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Assessing Effective Population Size and Rate of Inbreeding In Bunaji Cattle Under Pastoral Production System

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Abstract

The present study was carried out to assess herd structure, effective population size and rate of inbreeding among white Fulani bunaji cattle herd managed by pastoralist in the Benue basin of Nasarawa and Benue states. Forty three cattle herds belonging to three pastoralist group agro-pastoralist, pastoralist and transhumant nomads were considered for the study. Flock composition was evaluated for the total population under consideration while, effective population size and inbreeding rate of select herds were computed. Herd size recorded were between 41±4.12, 52±5.32 and 58±3.21 for the agro-pastoralist, transhumance and Pastoralist nomads respectively. Breeding male to female ratio were 0.22, 0.24 and 0.26 while the coefficient of inbreeding or inbreeding rate per generation was 0.022, 0.014 and 0.017 of selected population for the respective production system. This seemed to be less than the maximum acceptable level. However, the prevalence of inbreeding was inhabitable because of the uncontrolled mating practice. It can be concluded that low inbreeding rate indicate that the breed is not at risk and no difference existed in small population genetic parameter between the various pastoral systems.

Keyword: *Herd composition; effective population size; inbreeding; extinction*

Introduction

Among all the livestock that makes up the farm animals in Nigeria, ruminants, comprising cattle, sheep and goats, constitute the farm animals largely reared by farm families in the country's agricultural system. Nigeria has population of 34.5million goats, 22.1million sheep and 13.9million cattle (Lawal-Adebowale, 2012). Among the indigenous cattle, the white Fulani bunaji constitute 51% of the total herd and are most widely distributed. The larger proportion of these animals' population are however largely concentrated in the northern region of the country. Pastoralism and agro-pastoralism are the dominant livestock production-based, land-use systems in Nigeria, covering many agro-ecological zones under which the indigenous animals are managed. Pastoral management systems commonly practiced by cattle herders in the country include the exclusive, transhumance and agro pastoral systems.. The cattle are run on herds and mate uncontrollable within the herd, though the herd sizes varies but they animal are at risk of depression resulting from continuous inbreeding.

Inbreeding refers to the mating together of individuals that are more closely related than would be the case if mating was at random (Falconer and Mackay, 1996). The consequence of the inbreeding process is the reduction in the genetic variability within a population and in performance mainly in traits that are associated with the fitness of an individual (e.g. fertility). While the impact of inbreeding in populations

of large sizes is negligible, its effect in typical livestock population where selective breeding is practiced, cannot be ignored.

Breeders are becoming aware of the risks of inbreeding increase and parameters derived from probability of genes origin are been widely used to precisely monitor the genetic diversity within subpopulations after a small number of generations. Also, parameters derived from probabilities of gene origin may provide a better under- standing of the changes taking place in the genetic pool of a breed, especially when those are considered over a small number of generations (Boichard *et al.*, 1997). Population size has a major impact on the dynamics of a population, the smaller the population the higher the tendency to be depressed in its reproductive potentials due to inbreeding (Klemetsdal, 1998).

The effective population size is directly related to the genetic variation and inbreeding in populations. Therefore knowledge of it help in predicting rate of loss of genetic variation and rate of increase in inbreeding and also provides useful information on the evolutionary history of populations. Small population genetic parameters such as effective population size (Ne) and rate of increase in inbreeding per generation had been generalized before under community-based management of animal genetic resources in Africa (Rege and Gibson, 2003; Wollny, 2003). These parameters determine the strength of genetic drift in a population and have long been recognized as an important parameter for evaluating conservation status and threats to genetic health of populations (Nomura *et al*., 2001; Hare *et al*., 2011). There is shortage of information on rates and level of inbreeding on cattle under traditional pastoral system in Nigeria, such information is crucial in designing breeding strategy and selection scheme for the improvement of the indigenous cattle breeds. This study was carried out with the objective of ascertaining the risk status class, herd structure and small population genetic parameters of the indigenous cattle breed white Fulani bunaji across pastoral herds.

Materials and Methods

Study location

The study was conducted in the Benue trough consisting two States of Benue and Nasarawa. These States lies within the north central zone of Nigeria, extending roughly from latitude 60 50'N to 90 30'N of the Equator and longitude 70 30'E to 100 00'E of the Prime. The study was carried out between November 2013 to March 2014. This area is largely located in the savannah of Nigeria with its northern edge lying on the border of the Sahel and its southern edge lying on the border of the rain forest of Nigeria. It is an ecological transition zone between the arid north and the moist south with temperature fluctuating between 18^oC – 37^oC in the year and rainfall of 1000mm to 1500mm. Nasarawa and Benue States are located in the Benue trough.

Forty three Pastoral nomads were the main respondent for the study, they were divided into fifteen agro-pastoralist who keep livestock and also cultivate crops,

fourteen pastoralist who keep only livestock and always move to the area during dry season for grazing, and fourteen transhumant nomads who are permanent settlers and keep only livestock. They were selected based on the disposition to respond to questions using their local heads (Ardo). The communities considered for the study include pastoralist settlement around Mbagwen communities in Guma and Makurdi Local government areas and while in Nasarawa state pastoralist settlements in Lafia, Obi, Keana and Doma Local government areas were used. The forty three cattle farmers selected only keep bunaji cattle and other small ruminants and were considered for the calculation of the herd distribution, while only two herds each were used to estimate inbreeding parameter.Effective population size (*Ne*) and increase in inbreeding per generation (ΔF) were calculated using the formulas by Wright (1931; 1977)

Results and Discussion

Population size of a livestock species is an important factor in determining its risk status (FAO 2007). Herd structure distribution of the various pastoralist system is presented in Table1. With the exclusive pastoralist nomads who concentrate on livestock farming and are always moving about with their cattle having higher number of herd size 58±3.21 compared to 52±5.32 and 41±4.12 for the transhumance and agro-pastoralist. The herd size obtained is within same range as reported by Akpa *et al*. (2012) of cattle herds around Zaria a sub-humid guinea savanna zone, lower than what Iro (2009) reported which shown slight decline. The decline in cattle herd size per household was in line with the reports of the studies conducted by Desta and Coppock (2002) who concluded that there would be declining trend in cattle holding per household in the Borana pastoral system induced by loss of animals because of the frequently recurring droughts combined with other factors such as increased human population and land use changes. Numerically, the current population size of breeding females 18, 32 and 24 and breeding males 4, 6 and 5 of the bunaji cattle in the herds obtained in the various pastoral systems in the present study does not classify the breed under the endangered category based on the classification used by FAO (2000). The high number of bulls in the communal areas offers a chance to effect selection and to minimize the inbreeding rate as low bull fertility was reported by Mapiye *et al*. (2007). Generally the herd structure are similar but varies with size of the ageing. Klemetsdal (1998) reported that herd structure varies considerably with the size of the herd, season of the year, the availability of the pasture as affected by rainfall and location. Similarly, Yousif and Fadl El-Moula (2006) reported that a large size herd will contain relatively more bulls at different ages than those of a small size because the smaller herd owners seek to replace excess male calves with females bought from the nearby markets

Table 1. Mean± SE herd distribution of cattle according to production system

	Agropastoral	Pastoralist	Transhumance
Bulls	4±012	6±1.31	5±1.23
Cows	18±3.14[c]	32±5.23[a]	24±2.61[b]
Female calves	3±0.16	4±0.31	3±0.10
Males calves	2±0.10	3±0.12	3±0.11
Bullock	2±0.10	3±1.10	4±1.12
Heifers	6±1.23[b]	12±2.14[a]	11±3.13[ab]
Average herd size	41±4.12	58±3.21	52±5.32

[abc]*Values with different superscript letter in each row are significantly different (P <0.05).*

Table 2 present estimate of rate of inbreeding, actual and effective population size and ratios. The average breeding male to female ratio obtained in this study 0.22, 0.26 and 0.24 do not varies between production system and is similar to what Tada *et al*. (2013) reported for indigenous Nguni cattle of southern Africa. Though higher than the recommendation for commercial beef herd 0.05 (Mapiye *et al*., 2009). The high number of bulls in the pastoral herds offers a chance to affect selection and to minimize the inbreeding rate resulting from some low bull fertility (Mapiye *et al*., 2007). Effective population size (Ne) is a measure of genetic variability within a population with large values of Ne indicating more variability and small values indicating less genetic variability. The estimate of effective population size (Ne) varies between farming system, a reflection of the actual population size, is on the high side compared to what Tada *et al.* (2013) recorded but still within recommendation of 50 for breeds under threat owning to inbreeding (Wollny, 2003). A low *Ne* value can be attributed to the unequal breeding sex ratio in favour of females and overlapping generation from random mating with no defined breeding season (Felsenstein, 1971). Inbreeding rates less than 1% per generation and a Ne of 50 have been recommended to avoid inbreeding depression and to maintain genetic diversity at sustainable levels for populations in the mid-term (FAO, 1988).In all cases, the level of inbreeding was within the proposed level to conserve endangered domestic animals that would result in inbreeding rates of between 1 and 4% (Mapiye *et al*., 2009).

Table 2 Estimate of rate of inbreeding and other parameter for the three cattle management system. .

Parameter	Agropastoral	Pastoralist	Transhumance
Breeding male to female ratio	0.22	0.26	0.24
Actual population size (Na)	76[c]	94[a]	82[b]
Inbreeding effective population (Ne)	22.97[c]	35.04[a]	29.11[b]
Increase inbreeding per generation(ΔF)	0.022	0.014	0.017
Ratio of effective pop size to actual pop(Ne/Na)	29	28	29

[abc]Values with different superscript letter in each row t significantly different (P <0.05).

Conclusion and recommendation

It can be conclude that there is no significant variation in the herd structure of the various traditional cattle management systems similarly with low level of inbreeding rate it is an indication that the indigenous cattle population is not under threat. Though with favourable breeding rate there will be tendency of increase inbreeding with decline on herd size, thus the urgent need for conservation programme that will target loss of genetic diversity and reduce inbreeding.

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References

Akpa G N., Alphonsus C and Abdulkareem A. (2012). Evaluation of herd structure of white Fulani cattle holdings in Zaria Nigeria. Science Research and Essay 7 (42) 3605 -3608

Boichard, D., L. Maignel, and E. Verrier. (1997). The value of using probabilities of gene origin to measure genetic variability in a population. Genet. Sel. Evol. 29:5–23.

Desta S. and Coppock D.L. (2002). Cattle population dynamics in the southern Ethiopian rangelands, 1987 – 97. Journal of Range Management, 55: 439 – 451

FAO (Food and Agricultural Organization of United Nation) (2000). World Watch List for Domestic Animal Diversity, 3rd ed. B. D. Scher (ed.). FAO. Rome, Italy, 726pp.

FAO (Food and Agricultural Organization of United Nation) (2007). The State of the World's Animal Genetic Resources for Food and Agriculture. Rome, Italy, 352pp.

Falconer, D.S. and T.F.C. MacKay, (1996). Introduction to Quantitative Genetic. Longman, London, New York.

Felsenstein, J., (1971). Inbreeding and variance effective numbers in populations with overlapping generations. Genetics 68, 581-597.

Hare, M.P., Nunney, L., Schwartz, M.K., Ruzzante, D.E., Burford, M., Waples, R.S., Ruegg, K.and Palstra, F., (2011). Understanding and estimating effective population size for practical application in marine species management. Conservation Biology 25 (3), 438-449.

Iro I (2009). Fulani Herding System. Data Analyst in Washington, D.C. USA.

Klemetsdal, G., (1998). The effect of inbreeding on racing performance in Norwegian cold blooded trotters.Genet. Sel. Evol., 30: 812-821.

Lawal-Adebowale, O. A. (2012). Dynamics of Ruminant Livestock Management in the Context of the Nigerian Agricultural System. Livestock Production, 61-

80
Mapiye, C., Chimonyo, M., Muchenje, V., Dzama, K., Marufu, M.C. and Raats, J.G., (2007). Potential for value-addition of Nguni cattle products in the communal areas of South Africa. Afr. J. Agric. Res. 2 (10), 488-495.
Mapiye, C., Chimonyo, M., Dzama, K., Raats, J.G. and Mapekula, M., (2009). Opportunities for improving Nguni cattle production in the smallholder farming systems of South Africa. Livest. Sci. 124, 196 204.
Nomura, T., Honda, T. and Mukai, F., (2001). Inbreeding and effective population size of Japanese Black cattle. J. Anim. Sci. 79, 366-370.
Rege, J.E.O. and Gibson, J.P., (2003). Animal genetic resources and economic development: issues in relation to economic valuation. Ecol. Econ. 45, 319-330.
Tada O., Muchenje V and K Dzama (2013). Effective population size and inbreeding rate of indigenous Nguni cattle under in-situ conservation in low inpt communal production system. South African Journal of Animal Science 43 (2) 137-142
Wollny, C.B.A., (2003). The need to conserve farm animal genetic resources in Africa: should policy makers be concerned? Ecol. Econ. 45 (3), 341-351.
Wright, S., (1931). Evolution in Mendelian populations. Genetics 16, 97-159.
Wright, S., (1977). Evolution and the Genetics of Populations. vol. 3. Experimental Results and Evolutionary Deductions. University of Chicago Press, Chicago