

## COMPARATIVE GENETIC ANALYSIS OF MOLECULAR DIVERSITY OF AFRICAN CATTLE

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D. N. Mburu and O. Hanotte

International Livestock Research Institute (ILRI), P. O. Box 30709, Nairobi, Kenya  
d.mburu @cgiar.org

### Summary

There is large variation in the genetic diversity among the African cattle ( $MNA = 3.73-7.40$ ;  $A_E = 1.92-3.91$ ;  $H_E = 0.478-0.744$ ). In pooled geographic region samples, diversity is highest in the North African *Bos taurus* and it is lowest in the western part of the continent. Genetic structure analysis support isolation by distance in all, but the Southern African region, with extensive gene flow between populations.

### Keywords

African cattle, genetic variation, genetic differentiation, population structure, microsatellite

### Introduction

Through natural selection, indigenous African cattle breeds have become locally adapted to a wide range of environments including: adaptation to heat and drought, tolerance to diseases (e.g. trypanosomosis) and ability to efficiently utilize low quality forages. In spite of these adaptations, a great number of breeds are endangered. A successful genetic conservation programme will require knowledge of the genetic base available and an understanding and quantification of genetic differentiation between breeds. Here we examine the genetic diversity, population structure and phylogeography of African cattle breeds.

### Materials and Methods

Genetic diversity and population structure of 52 populations of African cattle were studied using 15 microsatellite markers. Populations were grouped as *Bos taurus* and *Bos indicus* following Hanotte *et al.* (2002). Details of the samples, DNA extraction and genotyping is as presented by Hanotte *et al.* (2002). Statistical and phylogenetic analyses were done using DISPAN (Ota 1993), GENEPOP (Raymond & Rousset 2001), FSTAT (Goudet 2001) and BOTTLENECK (Piry *et al.* 1993) packages.

### Results

A total of 183 alleles were detected across 1807 individuals. The mean number of alleles ranges from 3.73 in N'Dama to 7.13 in Baladi. The Kenyan Boran displays the highest levels of expected heterozygosity ( $0.744 \pm 0.027$ ) while the N'Dama ( $0.478 \pm 0.050$ ) has the lowest. Summary statistics of pooled populations by geographic regions is presented in Table 1. Tests of mutation-drift equilibrium show evidence of bottleneck in 20 populations.  $F_{ST}$  indicate that all population pairs amongst the West African *B. indicus*, West African *B. taurus*, North African *B. taurus* and Southern African *B. indicus* are significantly differentiated ( $P < 0.05$ ). However, genetic differentiation is on average lower between cattle breeds from the East African region, with no genetic differentiation observed between some population pairs. There is substantial amount of gene flow ( $Nm$ ) between populations, and it ranged from 1.5 to 11.7 migrants per generation in the North African *B. taurus* and East African *B. indicus*,

respectively. Significant positive correlation between genetic differentiation and geographical distance is found in the East African *B. taurus* (Fig. 1a). By contrast, the trend is non-significant within the Southern Africa *B. taurus* (Fig. 1b).

**Table 1** Summary statistics of African cattle breeds pooled by species and geographic origin. MNA =(a) mean number of alleles,  $A_E$  = effective number of alleles,  $H_E$  = expected heterozygosity

Population	Breeds	Samples	MNA	$A_E$	$H_E$
<i>Bos taurus</i>					
East Africa	Twelve	414	9.80	3.47	0.712
Southern Africa	Twelve	419	9.47	3.23	0.690
West Africa	Six	210	9.07	2.72	0.633
North Africa	Three	110	8.53	3.57	0.720
<i>Bos indicus</i>					
East Africa	Twelve	407	9.40	3.56	0.719
West Africa	Four	140	8.07	3.37	0.703
Southern Africa	Three	105	7.47	3.22	0.689

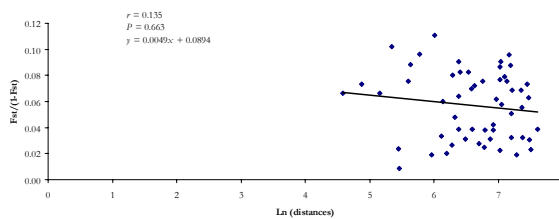
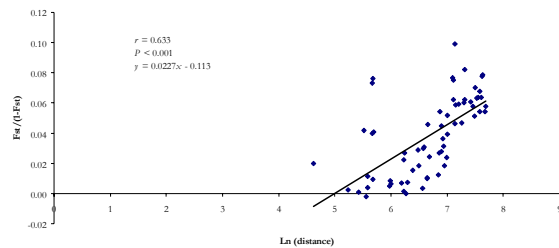


Fig. 1 Logarithmic scatter plot of pairwise FST (1-FST) against geographical distance for the (a) East African *Bos taurus* (b) Southern Africa *Bos indicus*

## Conclusion

There is a large spectrum of genetic diversity in African cattle, with some populations exhibiting high and others low diversities suggesting different evolutionary histories. Population genetic analyses reveal extensive gene flow between some populations and evidence for genetic drift and recent bottleneck in others. Genetic diversity and differentiation data supports the partitioning of African cattle into four geographic groupings (East, West, North and Southern Africa). Some population pairs are very closely related, questioning their classification as separate populations using phenotypic or ethnographic criteria. The today diversity of African cattle reflects their long and complex history of differentiation and admixture.

## REFERENCE LIST

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