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MORPHOMETRIC CHARACTERIZATION OF TWO GOAT BREEDS REARED IN SOUTH EAST OF ALBANIA

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ABSTRACT

The study was conducted at the Agricultural Technology Transfer Center (ATTC) Korca in South East area of Albania. Two imported goat breeds, Alpine and Saana not previously characterized were included in the study. Their characterization is of great importance, and the information provided is of great value, especially for the ATTC which use these breeds for the improvement of the local populations by crossbreeding. Morphometric measurements of 50 animals were analyzed. Both breeds have similar values of body measurements. All morphometric traits were positively correlated, where most of them were statistically significant. Body weight has the highest positive correlation with CC (0.763), which is statistically significant. The PCA of all morphometric parameters indicated that the three components accounted 80.1% of the cumulative variance. The PCA and discriminant analysis indicated admixture between breeds. A regression analysis was performed to predict the body weight from morphometric measurements, which indicated that HG and CBC were best fitted to the model with R^2(adj) values 66.87 and 65.29 respectively. The information obtained could be used by the ATTC in a near future for the the management, conservation, and for designing the breeding programes.

Keywords: Body measures, Correlations, Regression, PCA

1. INTRODUCTION

Goats play an important role for the local community of the farmers that raise them. Animal husbandry and dairy production activities have a long tradition in Albania due to the favorable

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natural resources for small ruminants, where the pastures and meadows in the hills and mountains regions are more suitable for sheep and goat production [1]. The same authors [1] report that the families keep a small number of goats (3-5 heads) in order to meet their needs for milk, cheese and meat.

The number of goats during 2020 was 774 thousand heads, where the milked goats were 1619 thousand heads [2]. The goat milk production for 2020 was 80 thousand litters. Native goat breeds account for about 97% of the total goat population [3]. Goat management is mainly extensive, grazing in the pasture. Some of the local goat breeds are previously studied by molecular markers [4], but most of the studies are focused mainly on nutritional aspects [5].

Two imported goat breeds "Alpine" and "Saana are included in this study. These breeds are imported and reared in the Korca region which is located in South East of Albania under the care and supervision of Agricultural Technology Transfer Center (ATTC). The breeds are well adapted to the local environment and semi extensive farming system. One of the main duties of ATTC in Korca is the designing of the programmes that should be undertaken for goat breeds improvement according to the market and society needs for increasing the livestock production and income of our farmers [6]. The ATTC has 30 animals of Alpine breed and 50 of Saana breed. These breeds are considered as a pure breed nucleus that is used for the genetic improvement of local goat population.

Body weight and morphometric traits are easily measurable. Morphometric measurements have been widely used to evaluate the characteristics of various breeds from different livestock species, because the information can be used for development of selection strategies, feeding management, health care and consumer's choice for slaughtering [7].

Morphometric traits are important predictors of body weight and they could be included in selection criteria [8]. The regression analysis based on different body measurements is an easy and reliable method for prediction of body weight. This method is applied in different livestock species such as sheep [9], cattle [10], goats [7], equids [11]. Therefore, in the present study we are focused in morphometric traits and the evaluation of body weight of two imported goat breeds reared in South East of Albania, that are not previously characterized.

2. MATERIAL AND METHODS

2.1 Data collection and morphometric traits characterization

Morphometric traits of a total of 50 indivuals from the two goat breeds (25 individuals per each breed) were recorded. The individuals, older than one year, were randomly selected from different flocks. The measurements on the animal were recorded in their normal standing

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position using a tape measure. The trait recorded were Wither Height (WH), Rump Height (RH), Body Length (BL), Chest Depth (CD), Chest Width (CW), Rump Width (RW), Heart girth (HG), Cannon Bone Circumference (CBC) and Body Weight (BW).

2.2 Statistical analysis

Descriptive statistics for the morphometric traits were obtained using Minitab software [12]. The following values were calculated: the mean, standard error (SE), coefficient of variation (CV) and minimum (Min) and maximum (Max) values. The same software is used for the discriminant analysis and Pricnipal Component Analysis (PCA). The data were analyzed statistically through SPSS computer software version 10.0 [13] for Spearman's correlation coefficients and regression (stepwise multiple linear). Stepwise multiple regression analysis was performed to predict the live weight from body measurements.

3. RESULTS

Least square means (LSM) and standard errors (SE) for morphometric measures and body weight are shown in table 1. In figure 1 are shown the minimum and maximum values of each morphometric measurements, per each breed. For all traits significant differences ($p<0.01$) were found between both breeds. Both breeds do not differ very much from each other regarding the morphometric measurements. Both breeds have greater rump heights than wither heights.

The Coefficient of Variation (CV) values range from 5.03 (WH) to 17.98 (CBC). Coefficient of variation of BW was 2-3 times greater than other body measurements.

Table 1: The descriptive statistics, coefficient of variation (%), minimum and maximum values of body measurements (cm) and body weight (kg) of two goat breeds

Variable	Alpine	Saana	Whole population	CV (%)	Minimum	Maximum
WH	66.5±0.64	67.048±0.797	66.756±0.501	5.03	58	73
RH	71.667±0.798	71.81±0.841	71.733±0.572	5.35	63	79
BL	116.58±1.24	113.43±1.24	115.11±0.901	5.25	101	127
CG	35.958±0.672	37.429±0.678	36.644±0.485	8.88	30	45
CW	14.542±0.248	14.429±0.245	14.489±0.173	8.01	13	18

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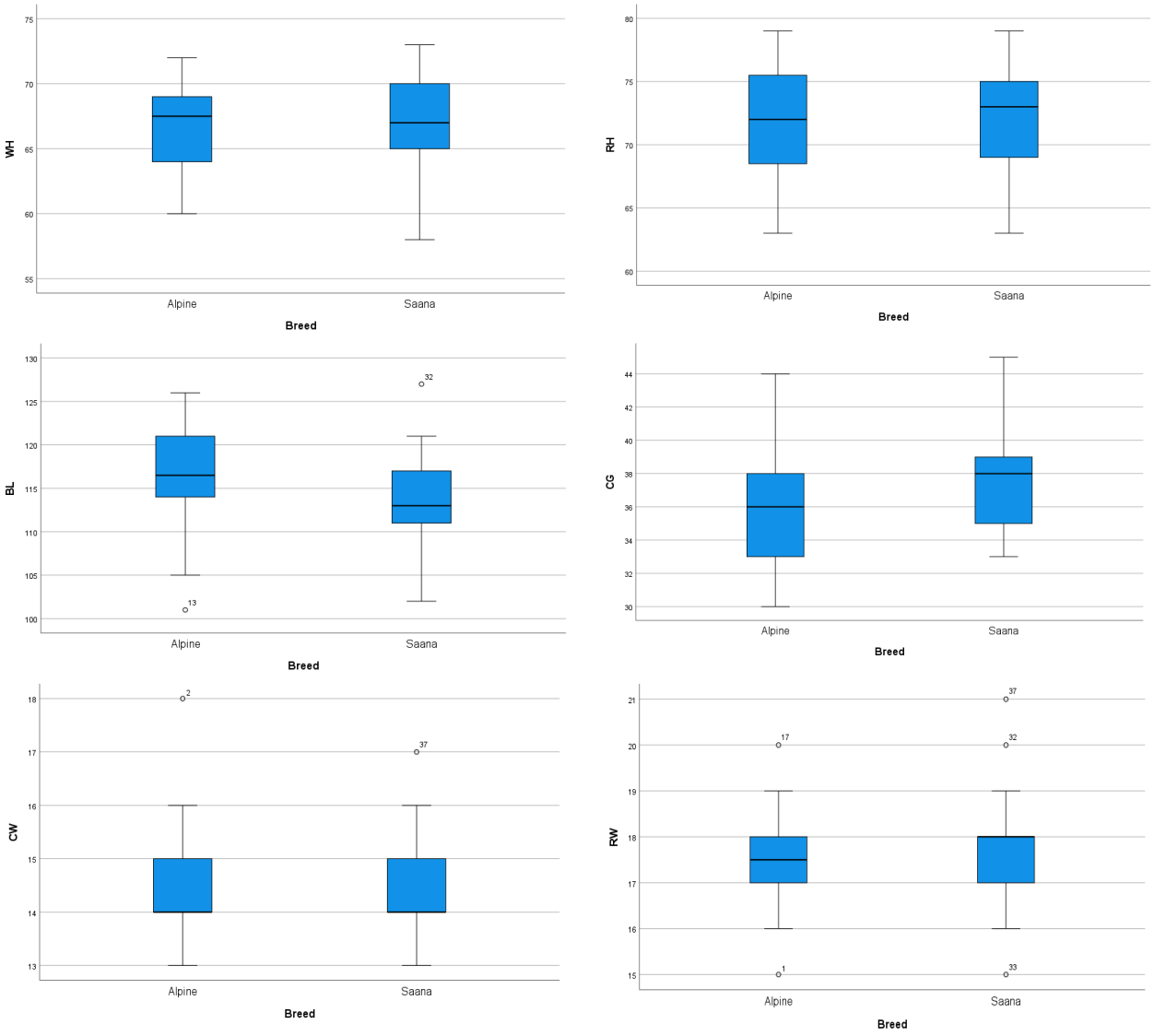
RW	17.5±0.217	17.81±0.298	17.644±0.18	6.85	15	21
CC	84.292±0.93	82.76±1.25	83.578±0.764	6.14	72	94
CBC	6.625±0.232	6.762±0.284	6.689±0.179	17.98	5	10
BW	46.29±1.27	47.57±2.16	46.89±1.2	17.20	33	65

WH – wither height, RH – rump height, BL – body length, CD – chest depth, CW – chest width, RW – rump width, CC –chest circumference, CBC – cannon bone circumference, BW – body weight.



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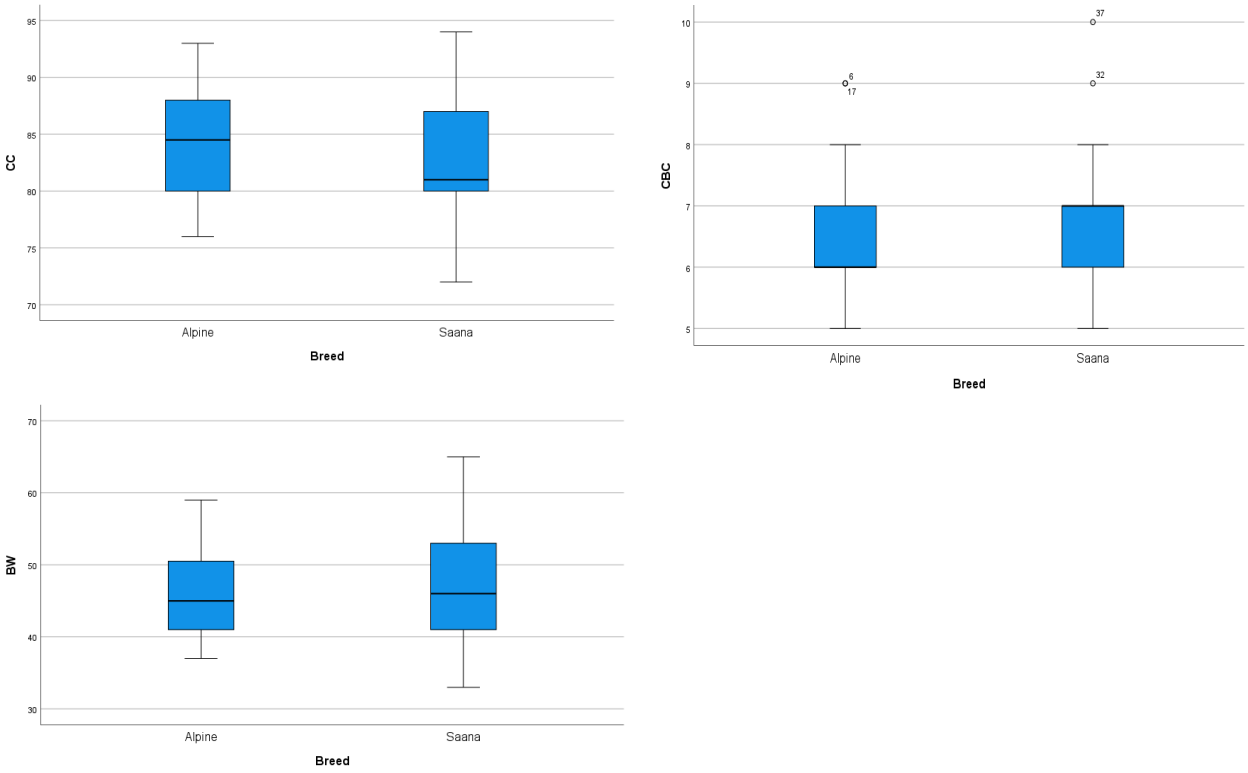

Fig. 1: Boxplot of body morphometric measurements for both breeds. Black lines in each box represent the median value

The total phenotypic Spearman's correlations among all morphometric measures for all animals is presented in the Table 2. All correlations were positive, most of them, statistically significant. The lowest value of correlation was found between WH and HG (0.064). The highest value of correlation was between WH and RH (0.803). Body weight also positively correlated with all body measurements, and the highest value was with HG (0.763), which are statistically significant

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Table 2: Pearson's correlation coefficients between the morphometric traits of investigated goat breeds.

	WH	RH	BL	CD	CW	RW	HG	CBC
RH	0.803**							
BL	0.255	0.460**						
CG	0.595**	0.443**	0.372*					
CW	0.085	0.283	0.588**	0.187				
RW	0.447**	0.387**	0.329*	0.596**	0.297*			
HG	0.064	0.266	0.658**	0.375*	0.536**	0.564**		
CBC	0.353*	0.540**	0.591**	0.407**	0.213	0.538**	0.555**	
BW	0.101	0.233	0.593**	0.317*	0.534**	0.498**	0.763**	0.579**

**Correlation is significant at the 0.01 level (2-tailed).*Correlation is significant at the 0.05 level (2-tailed).

WH – wither height, RH – rump height, BL – body length, CD – chest depth, CW – chest width, RW – rump width, HG –Heart girth, CBC – cannon bone circumference, BW – body weight.

The Principal Component Analysis (PCA) based on the average values of all morphometric parameters showed that the first two PC contributed 71.3 % of the total variance, while the first three factors accounted for 80.6% of the total accumulated variance (Table 3). All traits that were contributing to PC1 have positive value, where the most contributing was RW(0.370). The most contributing trait to PC2 was CW (0.395) and to PC3 was RW (0.435). The plot of principal components is shown in figure 2. The figure indicates admixture between these goat breeds. The communalities for each trait were higher than 0.713, which indicate a great variability of the traits.

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Table 3: Eigenvalue, the proportion of variance, eigenvectors and cumulative variance of morphometric measurements and body weight in the four sheep populations.

Variable	PC1	PC2	PC3
WH	0.270	-0.586	-0.186
RH	0.320	-0.409	-0.431
BL	0.348	0.180	-0.398
CD	0.322	-0.293	0.362
CW	0.255	0.395	-0.473
RW	0.370	-0.096	0.435
CC	0.365	0.315	0.199
CBC	0.363	0.065	0.110
BW	0.365	0.320	0.158
Eigenvalue	4.8359	1.5772	0.8004
Proportion	0.537	0.175	0.089
Cumulative	0.537	0.713	0.801

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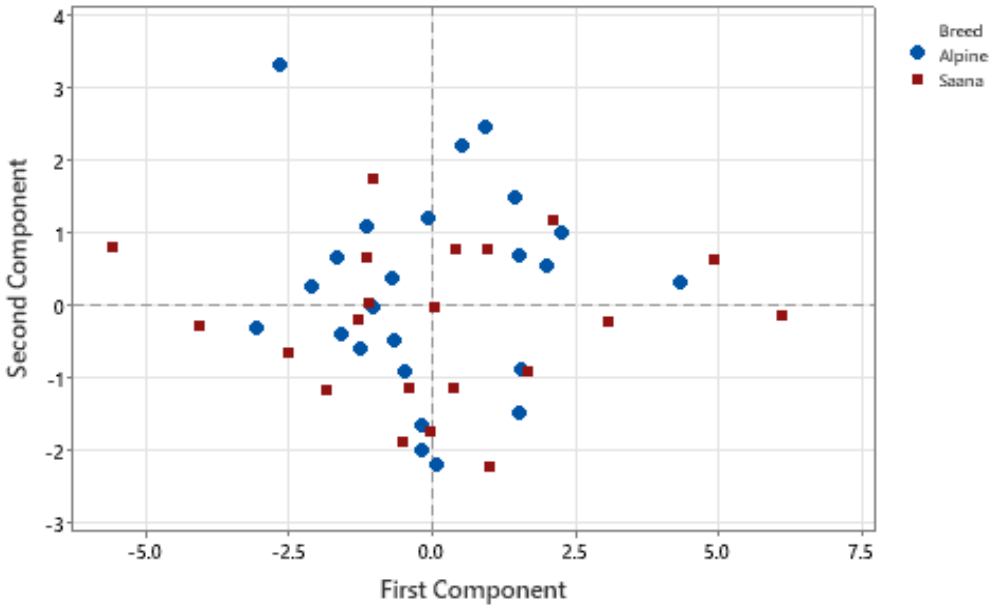

Fig. 2: Scatter plot of the principal component analysis, based on morphometric measurements and body weight.

The breeds grouping based on discriminant analysis is shown in table 4.Only 79.2% of animals were placed in the correct group Alpine and 85.7% of individuals were placed correctly in group Saana. Alpine group has the lowest proportion of correct placement, with 19 out 24 animals were placed correctly.

Table 4: Breed grouping based on discriminant analysis

Put into Group	Alpine	Saana
Alpine	19	3
Saana	5	18
Total N	24	21
N correct	19	18
Proportion	0.792	0.857

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The body weight of goats was predicted from morphometric traits. The results on prediction of BW using body measurements are shown in table 5. All body measurements were included in the model. Two body measurements were found to fit in the model (HG and CBC), through the stepwise elimination procedure. The analysis indicates that the predicted variables, have p-values that are less than the significance level of 0.05, which indicate that these predictors have a statistically significant effect on body weight. The regression equationsare shown in table 6.

Table 5: Regression analysis for all body measurements

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	1725.405	1	1725.405	65.365	<.001[b]
	Residual	1135.040	43	26.396		
	Total	2860.444	44			
2	Regression	1912.789	2	956.395	42.387	<.001[c]
	Residual	947.655	42	22.563		
	Total	2860.444	44			

b. Predictors: (Constant), CC; c. Predictors: (Constant), CC, CBC

Table 6: Stepwise Multiple Regression Analysis for different body linear measurements in both goat breeds.

Model	S	R^2	R^2 (adj)	Mallows' Cp	P-value
-55.2+1.221HG	5.137	60.32	66.87	9.01	0.000
-44.2+0.919HG+2.147CBC	4.750	59.40	65.29	2.76	0.006

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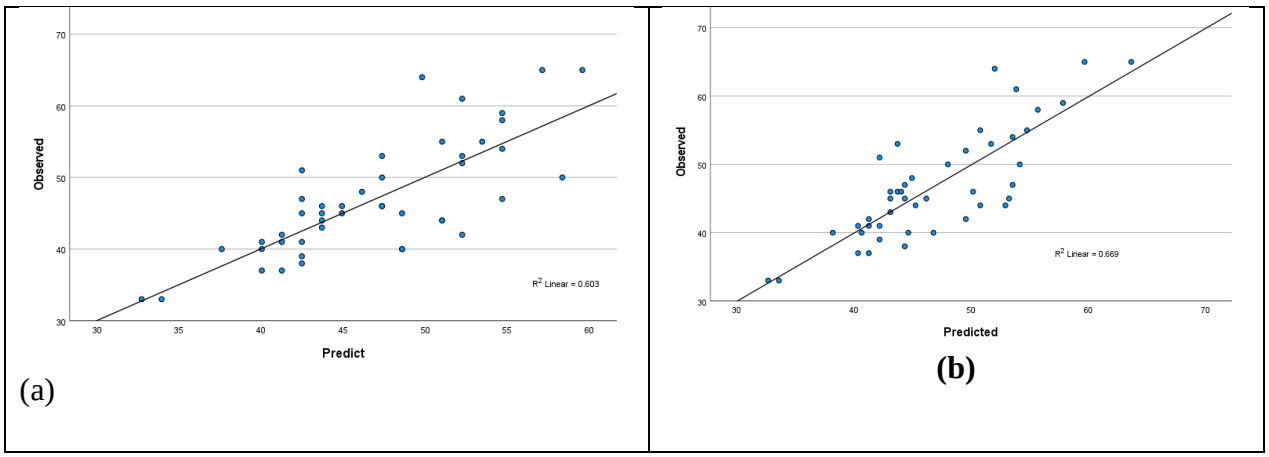

Fig. 3: Correlation of the Observed body weight with the predicted body weight from best fitted regression equation

The correlation of observed BW with the predicted weights according to the stepwise multiple regression analysis are 0.603 and 0.669 for HG and HG+BCC respectively which indicate a good accuracy of the prediction (figure 3)

4. DISCUSSIONS

Characterization of goats based on body measurement will increase the eficasy of selection for different production traits and thereby economic viability [8]. The studies regarding the morphometric characterization of goats are almost lacking in Albania. The regression of body weight on different body measurements easily measureable, is usually a method of choice for prediction of body weight.[14] have shown that a high value of the coefficient of variation indicate a heterogenous nature of the traits, which can be exploited for the genetic improvement.

All morphometric were positively correlated to each other. That means that selection for these traits could result in responses in the correlated traits[15]. The high positive relationship among traits suggests that they can also be predicted from one another singly or in combinations. The results show a positive correlation of BW with all morphometric traits, that is in line with the findings of many other authors. All the morphometric traits that showed high positive correlation with the body weight are good estimators of body weight [16]. The high correlations values of BW with morphometric measurements can be indirectly used for the improvement of BW[9]. [8] have summarized that the heritability estimates for body weight and morphometric traits of goats were moderate to high. Therefore, body morphometric traits can be used as selection criteria. [17] recommend the use of body measurements in the Jamunapari goat breeding program owing to their high genetic correlation with corresponding live weight. The highest correlation of BW

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was with CC (0.763), which is statistically significant. High correlation of chest circumference with body weight was reported also by other authors [18].

The principal component analysis is a multivariate methodology used when evaluation of animals is based on a large number of significantly correlated traits [8]. The results of Discriminant analysis support the PCA indicating admixture in these goat breeds. The discriminant analysis displayed a high level of error regarding the individuals assigned correctly to the population of origin. The high error rate indicates the presence of the gene flow between breeds. The admixture can be explained with the small population size and with the management of these breeds. These breeds are considered as a small nucleus reared and managed under the care and supervision of ATTC, especially for the improvement of the local goat populations by crossbreeding. The level of admixture can be explained with the lack of herdbooks and extensive management of small ruminant species in Albania [19, 20].These breeds are found in the same geographical region and managed by the same institution, in the similar way, which might cause their intermixing. Population substructure may lead to Wahlund effect [21, 22], since the sampling is carried out only in the small geographical area, where these both breeds are raised. The findings of this study must be used by the ATTC in order to design breeding programmes to conserve them and to use pure breed animals for the improvement of local goat populations.

Developing of equations for estimation body weight from linear body measurement is very helpful,practical, faster, easier and cheaper in the rural areas for the smallholder farmers to know the body weight of their animal whenever necessary [23]. The stepwise multiple regression analysis indicated that the best predictor was CC, which is in line with the results of [24]. Chest circumference is the easiest way for the estimation of body weight at rural farm conditions. Thephenotypic characterization, body weight and linear body measurement description can be used as initial input for efficient utilization, conservation and designing improvement strategy as is suggested by [25]. The findings of this study might be very helpful in the case of ATTC in Korca, whose main mission is the designing of breeding programmes for conservation of local small ruminant breeds that are at risk of extinction, or the improvement programs for the local small ruminant populations by the crossbreeding with the imported breeds. Further research is needed to characterize these breed by molecular markers.

5. CONCLUSION

The study is focused on the characterization of two imported goat breeds based on morphometric measurements. Both breeds have similar body measurements value. Discrimination analysis and Principal Component Analysis indicate admixture between breeds. This can be associated with the similar management practices, and breeding practices between them. The study reveals positive correlation between body weight and the morphometric traits, where the highest

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statistically significant correlation was found between BW and HG. A stepwise multiple regression analysis indicated that body weight can be predicted by HG and CBC,. The results can be used by ATTC in the designing of conservation strategy and breeding programmes which are the main objectives of this center. The study must be extended with more data that will be obtained by the use of molecular markers.

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