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Effects of age of cow at first calving, period of calving and calving sequence on calving interval of N'dama and Keteku Cattle, and their crosses in southwestern Nigeria.

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Abstract

Calving records of N'dama and Keteku cows on range in the humid tropical environment of southwestern Nigeria were analysed to determine the effects of cow age at first calving, period of calving and calving sequence on length of calving intervals. Cow age at first calving and calving sequence significantly affected calving intervals ($P < .01$). Heifers calving for the first time at 3.6 – 4 years had an average calving interval of 511 days while heifers calving for the first time before 3.6 years had intervals that were 36 days longer. Those calving for the first time at over four years had average calving intervals that were shorter by 73 days. There was a progressive decrease in length of calving interval as calving sequence increased. Period of calving had no significant effect on length of calving interval.

Introduction

Reports on extensively kept cattle in both temperate and tropical areas indicate that environmental factors have pronounced influences on length of calving interval (Dunbar and Henderson, 1950; Braude and Walker, 1949; Maule, 1967; Akinokun, 1970; Lin and Allaire 1978). Mahadevan (1956) suggested that length of calving intervals and dry periods were almost entirely under the control of management, based on observed low intra-herd correlations and observation of consistent improvement in those measurements from year to year. Researchers in central Africa (Rhodesia, Zambia, Malawi Agricultural Research Council of Central Africa, 1967) investigating variables affecting sexual activity of ranch cows, reported that sexual activity of ranch cows was higher at the equinoxes than at any other times. Mahadevan *et al.* (1972) reported that year of birth, age of cow and temperature changes significantly affected length of calving interval. They also reported significant sire effects, but no dam effect, on calving intervals of daughters. Amble *et al.* (1958) reported herd differences in age at

first calving and calving intervals. Gill and Allaire (1976) reported that optimum age at first calving for total lifetime performance was between 22.5 to 23.5 months, while Lin and Allaire (1978) reported mean age at first calving of 30 months for 2312 Holstein cows in 38 California herds. There are no published reports on the magnitude of specific environmental effects on reproductive performance of N'dama and Keteku cattle. Estimates of the effects of factors such as age at first calving, season of calving and calving sequence are of interest as aids in planning production programme as well as for adjustments during selection and culling for stock improvement. Such information is of particular importance in efforts to intensify beef cattle production in Nigeria.

The following is a study of the effects of some environmental factors on reproductive performance as measured by length of calving intervals.

Materials and Methods

The data used include 1,084 calving records of 300 cows (158 N'dama,. 79 Keteku and 63 N'dama x Keteku) kept at the Western Nigeria Development Corporation beef cattle ranch at Upper Ogun in the derived savannah zone of the Western State of Nigeria during the years 1961 to 1970. The ranch was established in 1954, but the data from early years were incomplete.for the purpose of the present analysis, and were excluded. The N'dama stock was multiplied from a foundation stock which originated from Sierra Leone and Guinea in West Africa, and Zaire in central Africa. The Keteku is a white, black and white or reddish beef cattle, which originated from a cross of humpless N'dama with the White Fulani (Mason, 1969).

The cows were pasture bred with the bulls running with them throughout the year. Calves were weighed at birth, and allowed to run with their dams until six to nine months of age depending on season of birth, before they were weaned. Heifers were transfered into cow herds at 18-24 months of age. Improved pasture was used mainly during the dry season, while the animals were mostly bushgrazed during the rainy season. Cows and calves were routinely dewormed, inoculated against anthrax and blackquarter, and sprayed against external parasites. A least squares analysis by fitting constants (Steel and Torrie, 1960) was carried out to estimate the effects of period of birth of calf and calving sequence as independent variables, on calving interval. Each year was divided into six two-month periods starting from April and corresponding to early, mid and late rainy season; and early, mid

and late dry season. Climatological observations show that there are more similarities in temperature and relative humidity within the sub-classifications of seasons than within each of the two main seasons (Table 1). While similarities in rainfall figures may not be as obvious, the periods were quite similar in terms of the effect of onset of the rains on growth of pasture. Thus, stages of growth of pasture change from little or no growth in March and April, to a stage of full maturity in July and August; pasture starts drying off in November and December and are completely dried up by January and February. Four calving sequences were considered. The first calving interval was the period between the birth of the first and second calves produced by the same cow; similarly the second, third and fourth calving intervals were the intervals between subsequent conseutive calvings.

TABLE 1 – AVERAGE MONTHLY TEMPERATURE HUMIDITY AND PRECIPITATION OVER 5 YEARS.[1]

	Temperature °C		*% Relative Humidity at 10.00hrs.*		*Monthly Precipitation (mm)*
Month	*Max.*	*Min.*	*Min.*	*Max.*	
April	32.1	23.3	60.8	82.2	121
May	31.5	23.2	62.4	82.8	171
June	30.0	22.4	69.2	85.2	203
July	28.4	22.8	73.2	90.4	176
August	27.5	22.1	77.0	92.6	91
Sept.	28.8	22.6	72.0	89.9	294
Oct.	31.0	22.7	63.4	86.4	174
Nov.	32.9	22.3	46.8	77.2	14
Dec.	33.4	21.3	40.2	72.6	6
Jan.	32.5	20.9	40.9	77.6	14
Feb.	34.7	23.6	38.6	72.0	31
March	33.8	23.5	52.6	80.0	117
Ave.	31.4	22.5	58.1	82.8	–

1 – From Duncan (1974)

A second analysis, similar to the first, but which included 210 cows and 766 calving intervals, was carried out to determine the effect of age of cow at time of first calving and calving sequence on calving intervals. Cows were grouped according to their ages at time of first

calving as follows: 3 years or younger; 3.1-3.5 years; 3.6-4.0 years and 4.1 years or older. Calving sequence classified calving intervals in terms of whether they followed the first, second, third or fourth calf produced by the same cow. A test on differences between all pairs of estimated constants within subclasses, was carried out using the t-test. Also, a regression of average of our calving intervals on age at first calving which was considered as a continuous variable was calculated.

Results and Discussion

Period of Calving

Least squares analysis of variance (Table 2) shows that period of calving had no effect ($P > .05$) on the length of subsequent calving intervals. Constant estimates for the six periods (Table 3) indicate that cows calving between October and March, roughly corresponding to dry season months had slightly longer calving intervals. Quality of available pasture, temperature, and humidity are main differences between the two tropical seasons but it appears these were not striking enough to significantly affect reproductive performance as measured by the intervals between calvings.

Steinbach and Balogun (unpublished) observed significant effect of months on conception rate, which they attributed to photoperiodicity, rather than quality of pasture or temperature changes. Mahadevan and Marples (1963) did not detect month effect on number of calvings. Mercier and Salisbury (1947) found significant differences between seasons in percent successful services which were associated with length of daylight, but temperature changes had no effect on fertility. Also, Fisher and Williams (1978) observed that month of birth had a significant effect on reproductive performance. Other factors may be important, such as the length of suckling period, which in the case under study, was not closely controlled from year to year.

TABLE 2 – SUMMARY OF THE ANALYSIS OF VARIANCE OF THE EFFECT OF PERIOD OF CALVING AND CALVING SEQUENCE ON LENGTH OF CALVING INTERVAL.

Source of Variation	*d.f.*	*Mean Square*
Period adjusted for sequence	5	0.8053
Sequence adjusted for period	3	4.7529**
Error	1031	0.5223

**Significant ($P < .01$)

TABLE 3 – LEAST SQUARES ESTIMATES FOR PERIOD OF CALVING AND CALVING SEQUENCE, THEIR STANDARD ERRORS AND RESULT OF A T–TEST FOR DIFFERENCES WITHIN SUBCLASSES.

Mean	*L. S. Constant** 1.4362
Periods	
April - May	- 0.0662 ± 0.00035[a]
June - July	- 0.0386 ± 0.0030[a]
August - September	- 0.00073 ± 0.0045a
October - November	0.055 ± 0.00030[a]
December - January	0.0017 ± 0.0024[a]
February - March	0.0554 ± 0.0020[a]
Calving sequence	
1st Calving Interval	0.1433 ± 0.0013[a]
2nd Calving Interval	0.1208 ± 0.0017[a]
3rd Calving Interval	- 0.0457 ± 0.0022[b]
4th Calving Interval	- 0.2184 ± 0.0048[c]

*Estimates with at least one common superscript are not different ($P > .01$).

Calving sequence

The effect of calving sequence on length of calving intervals was highly significant (Tables 2 and 4). Test of significant difference betwween least squares constant estimates (Tables 3 and 5) indicate that the first two calving intervals were longer than the third and fourth intervals. There were no differences ($P > .05$) between the length of first and second calving intervals in the first analysis but the difference was highly significant in the second analysis ($P < .01$) probably due to adjustments for cow age in the second analysis. There was a progressive decrease in the length of calving interval as number of calves produced increased.

Reports on the effect of cow age on reproductive performance in tropical and temperate areas (Braude and Walker, 1949; Schalles and Marlowe, 1967) indicate that cows reach average performance at 5-6 years of age. This is early compared with the result of the present analysis which shows that the performance of the N'dama and Keteku cows with respect to length of calving intervals is about average between the third and fourth calvings. Preliminary comparison between N'dama and Keteku cows and their crosses showed that there was no difference in their performance. With an average of 3.4 years at first calving (Akinokun, 1970), the period of average performance was reached at 6.5 to 8.0 years, with further improvements thereafter. Adjustment factors would thus be needed during culling within a herd, if length of calving interval were to be used as a criterion as might be done in situations where breeding time is undefined.

Age at first calving

The age at which a cow first produced a calf had a highly significant effect on subsequent calving intervals (Table 4). Least squares constant estimates showed that cows calving for the first time as three year-olds and between 3.1 and 3.5 years of age had similar length of calving intervals, which were above average by about 36 days. Cows calving for for the first time at 3.6 – 4 years were about average, and those that were above four years at time of first calving, had intervals that were 73 days shorter than average.

The results suggest that heifers calving for the first time between 3.6 and 4.0 years would be about average. Delaying transfer into cow herd for calving at ages in excess of four years has the effect of further reducing the average calving interval. Heifers going into the cow herd

before two years of age so that calving would occur before they are 3.5 years old under the conditions in this environment, would have longer lifetime average calving intervals.

TABLE 4 – SUMMARY OF THE ANALYSIS OF VARIAMCE ON THE EFFECT OF AGE GROUP OF COW AND CALVING SEQUENCE ON LENGTH OF CALVING INTERVAL

Source of Variation	*d.f.*	*Mean Square*
Group adjusted for sequence	3	5.26760**
Sequence adjusted for Group	3	6.43148**
Error	754	0.53857

*Significant (P< .01)

TABLE 5 – LEAST SQUARES ESTIMATES FOR COW AGE GROUPS AND CALVING SEQUENCE, THEIR STANDARD ERRORS AND RESULT OF A T–TEST FOR DIFFERENCE WITHIN SUBCLASSES.

Mean	*L. S. Constant** 1.41198*
Cow Age Group	
3 years or younger	0.0795 ± 0.0017[a]
3.1 - 3.5 years	0.1149 ± 0.0024[a]
3.6 - 4.0 years	0.0077 ± 0.035[a]
4 years or older	-0.2021 ± 0.0076[b]
Calving Sequence	
1st Calving Interval	0.2695 ± 0.0018[a]
2nd Calving Interval	0.1410 ± 0.0033[b]
3rd.Calving Interval	0.0211 ± 0.0035c
4th Calving Interval	-0.4317 ± 0.0035[d]

*Constant estimates with at least one common superscript are not different (P > .01).

TABLE 6 – SUMMARY OF THE ANALYSIS OF VARIANCE ON THE REGRESSION OF AVERAGE OF FOUR CALVING INTERVALS ON AGE AT TIME OF FIRST CALVING.

Source of variance	*d.f.*	*s.s.*	*m.s.*
Total	183	41.578	–
Linear	1	1.143	1.143**
Quadratic	1	39.420	39.420**
Residual	181	1.015	0.006

**Significant ($P < .01$)

Table 6 shows the results of a regression of average calving intervals on age at first calving. Fitting a straight line accounted for only 2.7 percent of the variation in calving intervals; the quadratic curve accounts for 97.6 percent. These results show that cow age at first calving is an important factor in future reproductive performance of cows. Kress *et al.* (1969) found that age at time of first calving was the most important single variable for predicting differences in efficiency of production. Also Gill and Allaire (1976) observed that 5.3% of variation in profit/daylife was due to age at first calving. Reproductive traits in cattle have low heritabilities and repeatabilities. Legates (1954) reported heritability of zero and repeatability of 0.133 for calving interval. Dunbar and Henderson (1950) and Amble *et al.* (1958) reported heritability estimates of zero while Lin and Allaire (1978) reported near zero heritabilities for age at first calving and first calving interval. Estimate of repeatability of calving of interval from intraclass correlation coefficient calculated from the present data was 0.129. If the effect of age at first calving is as important as the environmental effect as the result here suggests, greater efficiency in reproductive performance would depend on improved management practices such as transfering heifers into cow herds for breeding at older ages. Also since the weight at time of first calving may be a significant factor in the age effect obtained, this would indicate the need for more adequate nutrition to get heifers to required weights at earlier ages.

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