

*Review article***Towards the conservation of the indigenous cattle of KwaZulu-Natal****W.D. Gertenbach and A.A. Kars**

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*Received (revised) 8 March 1999; accepted 8 March 1999***Introduction**

Mankind is becoming aware of the dangers associated with an exploitive attitude towards natural resources without concern for the depletion or pollution of these national assets (Hodges, 1984). The threat to the survival of livestock breeds is growing and, whereas there is great awareness of the disappearance of many wild animals and plants from the world, few people, especially in the developed countries, are aware of the threat to domesticated animals which supply their daily needs. In developing countries a demand for land for residential purposes is reducing the area available for grazing and, where poverty and hunger reign, the preservation of indigenous breeds features low on the list of priorities. Cunningham (1993) states that throughout the developing world, countries have placed their indigenous livestock populations at risk by the introduction of exotic breeds and/or crossbreeding programmes.

Cattle are not only part of the culture of many tribes in Africa, but also comprise a large proportion of tribal wealth. In traditional Zulu societies (Krige, 1965), the wealth of a man was always reckoned in cattle because the number of cattle he owned determined the number of wives he could *lobola* (gift, usually cattle, which was passed from the family of the groom to the family of the bride before the family of the bride allowed the wedding to take place). Furthermore, cattle were the mainstay of the economy because they provided meat, milk and draught power.

The KwaZulu-Natal Department of Agriculture administers two Nguni cattle herds. The Bartlow Combine herd is kept at Bartlow Combine, which consists of seven adjacent farms, comprising 7 496 ha situated in the lowveld of north-eastern KwaZulu-Natal (27° 54' S, 32° 03' E; rainfall 582 mm/annum; summer mean maximum and minimum temperatures 31.2°C and 20.2°C; winter mean maximum and minimum temperatures 24.1°C and 6.1°C). The Ogwini herd, which resides at the Owen Sithole College of Agriculture (OSCA; comprising 672 ha and situated at 28° 38' S, 31° 56' E; altitude 23 to 120 m; mean annual rainfall 1 160 mm; temperatures at nearest recording station are mean maximum of 27.2°C and mean minimum of 14.6°C), is primarily a training herd. One of the objectives of the Department with these herds is to 'conserve and evaluate the genetic base of domestic livestock indigenous to the Province, and to make available indigenous genetic material to the livestock industry' (White Paper on Agriculture for KwaZulu-Natal, 1996).

The cattle comprising the Bartlow Combine herd were bought from local Zulu people living in the vicinities of Nongoma, Ingwavuma, Ubombo and Hlabisa in Zululand. The first purchases were made in the early 1930s, with additional animals being bought between 1950 and 1957 (Kars, 1993). The Ogwini Ngunis were obtained at a later date from various areas in Zululand and it was stated that these cattle were not related to the Bartlow Combine cattle (Development and Management Plan, 1994).

At the time of the incorporation of the Bartlow Combine and Ogwini Nguni cattle herds into the KwaZulu-Natal Department of Agriculture (1 October 1995), the Bartlow herd had primarily been

kept as a closed herd from 1957. In 1981, 38 females and one bull were introduced into the Bartlow Combine herd. Bulls were regularly bought from Nguni breeders for use in the Ogwini herd.

History and origins

The Nguni breed of cattle is associated with the Nguni people who kept them, hence the name of the breed. Epstein (1971) classified the Nguni as *Bos indicus*, Sanga type, owing to its cervicothoracic hump (Mason & Maule, 1960) which is muscular in contrast to the fatty thoracic hump characteristic of true *Bos indicus*. Meyer (1984) showed that the Sanga have a sub-metacentric Y-chromosome in contrast to the acrocentric Y-chromosome of the Zebu types and proposes using the names *Bos taurus taurus* for the humpless European cattle, *Bos taurus indicus* for the Zebu types and *Bos taurus africanus* for the Sanga cattle. This proposal has as yet not been accepted by the international community.

Although it is accepted that cattle were domesticated around 2100 BC in the Middle East and migrated south with the tribes that kept them (reaching the area presently known as South Africa around 700 AD), much of this knowledge is based on what is assumed to be true of the migrations of people. As our knowledge of preliterate times expands through archeological findings, it is likely that the history of these earlier times will be overturned (Duminy & Guest, 1989) and, because it is assumed that cattle migrated with the people, assumptions concerning cattle migrations might have to be revised as well. It is commonly accepted that cattle were present in large numbers along the south-east African coast and the immediate interior by the 17th century, based on diaries kept by sailors passing these coasts at that time.

The recorded history of the Nguni cattle starts in the period spanning the last years of the previous century and including the first decade of the 20th century. Sir Arnold Theiler sent a number of cattle skulls to Germany for craniological study (Curson & Thornton, 1936), the results of which appeared as a thesis in 1911. This was the first effort to characterise indigenous cattle in South Africa. Curson & Thornton (1936) and Bisschop (1937), did pioneering work in bringing the Nguni cattle, which were considered inferior to European breeds, to the attention of scientists and farmers through publications and talks presented at shows and farmers' days. Kars (1993) stated that South African legislation of the 1930s was so negative towards the Nguni, that bulls showing signs of Nguni characteristics were condemned. Fortunately for the Nguni cattle, the legislation did not apply in the traditional Zulu areas. It was only in 1950 that the government appointed a committee (Bonsma *et al.*, 1951) to investigate the nature, numbers, desirability and means of preserving indigenous livestock. The preservation of Nguni cattle was assisted by the efforts of some far-sighted scientists who started a nucleus herd in 1931. Following recommendations contained in the report of the Committee (Bonsma *et al.*, 1951), the Bartlow Combine Nguni Cattle Breeding Station was established in 1954, and the Bartlow herd, which played a significant role as a foundation to the breed in southern Africa (Kars, 1993), found a home. The Ogwini Nguni cattle were purchased by the South African Development Trust and, after being kept at the Ntambanana group of farms for a time, were donated to the Department of Agriculture and Forestry of the KwaZulu Government Service in March 1993 (Development and Management Plan, 1994) and moved to OSCA.

Gene conservation

The late Dr Geoff Harwin reasoned that a preoccupation with high absolute production levels coaxed breeders beyond the bounds of functionally efficient cattle, and that genetic resources should be matched to the production situation (Harwin, 1989). All too often, goals are set well beyond the physiological bounds possible, given the breed of cattle involved, under the relevant

environmental conditions. Referring to developing countries, Cunningham (1993) is of the opinion that realistic and objective breeding goals are rarely set with the result that breed improvement schemes have mistaken objectives which are totally inappropriate. Hodges (1984) stated that those who keep breeds for profit, are narrowing the genetic base to a relatively few, highly selected top-performing animals. This trend must be evaluated in the light of the known fact (Warwick & Legates, 1979) that genetic variation is one of the essential ingredients that makes genetic change possible and provides the major means for adaptation to changing environmental conditions. From this it can be concluded that where financial gain is the norm when a gene pool is kept, so-called 'strict selection' is apt to lead to a breed of animal which is limited in its ability to adapt to new conditions and changing demands, especially in closed breeding herds. Although such in-bred lines are suited to the exploitation of heterosis, their buffer capacity to stress is affected (Rauw *et al.*, 1998). A disturbing trend is the increase in negative side effects, including behavioural, physiological and immunological problems, which have been detected in animals selected for high production efficiency (Rauw *et al.*, 1998).

In the past, the Bartlow Combine and Ogwini herds were run with the emphasis in selection placed on goals considered important for commercial cattle production, mainly 205-day weaning weights. Such goals cannot be ignored nor their implementation criticised. However, Maijala *et al.* (1984) concluded that it is important that genes are preserved for future production requirements, some of which could appear non-essential for present circumstances. Furthermore, Maijala *et al.* (1984) state that breeds must be preserved for adequate evaluation because each breed may contain unique and valuable genes not found in other breeds. Rapidly developing new techniques will increase in the near future and it is possible that molecular technologies (Rauw *et al.*, 1998) will increase the accuracy of selecting for such genes. Retaining genes in gene pools where production is not the norm is a form of insurance which makes it less risky for managers of production herds to concentrate on narrow, goal-orientated objectives. Unless such gene pool conservation herds are run with a stable source of funding which is not profit orientated, it is difficult to visualise adequate finances emanating from private organisations to maintain gene pool conservation herds without bias towards practices that have been shown to reduce genetic variation.

Cattle numbers

A survey conducted in 1984 (Minutes of Committee Investigating a Gene Bank for Farm Animals, 1985), showed that there were 750 breeding females in the Bartlow Combine herd, with a further 72 breeding females in the Ogwini herd. In June 1996, there were 423 breeding females in the Bartlow Combine herd, with a further 143 breeding females in the Ogwini herd and there were in the order of 12 000 Nguni cattle registered with the Nguni Cattle Breeders' Society of South Africa (pers. comm. — Secretary of the Nguni Cattle Breeders' Society, 1996).

Maijala *et al.* (1984) were of the opinion that cattle breeds in which numbers are less than 1 000 should be considered endangered. Based on their criteria, Maijala *et al.* (1984) found that in all the populations of cattle, sheep, goats and pigs in Europe, there were 241 endangered populations, with cattle and sheep populations occupying the highest positions on the endangered list.

Based on the opinion of Maijala *et al.* (1984) and the number of cattle registered with the Nguni Cattle Breeders' Society, the likelihood that the Nguni cattle are endangered appears to be very small. However, should the Nguni Cattle Breeders' Society apply 'strict selection' criteria which are unrealistic or inappropriate, and in this way narrow the gene pool, then the need for a herd where gene conservation is practised is essential. Furthermore, the Department's Nguni cattle herds will have to be increased to include at least 1 000 breeding cows if this population is to be considered no longer endangered, according to the criterium used by Maijala *et al.* (1984).

Breeding goals

With reference to cattle breeding it has been stated that differences between breeders and geneticists are mostly about aims, less about methods and not at all about theory (Lerner & Donald, 1966) and setting breeding goals is the first step in animal breeding. If the goal for the conservation of the Nguni breed of cattle is to retain its character as a breed suitable as a mother line to promote maternal characteristics and fertility suitable for communal and commercial farming practices, certain traits must be retained. Thus, selection for maternal breeding values and not direct breeding values for 205-day weight should have been made. The opposite happened at Bartlow Combine. An examination of the data presented by Kars (1993) over a period of 31 years, indicates that the result of the selection applied was improvement in direct breeding values for 205-day weight, whereas the maternal breeding values for 205-day weight remained relatively constant (Figure 1). It is noteworthy that there is a negative genetic correlation ($r = -0.389$; Kars, 1993) between these two traits. It is concluded from this data that the cows of the Bartlow Combine herd would produce weaners with the potential to have a higher 205-day weight, whereas their dams have not improved genetically for this trait, which would place more stress on these cows if run under sub-optimal conditions. These dams would also not be suitable for use as a dam line in commercial farming because even if their calves had the genetic potential to wean at higher weights, the dam's poor mothering ability would place a ceiling on weaning weights. However, the estimate of total heritability and the genetic correlation between the direct and maternal components for 205-day weight suggest that a response to selection can be obtained if both direct and maternal breeding values are considered in a

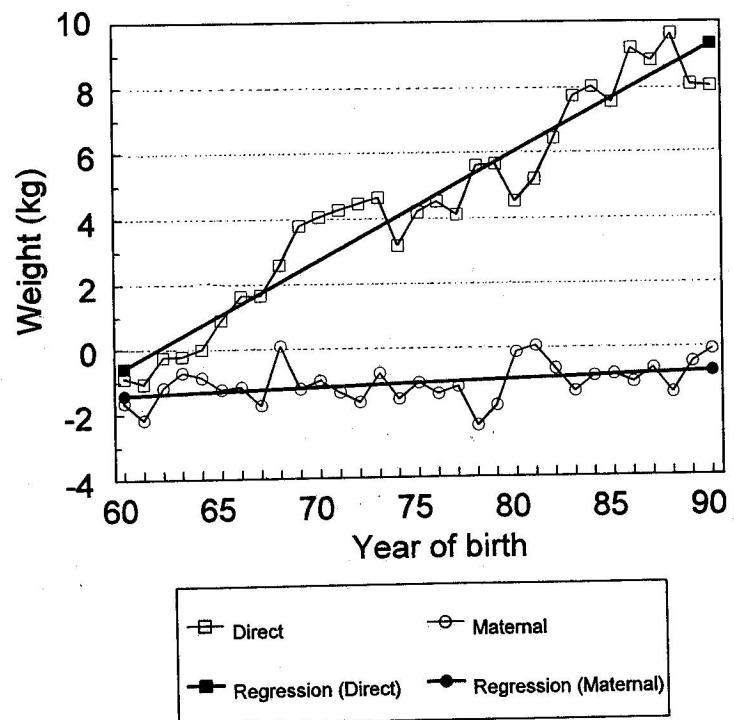


Figure 1 Annual mean direct and maternal breeding values and linear regressions on year of birth for 205-day weight in the Bartlow Combine Nguni herd.

selection program (Kars, 1993). The fact that there has been a genetic change i.e. a change in genes associated with weaning weight, it can be stated that the Bartlow Combine and Ogwini cows, although they were registered as stud Nguni animals, are no longer 'typical' Nguni, if such an animal did exist. Changing a gene-pool is not concomitant with gene preservation.

It was therefore concluded that breeding goals are needed, for example the promotion of a mother line breed by selection for maternal breeding values, could be desirable. Furthermore, it is essential that breeding goals are appropriate and realistic (Cunningham, 1993). Rauw *et al.*, (1998) stated that in future, livestock breeders will have to be satisfied with slower increases in production in order to avoid concomitant increases in stress which in turn impacts negatively on production. They suggest that a fundamental solution is to redefine breeding goals into broader perspectives e.g. selection for long reproductive life at optimal economical gain rather than maximising production to a level where the negative effects of stress result in financial losses. With new techniques (BLUP and molecular genetics) at the disposal of livestock breeders (Rauw *et al.*, 1998), mistakes inadvertently made in the past should be avoidable.

The time factor

An important consideration in breeding is the time span over which genetic change takes place (Warwick & Legates, 1979). In the case of the Bartlow Combine cattle, reliable data is available for evaluation dating back to 1960. This is valuable data which can be used as a basis of continued study of Nguni cattle and as a means to learn from past mistakes. Effective use of this data should serve as a means to eliminate genetic defects from the herd and form the basis of recommendations for suitable management practices for Nguni cattle in relation to the relevant environmental conditions.

Environmental factors

Breeding cannot be divorced from environmental factors. Thus, running the Bartlow Combine Nguni herd in an area where the environment is harsh and which is comparable to many communal farming areas in KwaZulu, is desirable. On the other hand, where gene conservation herds are run under environmental conditions which result in a loss of desirable genes, the continued existence of such herds and the particular genes present in these herds, is not assured. In the case of the Bartlow Combine herd, the environmental values for 205-day weight were just below 150 kg between 1960 and 1965, increased to a peak of 160 kg in 1980, where after there was a relatively sharp decline in weaning weights (Figure 2; Kars, 1993). These environmental and phenotypic trends at Bartlow Combine indicate a deterioration of the environmental conditions. It is therefore necessary that aspects such as veld management practices and water provision are investigated to determine the cause of the problem and form the basis for appropriate corrective measures.

Gene preservation

Frozen semen, embryos and live animals are at present the known and feasible methods to preserve cattle genes and must form part of the present conservation program.

Storing frozen semen should receive priority because it is a cheap, safe and quick storage method. However, certain criticisms of this method have been raised, specifically questions pertaining to which attributes are important for the selection of sires whose semen will be stored. It is also a fact that with this storage method the genes can only be released by inseminating a cow with the relevant semen. Enough semen must therefore be stored to provide a representative sample of viable progeny, keeping in mind that half the genes in the resulting progeny will not be from the stored

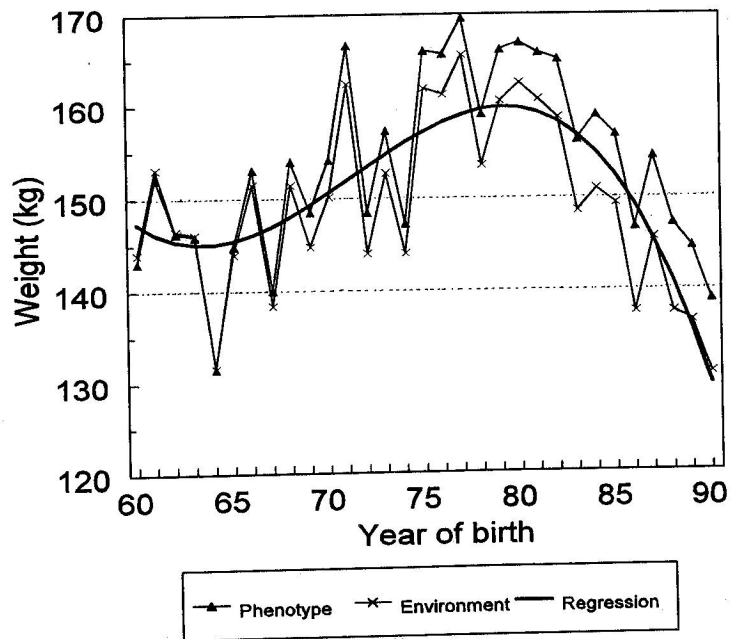


Figure 2 Annual mean phenotypic and environmental values and cubic regression of environmental values on year of birth for 205-day weight in the Bartlow Combine Nguni herd.

semen (Simon, 1984).

Problems associated with embryo storage for gene conservation, also include factors related to identifying suitable genes and deciding which genes should be kept. An advantage of embryo storage in comparison to semen storage, is that the resulting progeny will comprise a complete set of preserved genes.

Retaining genes within functional herds is fraught with problems, most of them related to interference by people, creating bias. Professor Price stated in 1933 (Warwick & Legates, 1979) that breeding is an art, to be learned only by practice, but knowledge of principles supplies the only firm foundation for its practice. This statement is as true today as it was 60 years ago, primarily because of the multiplicity of attributes demanded by changing market demands and fads, as well as the ever changing opinions of so-called 'experts' and selection criteria used by breed societies, not to mention the unpredictable demands of commercial cattle producers.

The major advantage of keeping genes in functional herds is the opportunity to monitor traits continually within the relevant herds in relation to changing environmental circumstances.

Simon (1984) put forward the following list of reasons why conservation is necessary:

1. Based on Robertson's (Robertson, 1960) theory that in breeding a selection plateau will be reached sooner or later, there is a need for preserved breeding populations from which genes can be obtained when genetic improvement appears to show signs of flagging.
2. Breeds now in danger may be better suited for future requirements.
3. The retention of genetic variation is essential, especially with extensive animal production under stressful environmental situations where adaptation to the relevant environments becomes a high priority (Rognoni, 1980). Animals must be continuously tested for their use in breeding systems

commonly employed in such harsh environments (Cunningham, 1980).

4. Bowman & Aindow (1973) stated that there is a need to continue our study of all aspects of animal biology in order to provide answers to questions which will allow a better understanding of selection principles.
5. There are cultural and educational reasons to retain breeds for future generations.

Suitability

The suitability of the Nguni breed of cattle in terms of ability to produce and reproduce under harsh environmental conditions (Barnard & Venter, 1983; Scholtz, 1988) and its tolerance of endemic tick-borne diseases (Spickett & Scholtz, 1985) has been demonstrated. These attributes are valuable for cattle breeds to be used in sub-tropical environments in places where management could be sub-optimal. Management practices must include development of these characters.

Costs

Smith (1984) points out that continuous improvement in current breeds may make it increasingly difficult for conserved populations to compete, unless there is a reversal in breeding goals. However, he states that the returns from retaining genetic diversity may be large, whereas the costs of conserving genes, if properly planned and implemented, are trivial in comparison.

Conclusions

There is a demand for Nguni cattle as cows for commercial purposes and bulls are bought regularly at auctions. Furthermore, there is a need to provide breeding material for use by small-scale farmers, as well as by commercial farmers. Where the profit motive plays a role, it is likely that selection will take place and, because small-scale farmers will in all probability become the commercial producers of the future, it is likely that selection criteria will have to be adapted in order to satisfy changing needs and ensure that appropriate goals are striven for.

Maintenance of Nguni cattle should not be the sole means of conserving a Nguni gene pool. Semen must be collected from selected bulls and embryos obtained from each generation of cows for storage and periodic re-introduction of the relevant genes into the gene-pool. These steps will reduce the loss of genes from the gene pool and assist in maintaining genetic variation. Should it appear that past management has excessively narrowed the gene pool, leading to inbreeding problems and a loss of genetic variation, bulls will have to be bought in, preferably from communal areas where there is evidence that the local genetic resources are relatively pure. Many Nguni cattle that are phenotypically very pure, have been seen by both authors, especially in the far northern parts of KwaZulu-Natal.

Considering the need to finance gene conservation from an unbiased source, the stated objective of the KwaZulu-Natal Department of Agriculture to maintain the Nguni cattle at Bartlow Combine and OSCA must be commended. This is in the interests of the people of South Africa, particularly small-scale farmers, and could contribute to cattle improvement in other parts of Africa where similar environmental conditions are experienced and where, as has happened in Maputu (pers. comm Dr Pierre Ronchietto), human conflict has resulted in the destruction of local cattle breeds. The ability of the herds to fulfill this role will be subject to improvement of environmental factors i.e. resource management.

Preservation is to 'keep alive', but includes the connotation that the preserved item is for the use of a certain person or persons alone (Concise Oxford Dictionary, 1990). On the other hand, conservation is to 'keep from harm, with a view to later use'. The term conservation therefore seems more

appropriate in the context of gene pool maintenance and the statement that 'preservation without utilization is a waste' (Rege, 1993), highlights the fact that utilisation is an essential part of keeping from harm.

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Prediction of cattle performance on Coastcross 2 at different fertilizer and stocking rates

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The performance of young cattle, grazing Coastcross 2 (a cynodon hybrid) was studied at two sites in the Eastern Cape (Republic of South Africa). The rainfall and the fertilization rates at the two sites differed. Three stocking rates were applied at each site. Animal weight gains per hectare are related to initial weight, rainfall and nitrogen fertilization rate. The results indicate a regression model to describe a suitable stocking rate and weight gains per hectare with a given nitrogen fertilization rate, rainfall pattern and initial body weight. The difference between economic responses and animal performance are mentioned, and in this case the best economic response was achieved at a lower stocking rate than needed for optimum weight gains per hectare.

Die prestasie van jong beeste wat Coastcross 2 ('n cynodon baster) bewei het is op twee lokaliteite in die Oos-Kaap ondersoek. Die reënval en bemesting het by die terreine verskil. Drie veeladings is by elke terrein toegepas. Massatoenames is met aanvangsmassas, reënval en stikstofbemestingspeil in verband gebring. Die resultate dui op 'n regressiemodel om 'n geskikte veelading en massatoename per hektaar te skat met 'n bepaalde bemestingspeil, reënvalpatroon en aanvangsmassa. Die verskil tussen ekonomiese reaksies en diereprestasie word genoem, en in hierdie geval is die beste ekonomiese resultate by 'n laer veelading as die wat die hoogste massatoename per hektaar gelever het, verkry.

Keywords: Cynodon, summer pasture, fertilizer level, animal performance

Introduction

Coastcross 2 is a cynodon hybrid which constitutes 8 000 ha of the 36 000 ha of cultivated pastures in the Bathurst (Eastern Cape, Republic of South Africa) area. It has the local reputation of being more drought-tolerant than *Pennisetum clandestinum* (kikuyu grass), an important advantage in the area. In view of the popularity of this grass among farmers, and the absence of locally generated research results to guide advisers, it was decided to study the performance of young cattle grazing Coastcross 2. After the trial had been conducted for a number of years, and expanded to another site, the opportunity arose to investigate the effect of rainfall, nitrogenous fertilizer and initial animal weight on weight gains per hectare. If gain/ha could be described by these factors, it would be very useful for advisers and an important advance on the model of Bransby (1984), who described production in terms of rainfall only.

Procedure

The trial was conducted at two sites, the Bathurst Research Station (33°30'S; 26°50'E) (1986–1994) and on the farm Boslaagte (33°45'S; 25°55'E) (1990–1994). Both sites are frost free, but Bathurst (714 mm