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Phenotypic and genetic trends of some reproductive traits in N'Dama herd at Fashola Stock Farm, Nigeria

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ABSTRACT

Age at first calving (AFC) and calving interval (CALINT) records of 1349 N'Dama dams reared at Fashola Stock Farm between 1947 and 1984 were analyzed. Estimated phenotypic trend was .75±.02 months/yr and -.003±07 days/yr in AFC and CALINT respectively. Annual phenotypic mean increased from 27.47 to 78.51 months in AFC and 383.67 to 790.52 days in CALINT. Genetic trends were not linear. Sequential polynomial fitting of the data showed quadratic function would be adequate to describe the phenotypic trend while the genetic trends can be better fitted by the cubic function. The regression equations obtained for the phenotypic trend were:

$Y = 21.98 + .09b^1 + .01b^2$ for AFC, and $Y = 325.01 + 2.48b^1 + .001b^2$ for CALINT,

While the genetic trend curve equations were:

$Y = -.04 + .001b^1 - .77b^2 - .13b^3$ for AFC, and $Y = -.01 + .002b^1 + .11b^2 + .43b^3$ for CALINT.

Key words: Beef cattle, genetic trends, N'Dama, Nigeria, phenotypic trends

INTRODUCTION

In any livestock industry, there is a need for the become improvement of reproductive traits. This is because they determine the rate of herd increase and the extent to which culling can be practised. Improvement of such traits will be faster when animals of superior genetic merit are used to produce the next generation. This could be achieved through maximum exploitation of the genetic potential of the indigenous breeds.

In Nigeria, one of the outstanding beef breeds is the N'Dama (Roberts and Gray 1973). Because of its outstanding qualities, numerous investigations were made on its phenotypic characterization (Orheruata 1988), growth (Mgbere 1995) and reproductive performance (Sada 1968; Akinokun 1982). However, sufficient attention has not been given to phenotypic and genetic merit of beef breeds over time. Meanwhile paucity of information are available in dairy cattle populations (Van Vleck and Henderson 1961; Schaeffer *et al.* 1975). The lack of sufficient information on beef cattle may have been because it has not been possible to determine what part of a total change was in fact genetic (Brinks *et al.* 1961). However, with the recent computational procedure of Wilson and Willham (1986) it has now become possible to estimate the genetic component of the changes.

Therefore, the objective of this study was to estimate the phenotypic and genetic trends of age at first calving and calving interval in N'Dama cattle over a thirty-five year period. Such knowledge will aid in giving direction to improvement of this breed.

Abbreviations: AFC - age at first calving, CALINT - Calving interval, EPD - Expected progeny difference

MATERIALS AND METHODS

The data used for this study were obtained from Fashola Stock Farm established in 1947 for the breeding and multiplication of N'Dama cattle for distribution to local farmers and for research purposes. The farm is located in the Derived Savannah Zone of Nigeria (latitude 71° 54'N and longitude 3° 43'E). The average annual rainfall, temperature and relative humidity were 1045mm, 28.29°C and 67.6%, respectively.

The rainfall pattern is controlled by two opposing winds:- the North-east trade wind which is characterized by a drop in relative humidity and drying of vegetation and the South West Monsoon wind which brings about high relative humidity and consequently, luxuriant pasture growth. Based on these winds and rainfall the year is divided into 4 seasons: The late dry (January-March); early rain

(April - June); late rain (July-September) and early dry (October - December) with percentage rainfall of 9.48, 36.42, 33.02 and 21.08, respectively.

Fodder is relatively scarce and of low quality in the late dry and early wet seasons while it is in abundant supply and of relatively good quality in the late wet and early dry seasons. The animals were rotationally grazed on established pastures and/or bush during the day and put under shelter in the night. Grazing was supplemented with hay, sweet potatoes, cassava and concentrates composed of guinea corn, groundnut and cotton seed cakes in the early days of the farm (Joshi *et al.* 1957).

Animals had access to water and saltlick at all times. Disease control included inoculation against common diseases like black quarter, bovine pleuro-pneumonia, anthrax and hemorrhagic septicemia. Ectoparasites were controlled by dipping adult animals and by spraying pregnant ones and calves every fortnight during the rainy season and every month during the dry season. Control of endoparasites involved the deworming of all animals every four months. These were accompanied with occasional burning of pastures to disrupt the life cycle of worms and ticks.

Calves were promptly identified and weighed after birth and records of their parentage kept. They were weaned at 6 to 12 months. Natural mating at grazing was the breeding practice with a few cases of artificial insemination.

In the history of the farm there were no laid down selection criteria. Animals were selected based on their performance. Culling from the breeding herd was based on the following criteria: old age, health and reproductive problems. Orheruata and Olutogun (1998) also observed that changes in farm policy, introduction of crossbreeding programme in the farm, state creation and the resultant assests sharing and haphazard removal of prolific animals affected the number of animals in the herd. These factors no doubt affected selection. However, bull: cow ratio fluctuated between 1:20 and 1:30. Young heifers were introduced to bulls at 2.3 years of age and nursing cows at 45-60 days after calving.

Records of age at first calving (1349) and calving interval (3442) between 1947 and 1984 were obtained for data analysis.

Statistical analysis

Annual phenotypic means were computed using ML procedure of Harvey (1987), the model assumed was

$Y_i = (\Sigma Y_{ij})$ (Wilson and Willham 1986)

where

Y_i = the phenotypic average for trait X of the calfcrop born in the i^{th} year.

Y_{ij} = the record of trait X of the j^{th} cow in the i^{th} year.

n_i = the total number of records belonging to the i^{th} year.

Annual genetic merit was computed as expressed below:

$G_i = (\Sigma\, n_{ik}, S_k) / n_i + (\Sigma\, d_{ij}) / n_i$ (Wilson and Willham 1986)

where

G_i = the genetic merit of the calfcrop for the trait X in the i^{th} year

n_{ik} = the number of progeny of the K^{th} sire in the i^{th} year in the herd

S_k = the expected progeny difference (EPD) for trait X of the K^{th} sire

d_{ij} = the EPD for trait X of the j^{th} dam in the herd with a progeny record in the i^{th} year and

n_i = the total number of progeny with records for trait X in the i^{th} year in the herd

Phenotypic and genetic trends were obtained by regressing the various values on years.

EPD which is one half the breeding value was estimated as

$EPD = b(X_b - X_n)$ (Legate and Warnick 1990)

where

b = the regression coefficient which depends on the number of progeny and the heritability of the trait.

X_b = the average of the bulls progeny

X_n = the average of the other progeny in the same herd, and

$$b = \frac{n}{n + (\sigma_s / \sigma_e)}$$

$$b = \frac{n}{n + [(4 - h^2)/h^2]}$$

where

n = the number of progeny

σ_s = the variance due to sire and

σ_e = the residual variance

Heritability was estimated with variance components adopting Handerson Method I mixed model (1953).

Sequential polynomial fitting of the phenotypic and genetic curves was done using regression technique.

RESULTS

The phenotypic, genetic and environment trends obtained by subtracting genetic trend from phenotypic trend for age at first calving and calving interval are presented in Table 1. The trend curves for the traits are depicted in Fig. 1 and 2, respectively. The results of the sequential polynomial fitting of the data are in Table 2.

Table 1. Within herd estimates of phynotypic, genetic and environmental trends of age at first calving and calving interval of N'Dama cattle at Fashola Stock Farm, Nigeria.

Trends	Traits	
	AFC (months)	CALINT (days)
Phenotypic	0.73±0.09**	15±3.28**
Genetic	-0.02±0.02	-0.003±.01
Environmental	0.75±0.09	15.79±3.28

CALINT = Calving interval
AFC = Age at first calving
* p≤0.05
** p≤0.01

Heritability estimates of 0.49±0.17 and 0.04±0.06 were obtained for age at first calving and calving interval, respectively. Average age at first calving varied from 27.47± 3.33 months in 1947 to 78.51± 5.21 month in 1983 while calving interval varied form 383.67±59.06 days in 1948 to 790.52±62.63 days in 1982. Estimated phenotypic trend of age at first calving was significant (P<0.01) but undesirable in direction (0.73±.09 months/yr). The genetic trend though in desirable direction, was however very small (-0.02±0.02 months/yr).

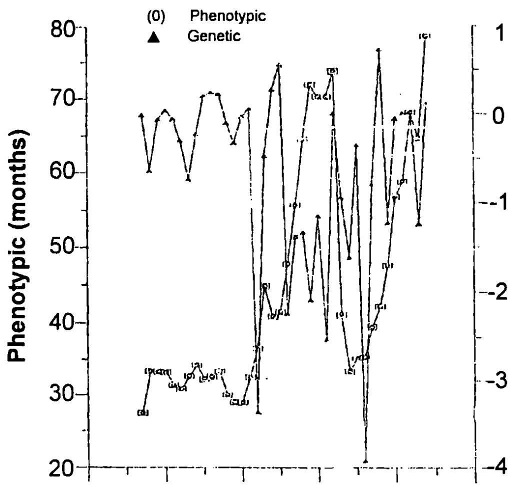

Fig. 1: Phenotypic and Genetic trend curves of age at first calving on N'dama cows at Fashola Stock Farm between 1947 and 1984.

Similarly, estimated phenotypic trend of calving interval was also significant (P< 0.01), high and in undesirable direction (15,79±3.28 days/yr). The genetic trend was not different from zero (-.003 days/yr). Sequential polynomial fitting of the phenotypic trend curves from linear to the quadratic

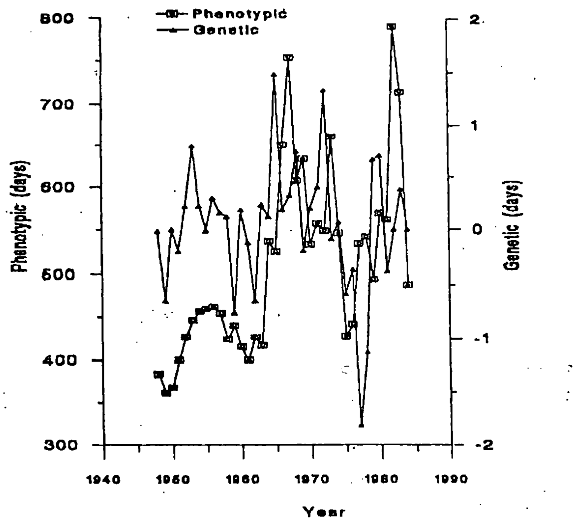

Fig.2. Phenotypic and genetic trend curves of age at first calving of N'dama cows at Fashola Stock Farm between 1947 and 1984.

Table 2. Results of polynomial fitting of the phenotypic and genetic trend curves of traits of N'Dama cattle at Fashola Stock Farm, Nigeria.

Variable & Polynomial	Regression Parameter Estimate				
	a	b_1	b_2	b_3	R^2%
Age at first Calving					
Linear	28.42	.73±09**	-	-	62.24
	-.25	-.02±.02	-	-	5.15
Quadratic	21.98	.09±.03	.01±.003**	-	98.66
	-.12	-.005±.01	-.29±.02**	-	81.78
Cubic	15.69	.01±0.01	.02±.0003**	-.0001±.000**	99.97
	-.04	.001±.01	-.77±.09	-.13±.02**	90.64
Calving					
Linear	337.74	15.79±3.28	-	-	39.82
	.10	-.003±01	-	-	.29
Quadratic	325.01	2.48±98	.001**	-	96.52
	.11	-.001±.01	-.11±.15	-	1.83
Cubic	223.96	.79±.18	.001**	-.000**	99.90
	-.01	.002±.01	.11±.9	.43±.05**	70.44

a = intercept, b's are partial regression coefficient;
value on top are phenotypic trend while those below are for genetic trend.

function increased the R^2 values from 62.24 and 39.82% to 98.66 and 96.52% in age at first calving and calving interval, respectively. The R^2 values of the genetic trends only changed form 5.15 to 81.78 and .29 to 1.83% in age at first calving and calving interval, respectively. However when the polynomial function was increased to the cubic level, R^2 value for genetic trend increased to 90.64 and 70.44%, respectively, thus suggesting a better fit because the total variance of such traits were better accounted for at such high polynomial function over time.

DISCUSSION

The trend curves of age at first calving depicts what appears to be inconsistent selection of parents. Since in some years where there was remarkable reduction in the genetic merit of N'Dama cattle in age at first calving it could not be sustained. This was evident from years preceding or following such years which were either higher or lower and did not follow any particular trend or pattern. Also the strong environmental influence did not allow such genetic merit to be observed phenotypically. The strong influence of the environment made age at first calving to increase tremendously from 27.47 in 1947 to 78.51 months in 1983. The tremendous increase started in 1966 (Fig 1).

Generally, the phenotypic value of age at first calving and calving interval increased steadily over the study period indicating deterioration in management practices over time. The annual fluctuations observed in the traits can be attributed to fluctuations in weather conditions which may have affected the plane of nutrition. In years where seasonal effect do not favour good pasture growth, the attainment of sexual maturity and resumption of sexual activity will be delayed. However, the values obtained were within those reported in the literature for N'Dama and other indigenous African breeds (Fall *et al.* 1982; Choudhuri *et al.* 1984; ILCA 1989; Rege 1991).

The genetic merital of these traits showed that in half the period of the study, the genetic merits though were in the favorable direction as depicted in Fig 1 and 2, did not bring any significant genetic improvement. The years 1970 to 1983 had higher genetic merit for age at first calving while 1947 to 1960 had better genetic merit for calving interval. The results indicated that little variability existed genetically among the cows in these traits. Therefore the wide variability often observed in such traits depends on environmental factors. Similar observation was reported by Oyedipe *et al.* (1982); Choudhuri *et al.* (1984); Well *et al.* (1986) and Rege (1991).

The genetic trend of - .003 days/ yr obtained for calving interval indicated that there was less improvement. The high change in actual calving interval which was undesirable was mainly due to environmental influences.

In the years 1948 to 1961, environmental influences were fairly constant and kept calving interval from continuing to go above 450 days. It changed in 1962, thus allowing calving interval to change sporadically.

The lack of genetic progress as indicated by the infinitesimal value obtained for genetic trend and the significant increase in the phenotypic values of these traits may have been due to lack of a monitored selection. Probably with a monitored selection genetic merit of N'Dama overtime for these traits could have been substantially better.

Though the phenotypic trends for the traits were significant at the linear function, the total variance of such traits would be adequately accounted for at the quadratic function level because of the high R^2 value (96%) at this function. Similarly, genetic trend would be better fitted by the cubic function since, the variability in these traits over time were better accounted for at this function with higher coefficient of determination values (90.64 and 70.46 percent for AFC and CALINT, respectively).

CONCLUSIONS

(i) The lack of selection criteria coupled with fluctuations in environmental factors, influenced the reproductive performance of the dams.
(ii) Cows showed little variation in genetic merits.
(iii) Trend curves were not linear indicating no direct relationship between time and the traits.

Therefore, improvement of these traits would require correct feeding and establishment of selection criteria which should be followed. This will enable exploitation of the full potential of N'Dama cows which continues to be in many cases grossly neglected.

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