

Geometric morphometrics to the study of skull sexual dimorphism in a local domestic goat breed

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ABSTRACT

Animal ethnologists should be especially keen on taking advantage of new quantitative methods for the description of form, such as geometric morphometrics (GM). Twenty-four skeletonized skulls from adult animals (12 males and 12 females) belonging to the White Rasquera goat breed were studied by means of GM methods. Specimens were from a private collection. No specific permits were required for this study as it did not involve either slaughtering any animal nor endangered or protected organic parts.

Skulls were dorsally photographed and on each picture fifteen craniofacial landmarks were digitized. The dorsal plane of each skull was photographed using a standard procedure with a tripod-mounted digital camera. The chosen landmarks represented different points from the neurocranium and viscerocranium and were selected because of their ease of location on fixed bony points; moreover they were not “masked” by the large horns that characterize this breed. Eleven landmarks were collected for each individual: (1) akrokranium, (2) and (3) ectorbitales, (4) and (5) nuchal points to the facial tuberosities, (6) and (7) facial tuberosities, (8) and (9) premaxillas (widest part), (10) nasion, and (11) prosthion. In addition to being highly reproducible, these landmarks encompass elements of the entire cranium. Two additional landmarks spaced 40 mm apart were also included for scaling. To assess differences in shape between sexes, principal-components analysis and discriminant function analysis were performed.

The first component, PC1, accounted for 34.24% of the variation. Medial and muzzle points made the largest contribution to the total variance. The PC2, accounted for 29.30% of the variation and was a measure of nasion and muzzle points. Variations in size were similar within the sexes (CV 3.4 and 3.7 % for males and females, respectively) and there appeared to be no shape differences between the sexes (Wilk's lambda = 0.006, $p = 0.285$). The centroid size was significantly different between the sexes ($F = 1.244$, $p = 0.0126$), being larger in male skulls than in females. Inter-individual allometry was not significant ($p = 0.104$) and explained only a small percentage (7.73 %) of shape differences according to size.

The global variation between sexes may be interpreted in relation to extensive management styles of the animals that moreover are under a low anthropogenic influence so they tend to reinforce the natural sexual size dimorphism of the species. This being the first known study to apply GM to a domestic goat breed, we advocate for further GM research in domestic breeds in order to have the possibility of comparing populations and easily exchanging information between research centres.

Key words: animal ethnology; dorsal cranium; neurocranium; viscerocranium; White Rasquera