Small Ruminant Research 140 (2016) 50–56

Contents lists available at ScienceDirect

Small Ruminant Research

journal homepage: www.elsevier.com/locate/smallrumres

Morphological differentiation amongst Zulu sheep populations in KwaZulu-Natal, South Africa, as revealed by multivariate analysis

Bafowethu S. Mavule [a], Francesca M. Sarti [b], Emiliano Lasagna [b,*], Nokuthula. W. Kunene [a]

[a] Department of Agriculture, University of Zululand, P Bag X1001, KwaDlangezwa, 3886, South Africa
[b] Dipartimento di Scienze Agrarie, Alimentari e Ambientali, Borgo xx giugno, 74, 06121, Università degli Studi di Perugia, Italy

ARTICLE INFO

Article history:
Received 5 April 2016
Received in revised form 25 May 2016
Accepted 1 June 2016
Available online 3 June 2016

Keywords:
Body measurements
Genetic variability
Characterisation
Conservation

ABSTRACT

Understanding morphological structure and variation of Zulu sheep is crucial for its identification and preservation. We measured 14 linear body measurements and scored 5 qualitative traits to evaluate the morphological variation and relationships among eight Zulu sheep populations in KwaZulu-Natal. Sheep were sampled from Empangeni, Escourt, Eshowe, Jozini, Msinga, Mtubatuba, Nongoma, and Nquthu rural communities. Dark brown coat colour, either in solid form or white patched, was most frequent amongst studied sheep. There were significant variations in body measurements amongst sheep populations from different areas. Sheep from Nqutu measured highest in most morphometric variables while sheep from Empangeni measured lowest. Discriminant analysis identified rump-width, head-width, heart-girth, thorax-depth and tail-length as the most distinguishing variables amongst sheep populations. Hierarchical cluster analysis revealed two major groups, one formed by Empangeni, Mtubatuba and Nongoma, the other by Jozini, Msinga and Eshowe populations. Estcourt and Nqutu distanced themselves from these groups as individual entities. About 62% of individual sheep could be correctly identified with the populations from which they were sampled. Nqutu had the highest percentage (88.9%) of correct assignment whilst Mtubatuba had the lowest (46.7%). High assignment errors were ascribed to a certain gene flow between sheep populations. The overall significant morphostructural variation amongst Zulu sheep populations, infers considerable genetic variability within the breed and its populations. Maintaining this genetic variation is very crucial for the continuity of the breed, as it provides animals with options to respond to change in climate, disease or consumer preference.

1. Introduction

Sheep like all other livestock species are recognised as important components of livestock biodiversity. In the rural communities of South Africa livestock production provides a livelihood for the majority of the population. Indigenous livestock breeds form the backbone of livestock production because of their ability to survive and produce under harsh environmental conditions (Ramsay et al., 2000; Kunene and Fossey, 2006). Nevertheless these breeds have received little attention from researchers and commercial farmers and are thus consequently depleting.

The Zulu sheep breed is a type of Nguni sheep predominantly found in the northern part of KwaZulu-Natal (Kunene et al., 2009). According to Kruger (2001), the Nguni people upon migrating down the east coast of Africa between 200 and 400 CE, brought with them sheep. These sheep are generally referred to as Nguni sheep. The dispersal of settlers from this point on led to the division of the flock into now known three groups; the Pedi sheep in Sekukunniland, the Swazi sheep in Swaziland and the Zulu sheep in KwaZulu-Natal (Kunene et al., 2007). Further spread of Zulu sheep into different locations of KwaZulu-Natal has fragmented the breed into isolated subpopulations occupying different ecological, socio-cultural and management environments. It is quite possible that these subpopulations may have developed into different "types" of Zulu sheep. The extent to which these sheep populations vary genetically has not been documented. Such information is essential for the development of appropriate breeding and conservation programme of the breed (FAO, 2007). Moreover, information obtained from the characterisation process would contribute significantly in defining the morphological standard of Zulu sheep from both variability and the mean point of view.

Unfortunately official data on the census of the Zulu sheep are not available at the present time; anyway in another survey (Mavule et al., 2013a) around four thousand heads were reported

* Corresponding author.
E-mail address: emiliano.lasagna@unipg.it (E. Lasagna).

http://dx.doi.org/10.1016/j.smallrumres.2016.06.001
0921-4488/

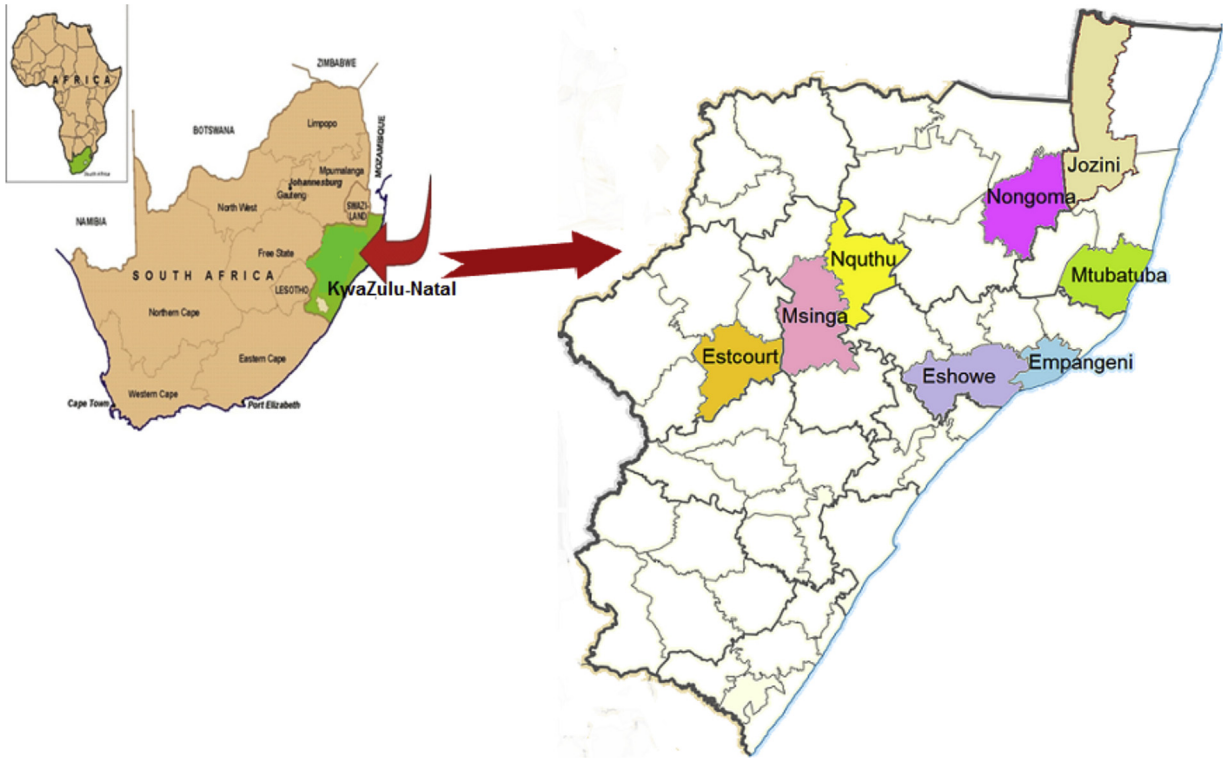

Fig. 1. Map illustrating municipal boundaries and rural areas from which sheep were sampled.

for the same populations; with the highest number in the area of Msinga.

Apart from the preliminary studies conducted by Kunene et al. (2007) as well as Mavule et al. (2013b), which investigated in part the morphological structure of Zulu sheep, there are no sources of information differentiating amongst Zulu sheep populations. Kunene et al. (2007) used only three flocks which were mainly obtained from research institutions, thus, inherent variation among and within the existing communal sheep populations were not fully represented. A wide coverage of geographic area would have given a better representation of the populations on ground. Moreover few traits were used in differentiating the studied populations and thereby restricting the study to the use of univariate analysis, whereas the current trend in livestock classification involves the use of multivariate statistical tools (Yakubu et al., 2010).

Canonical discriminant analysis, a multivariate technique, assess morphological variation between sheep populations; by identifying the most discriminating measurements and appropriately discriminating different sheep types by simultaneous consideration of all measured variables (Traoré et al., 2008b). Its use has been extensively applied in goats (Jordana et al., 1993; Herrera et al., 1996; Capote et al., 1998; Zaitoun et al., 2005; Dossa et al., 2007; Traoré et al., 2008a), few such studies exist in sheep (Riva et al., 2004; Carneiro et al., 2010; Legaz et al., 2011).

Morphological diversity is a good reflector of ecological selection regimes and history of a breed (González et al., 2011). In addition, phenotypes are an expression of genetic characteristics, modified by environmental conditions and variance in both genetics and environment may affect phenotypic variance (Yakubu et al., 2010; Kunene et al., 2014). It is in the context of these assertions that this study exclusively depended on morphometric measurements and geographic locations to unravel the characteristic of genetic diversity amongst Zulu sheep populations, which is most relevant for managing the present and future genetic diversity of the breed.

The objective of this study therefore, was to evaluate morphological variation amongst Zulu sheep populations in different geographical locations of KwaZulu-Natal, exploring the possibility of differentiating between these populations. Understanding these attributes is crucial in formulating breeding and conservation schemes where sheep taken from different populations are involved. A morphological standard of a "Zulu sheep breed" could also be set taking in to account the more frequent body features in the populations.

2. Materials and methods

2.1. Study area

The study was carried out in eight areas of KwaZulu-Natal, South Africa, selected on the basis of inhabiting Zulu sheep. The areas are namely Empangeni, Eshowe, Jozini, Mtubatuba, Nongoma, Msinga, Nqutu and Estcourt (see Fig. 1). They lie in the region between latitudes 27°07′–29°00′S and longitudes 29°52′ –32°04′E with the altitude ranging from 90 to 1900 m above sea level, and annual rainfall ranging from 600 mm to over 1 400 mm.

2.2. Data collection

A total of 803 ewes, were sampled from the 8 studied areas of KwaZulu-Natal. The number of ewes sampled in each area were: 101 (Empangeni), 100 (Estcourt), 99 (Eshowe), 100 (Jozini), 100 (Msinga), 97 (Mtubatuba), 104 (Nongoma), and 102 (Nqutu).

Age of each animal was determined by the dentition method as well as making enquiries from the farmers. Only sheep with two pairs of incisors and above were considered in order to minimise age effects. A scale was used to determine body weight (BW) of each animal sampled. Sheep were weighed in the morning before feeding to minimise post-prandial gut variation. A textile measuring tape was used to obtain different body measurements from