09 a	14.74 b	0.33	14.97	0.12	21.39

LW, live weight; HW: height at withers; CP, cane perimeter; HL, head length; NL, neck length; BL, back length; TP, thoracic perimeter; AP, abdominal perimeter; RW, rump width; SE: standard error; CV, coefficient of variation; MSD: minimum significant difference.

In this study, height wither was similar (55 to 60 cm), thoracic perimeter (70 to 77 cm) lower and CP 8 cm higher than the values reported in Tarahumara and Chiapas Creole sheep (Perezgrovas and Castro, 2000; Jaramillo *et al*., 2009). Aparicio (1974) indicated that cane perimeter is a measure related to the silhouette of the animal, while Bravo and Sepúlveda (2010) mentioned that this variable has a differentiating value between milk and meat breeds, being higher in meat breeds (Herrera and Luque, 2009). These observations correspond to the differences of the breeds with the Creole sheep of Chihuahua and Chiapas.

In general, abdominal measurements show high variation and are usually affected by intestinal filling, and in the case of females, a possible pregnancy, aspects that were taken care in this study. Ojonegecha *et al*. (2020) mentioned that the length of the head presents little variability due to its close association with the cranial bone. In small populations with minimal breed crossing, this variation was low, as observed in this study. Dekhili (2014) and Whannou *et al*., (2021) found that climatic variation, due to geographical distribution, influences the phenotypic variations of animals, so further research of Creole sheep that include different regions should be considered.

Although morphological variation is largely under genetic control (Dossa et al., 2007), it is subject to the influence of environment and management practices (Mirkena *et al*., 2010; Leroy *et al*., 2015). Therefore, it is likely that the higher values in morphological traits and life weight observed in the present study in females was mainly due to the fact that they represent a greater number of animals that exceed maturity, while sexually mature males are only between one and two per unit of production, because most males were castrated, and they are often sold at one year of age.

Multivariate discriminant analyses confirmed the morphological variability observed between males and females in the comparison of means. The results of the stepwise discriminant analysis (Table 3) showed that six of the eight quantitative variables included in the analysis contribute significantly to discriminate between the sexes ($p \leq 0.0001$). The thoracic and cane perimeters showed higher partial values of R^2 and F, illustrating their greater discriminant power than the other variables used to assess morphological diversity in the sheep population of the Oaxacan Mixteca. However, the use of the four significant quantitative variables ($p \leq 0.05$ for column $p > F$) in canonical discriminant analysis generated a significant ($p \leq 0.0001$) canonical variable (CAN 1) that explained 100% of the total variation, as revealed by the standardized coefficients for the discriminant function, canonical correlation, eigenvalue, and share of total variance taken account (Table 4).

Table 3. Results of morphometric variables obtained from step-by-step discriminant analysis.

Step	Variable entered	R^2 partial	F-Value	*p* > F	Wilks' Lambda	*p* < Lambda	ASCC	*p* > ASCC
1	CP	0.0328	24.34	<.0001	0.967	<.0001	0.033	<.0001
2	TP	0.171	147.88	<.0001	0.802	<.0001	0.198	<.0001
3	NL	0.0068	4.91	0.0270	0.796	<.0001	0.204	<.0001
4	HL	0.0036	2.56	0.1098	0.794	<.0001	0.206	<.0001
5	LW	0.0057	4.11	0.0430	0.789	<.0001	0.211	<.0001
6	AP	0.0048	3.44	0.0641	0.785	<.0001	0.215	<.0001

LW, live weight; CP, cane perimeter; HL, head length; NL, neck length; BL, back length; TP, thoracic perimeter; AP, abdominal perimeter; ASCC: Average quadratic canonical correlation.

Table 4. Total canonical coefficients for the canonical function, the adjusted canonical correlation and the eigenvalue obtained from the canonical discriminant analysis performed on eight morphometric variables and the live weight.

Variable	LW	HW	CP	HL	NL	BL	TP	AP	RW	ACC	EV
Can1	0.144	0.190	-0.390	0.239	0.203	0.167	0.327	0.354	0.113	0.49	0.27

LW, live weight; HW, height at withers; CP, cane perimeter; HL, head length; NL, neck length; BL, back length; TP, thoracic perimeter; AP, abdominal circumference; RW, rump width; ACC: Adjusted canonical correlation; EV, eigenvalue.

The canonical loads that measure the simple linear correlations between each independent variable and the canonical variables are shown in Table 4. CAN 1 was dominated by positive loads of abdominal perimeter, thoracic perimeter, head length and neck length; and negative loads of the cane perimeter. The figure, of the values of the centroid, of the first canonical discriminant functions showed difference between sexes, but with overlapping events (Figure 1). The distances of Mahalanobis between males and females (21.66) obtained from the canonical analysis of Creole sheep of the Oaxacan Mixteca showed that the distances were different ($p \leq 0.0001$).

Correlation analysis

All morphometric measurements were correlated ($p \leq 0.001$) with each other and, mainly, with the live weight (Table 5). The variables most correlated with live weight were thoracic perimeter, abdominal perimeter, back length, and the least correlated cane perimeter, neck length and rump width. The high correlation indicates the strength of dependence between variables and suggests that correlated characteristics can be used as indirect selection criteria in the absence of a scale (Cam *et al*., 2010). In this regard, it is mentioned that objectively measured body shapes could improve the selection of animals for growth characteristics by allowing the breeder to recognize animals of different sizes (Yakubu, 2009; Ojonegecha, *et al*. 2020), which may be useful as a selection criterion instead of live weight.

The positive and high correlation coefficient observed between live weight and thoracic perimeter, compared to all other correlations, agree to that reported by Afolayan *et al*. (2006) with a correlation coefficient of 0.94 between those two variables. Variables such as height at wither, back length and thoracic perimeter and abdominal perimeter, which are directly related to the size and weight of the animals, showed very high positive correlations with each other and were comparable with the values recorded for small ruminants in other studies (Yakubu, 2009; Sowande, *et al*., 2010; Ojonegecha, *et al*., 2020). The positive correlations between live weight and the morphological traits obtained here indicate that an increase in any measured variable would result in a corresponding increase in live weight. Therefore, data suggesting that either trait or combination of these could be used to estimate live weight in Oaxacan Mixteca Creole sheep in places where scale is not available.

There were high positive correlations between live weight and the morphometric variables studied, both in females and males, being greater in the latter (Table 6), with greater difference for cane perimeter and rump width. The abdominal perimeter showed the greatest similarity of correlation between both sexes with live weight.

Regression analysis

The results of the step-by-step multiple regression analysis, indicate that live weight variations in the Creole sheep of the Oaxacan Mixteca were mainly dependent on thoracic perimeter followed by height of wither (Table 7).

Four prediction equations with coefficient of determination (R^2) of 0.85, 0.89, 0.90 and 0.91 were obtained by using thoracic perimeter, height of wither, cane perimeter, neck length, back length and abdominal perimeter as predictors of live weight (Table 8). The values of R^2 increased with increasing number of variables included as predictors, but this increase was minimal. Therefore, the unique use of thoracic perimeter to predict live weight under field conditions could be feasible, reliable, and easy to apply by the producer. These results are consistent with those reported by other studies (Eyduran *et al*., 2009; Ojonegecha *et al*., 2020). For instance, Cam *et al*. (2010) considered that simple regression equations to predict live weight using morphometric variables, other than those evaluated in this study, represent a practical method to predict it. Ribeiro *et al*. (2004b) proposed an equation that only includes thoracic perimeter as the best measure to predict live weight of animals in all breeds and ages evaluated in their study. Resende *et al*. (2001) agree, with the above, when evaluated the live weight of goats of three different ages, using the thoracic perimeter, height of wither and head length. Authors concluded that thoracic perimeter was the most efficient measure to predict live weight, and this variable can be used to construct a general prediction equation for animals of all ages.

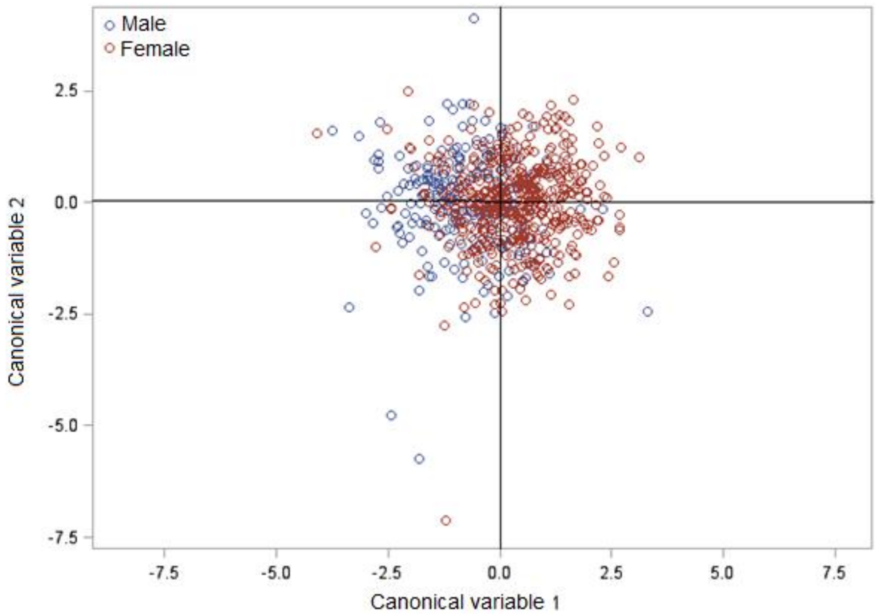

Figure 1. Scatter plot showing the 720 individual sheep sampled in the Oaxacan Mixteca, Mexico.

Table 5. Coefficient of correlation between morphometric measurements of Creole sheep, of both sexes, of the Oaxacan Mixteca (n = 720).

	LW	HW	CP	HL	NL	BL	TP	AP	RW
LW	1	0.90**	0.75**	0.88**	0.82**	0.89**	0.92**	0.90**	0.83**
HW		1	0.71**	0.89**	0.84**	0.89**	0.87**	0.84**	0.78**
CP			1	0.67**	0.66**	0.70**	0.72**	0.67**	0.67**
HL				1	0.80**	0.86**	0.87**	0.85**	0.76**
NL					1	0.80**	0.80**	0.75**	0.71**
BL						1	0.88**	0.86**	0.84**
TP							1	0.96**	0.84**
AP								1	0.83**
RW									1

LW, live weight; HW: height at withers; CP, cane perimeter; HL, head length; NL, neck length; BL, back length; TP, thoracic perimeter; AP, abdominal perimeter; RW, rump width; **Significant correlation ($p \leq 0.001$).

Table 6. Coefficient of correlation between live weight and morphometric measurements of female and male Creole sheep of the Oaxacan Mixteca (n = 720).

Variable	LW Female (n=481)	LW Male (n=239)
HW	0.88**	0.93**
CP	0.72**	0.84**
HL	0.83**	0.93**
NL	0.79**	0.86**
BL	0.88**	0.91**
TP	0.91**	0.95**
AP	0.90**	0.91**
RW	0.77**	0.85**

HW: height at withers; CP, cane perimeter; HL, head length; NL, neck length; BL, back length; TP, thoracic perimeter; AP, abdominal perimeter; RW, rump width; **Significant correlation ($p \leq 0.001$).

The prediction equations for females (Table 9) and males (Table 10) used different morphometric variables with three to six predictors, with abdominal perimeter included in the equation with three predictors for females and head length in males. The equation with six predictors differed in the variables neck length and head length for females and males, respectively, whereas the equations with one and two predictors used the same morphometric variables (thoracic perimeter and height of wither). The equations of males had the highest R^2, indicating least variability among them. In this sense, Souza *et al.* (2009) mentioned that both thoracic perimeter and body length, used independently and in specific equations for females and males would be good estimators of live weight. Various authors (De Aluja *et al.*, 2005; Castellaro *et al.*, 2019) mentioned that, if thoracic perimeter is used as the only predictor of live weight, it should consider specific equations for each sex, a recommendation that would apply to what was observed here.

CONCLUSIONS

Differences in morphological traits were found between females and males. The correlation coefficients between live weight and morphometric variables of the Creole sheep of the Oaxacan Mixteca were high. The thoracic perimeter variable alone, or associated with height at withers, was enough to explain the live weight of Oaxacan Creole sheep. The values of the coefficient of determination increased slightly when the variables cane perimeter, neck length, back length and abdominal perimeter were included in the statistical model. It is recommended to further use different equations for each sex and training of sheep producers in the use of those equations.

Table 7. F values and significance levels of direct selection of step-by-step regression between live weight as a dependent variable and morphometric variables.

Step	Variable	R^2 partial	R^2 model	F	*p* > F
1	TP	0.8500	0.85	4205.63	<0.0001
2	HW	0.0324	0.89	204.55	<0.0001
3	BL	0.0086	0.90	58.60	<0.0001
4	CP	0.0061	0.90	44.26	<0.0001
5	HL	0.0033	0.91	24.50	<0.0001
6	NL	0.0018	0.91	13.78	0.0002
7	AP	0.0022	0.91	16.94	<0.0001
8	RW	0.0003	0.91	2.39	0.1228

HW: height at withers; CP, cane perimeter; HL, head length; NL, neck length; BL, back length; TP, thoracic perimeter; AP, abdominal perimeter; RW: width of the rump.

Table 8. Coefficients of multiple linear step-by-step regressions for the prediction of live weight for males and females by morphometric measurements in Creole sheep of the Oaxacan Mixteca, Mexico (n = 720).

Variables	Intercept	b1	b2	b3	b4	b5	b6	R^2
TP	-22.04	0.66	-	-	-	-	-	0.85
HW + TP	-29.20	0.42	0.41	-	-	-	-	0.89
HW + CP + TP	-35.64	0.38	1.06	0.37	-	-	-	0.90
HW+ CP+ NL + BL + TP + AP	-34.05	0.25	0.98	0.13	0.13	0.19	0.10	0.91

LW, life weight; TP, thoracic perimeter; HW: height at withers; BL, back length; CP, cane perimeter; HL, head length; NL, neck length; AP, abdominal perimeter.

Table 9. Coefficients of multiple linear step-by-step regressions in morphometric measures for the prediction of live weight in female Creole sheep of the Oaxacan Mixteca, Mexico (n = 481).

Variables	Intercept	b1	b2	b3	b4	b5	b6	R^2
TP	-20.52	0.63	-	-	-	-	-	0.83
HW + TP	-27.62	0.38	0.40	-	-	-	-	0.87
HW + TP + AP	-26.25	0.38	0.19	0.18	-	-	-	0.88
HW + CP+ NL + BL + TP + AA	-31.15	0.23	0.78	0.22	0.10	0.09	0.18	0.89

LW, life weight; TP, thoracic perimeter; HW: height at withers; BL, back length; CP, cane perimeter; HL, head length; NL, neck length; AP, abdominal perimeter.

Table 10. Coefficients of multiple linear step-by-step regressions in morphometric measures for the prediction of live weight in male Creole sheep of the Oaxacan Mixteca, Mexico (n = 239).

Variables	Intercept	b1	b2	b3	b4	b5	b6	R^2
TP	-24.42	0.71	-	-	-	-	-	0.90
HW + TP	-30.94	0.42	0.44	-	-	-	-	0.92
HW + HL + TP	-32.23	0.30	0.69	0.37	-	-	-	0.93
HW+CP+HL + BL + TP + RW	-36.06	0.23	0.77	0.59	0.89	0.28	0.20	0.94

LW, life weight; TP, thoracic perimeter; HW: height at wither; BL, back length; CP, cane perimeter; HL, head length; NL, neck length; AP, abdominal perimeter; RW: width of the rump.

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Conflict of interest. The authors declare that there is no conflict of interest regarding this manuscript.

Compliance with ethical standards. The authors declare that this study have complied with national and international standards.

Data availability. The data is available through the first author on request: ravaloscas@hotmail.com.

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