Preliminary study on the validation of a traditional method of estimating parity in cow using horns growth rings.

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Abstract: Small scale farmers around North West Province in South Africa have for a very long time maintained and relied on traditional method of estimating parity in horned cows using the counting of growth rings. The determination of number of parity of cow in rural areas where farmers do not keep record is always a challenge for animal health practitioners as well as buyers at auctions. The main objective of this research was to test the reliability and validate the method of counting growth rings on horns of cows to estimate parity using comparisons with parity figures acquired from stock owner. This study has validated the traditional method of estimating parity in horned cow using growth rings on horns by using 122 cows, 65 for mixed breed and 57 Afrikaner cows of same sex. Results obtained indicated significant and regular variations in horn growth rings in relation to parity. This is an important tool to measure number of parity in cows where records are not kept by animal health practitioners as well as farmers.

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1. Introduction

Parity of the cow over a period of time is an important parameter of production efficiency. The approximate age of cows in years is equal to number of horn growth rings (HGRs) (Poespo, 1986; Propta, 1991). It may be obtained through recording but a measure of parity where records do not exist would be a valuable management tool (Jelantik, 2001). Parity estimation is often useful as part of guidelines guiding buyers prior to purchases of cows. However, owing to the often lack of records among subsistence farmers on obvious proneness of records to manipulation by sellers, buyers have often had to rely on traditional growth rings counting.

Horns are the pairs of hard, bonelike, permanent growths projecting from the heads of cattle. They grow from a unique area of skin cells at the base of the horn. At about two months of age, horns become attached to the frontal bone of the skull. The first growth ring (annulus) is laid down at approximately 1.5 years of age, and each additional ring is added every following winter, so by adding 1 to the number of growth rings on the adult horn will result in a close range of age for the animal. In a few animals with horns, these periods of growth are readily seen and counted. Males grow a longer first annulus than do females, thus their horns are always longer than those of the females (Bunnell, 1980). From the age of two years growth ring appear each year and an alternative method of estimating an animal's age is to count the rings on the animal's horn (Rudge, 1972). Much of the horn growth in cows occurs in early years; after 6-7 years, it slows so much that differentiating new horn rings becomes very difficult and thus less useful means to determine age in old animals (Elbroch, 2006). Small nubbins of a bison are counted up to about six months. A full curve in the horns at three years, with growth rings over three years. After the age of three, the next years start adding growth rings to the horns. Spacing between growth rings nearly varies and may have to do with nutrition. Generally after the first one or two, the rings get closer together and harder to count. (Patricia, 1990). It is important to mention that horn rings growths are influenced either by climatic conditions or hormones (O' Gara and Matson, 1975; Jacobson et al., 2004). For example wild ruminants like the European mouflon (*Ovis orientalis musimon*) and the Spanish ibex (*Capra pyrenaica hispanica*) have been found to attain maximum annual horn development just before the onset of the breeding season (Lincoln, 1998). It has been suggested that low testosterone levels throughout the sexually inactive period are required to promote male-type horn growth, but high testosterone levels prior to the rut inhibit this growth (Lincoln, 1994; 1998). Horns growth can be of value to wildlife veterinarians and managers for several reasons for one reason, individuals can be aged by counting the horn rings or annuli that develop each year (Bunnell, 1980;

Jelantik, 2001). However, with long-lived individuals, it is usually easier for age males than females. After about 4-5 years of age female horns grow very little, probably because of reproductive costs, so their horn rings become very crowded and hard to distinguish. In males, the first two years or more of horn growth can be lost to "brooming" or breakage of the horn tips during fighting, making precise aging problematic in older animals. (Krausman and Shackleton, 2000).

Another method which has been used to determine the age using growth rings was used in trees. Growth rings may be formed annually, biannually or irregularly in tropical trees, with a small group designated as continuously growing and without growing rings (Tomlinson and Longman, 1981). The same author, however, had noted that there is no difference in growth rate between the left and right horns. Variations in size and spacing of horns as well as clarity of horn rings have also been observed (Villegas, 1970; Cockrill, 1974), not only in relation to age but also to sex (Dyce et al., 1987) and breed (Sission and Grossman, 1975; Limcumpao, 1983; Dyce et al., 1987). The validity of traditional method of counting growth rings on horns in cows has never been subjected to scientific validation despite its common use among small scale farmers. Method validation is the process used to confirm that a given procedure employed for a specific test is suitable for its intended use and is expected before the test can be introduced or recommended for routine use. Result from the method validation can be used to judge the quality; reliability and consistency of its result. The objective of the present study is therefore to test the reliability of the method of counting horn growth rings to estimate parity in cows using comparisons with parity figures acquired from stock owners.

2. Material and Methods

Hundred and twenty two (122), horned cows of various breeds and husbandry were randomly selected for this study. Sixty five (65) cows were used for the experiment and fifty seven (57) for control. Both the left and right horns of each were observed. Growth rings were counted starting from the base of the horns and the counts entered on to records bearing the owners details, cow signalment and production history. Control data were obtained from Riekertskraal district using a parallel blind exercise conducted to obtain parity figures of all selected cows from farm where owner kept all records of parity and cows were not dehorned.

Statistical Analysis

Data obtained in this study were analyzed using SAS Software version 9.3 (TS1M0). A one way ANOVA was used to analyze the correlation of the parity and number of rings. Linear regressions were used to correlate parity with number of horn growth rings. The reference probability used throughout was $P \leq 0.05$.

3. Results

Results obtained in this study from observed experimental and control animals are summarized in tables 1 and 2 and detailed in tables 3 and 4.

Table1. Summary data of cow's parity vs horn growth rings obtained from the owner via interview.

Number of cow's parity	Number of cow's horn growth rings	Total cow (%)
1-2	0-3	41
3-4	4-5	19
5-6	≥6	5

Table 2. Summary of control data of randomly selected cow's parity vs horn growth rings obtained from a farmer with valid records**.**

Parity	Horn growth rings	Total cows
1 - 2	0 - 2	31
3 - 4	3	26
5 - 6	0	0

From the obtained results it was observed that cows with recorded parity between 1 and 2 had numbers horns growth rings varying between 0 and 3 while cows with 3 to 4 parities had horn growth rings, between 3 and 4. Cows with the number of parity between 5 and more had up to 6 horn growth rings (Tables 1 and 2). These results are in line with results obtained using a certified farm on which animal's horns was not cut and all parities recorded (Tables 3 and 4).

Table 3. Detailed of mixed female cow parity vs horn growth rings obtained from the farmers via interview

Owner's ID	N^{O}	Farm address (Locally/Village)	Est. Age	Estimated Weight	N^{o} of rings	Given parity
Farm 1	1	Lokaleng	1	194	3	1
	2	Lokaleng	3	190	2	1
	3	Lokaleng	1	200	4	3
	4	Lokaleng	6	200	4	4
	5	Lokaleng	1	210	4	3
	6	Lokaleng	1	220	2	1
	7	Lokaleng	3	200	5	5
	8	Lokaleng	2	220	3	4
	9	Lokaleng	1	190	4	3

	10	Lokaleng	2	180	3	2
	11	Lokaleng	7	220	7	5
Farm 2	12	Lokaleng	1	195	3	3
	13	Lokaleng	2	230	3	3
	14	Lokaleng	1	210	3	1
	15	Lokaleng	2	240	2	1
	16	Lokaleng	4	200	2	2
	17	Lokaleng	1	200	2	3
	18	Lokaleng	1	210	3	1
	19	Lokaleng	1	220	3	2
Farm 3	20	Lokaleng	2	195	1	1
	21	Lokaleng	2	196	1	1
	22	Lokaleng	1	200	3	3
	23	Lokaleng	1	200	0	1
	24	Lokaleng	8	240	6	6
	25	Lokaleng	4	190	2	2
Farm 4	26	Lokaleng	1	250	3	3
	27	Lokaleng	2	240	2	2
	28	Lokaleng	2	230	1	1
Farm 5	29	Lokaleng	1	235	1	1
	30	Lokaleng	4	241	2	2
	31	Lokaleng	6	246	5	4
	32	Lokaleng	4	191	4	2
Farm 6	33	Lokaleng	3	245	3	2
	34	Lokaleng	4	244	4	2
	35	Lokaleng	1	250	1	1
Farm 7	36	Lokaleng	2	245	4	4
	37	Lokaleng	2	255	2	2
Farm 8	38	Lokaleng	3	265	3	3
	39	Lokaleng	1	258	1	1
Farm 9	40	Lokaleng	1	254	1	1
Farm 10	41	Lokaleng	6	246	6	6
Farm 11	42	Lokaleng	2	248	2	2
Farm 12	43	Lokaleng	1	254	3	1
Farm 13	44	Lokaleng	3	259	1	3
	45	Lokaleng	1	251	1	1
Farm 14	46	Lokaleng	2	260	4	2
Farm 15	47	Lokaleng	3	262	2	3
	48	Lokaleng	3	250	4	3
Farm 16	49	Tlapeng	1	260	3	1
	50		1	270	2	1
	51		1	262	2	1
	52		1	259	1	1
	53		3	270	3	3
	54		2	234	2	2
Farm 17	55	Tlapeng	4	250	3	4
Farm 18	56	Madibe,Ga-kubu	3	262	3	3
	57		2	260	3	2
	58		5	258	3	5
	59		4	261	2	4
	60		1	258	2	1
	61		1	198	1	1
	62		3	200	4	3
	63		2	210	4	2
	64		2	250	3	2
	65		1	262	1	1

N^{o}= Cow's number

Table 4. Detailed control data of randomly selected Afrikaner cow with known and recorded parity vs horn growth rings obtained from a farm with complete records.

Animal ID	N° of rings	Parity
08/1126	2	2
08/1032	2	2
08/1146	2	2
08/1033	2	2
08/1130	1	2
08/1140	2	2
08/1039	2	2
08/1034	0	2
08/1153	2	2
08/1041	2	2
08/1048	2	1
08/1054	2	2
08/1035	2	1
08/1027	1	2
08/1036	2	1
08/1137	2	2
08/1156	3	3
08/1143	2	2
08/1151	3	3
08/1142	1	2
2009/11/04	1	1
08/1150	2	2
08/1012	2	2
09/1052	1	0
08/1002	1	2
07/111	3	3
07/1103	3	3
07/1101	3	2
07/1106	3	3
08/1123	2	2
07/1122	3	2
07/1113	3	2
07/1107	3	3
08/1117	2	2
07/1024	3	3
08/1115	2	2
09/1004	1	1
07/1121	3	3
07/1039	3	3
07/1025	3	3
07/1128	3	3
07/1119	3	3
07/1010	2	2
08/1129	2	2
07/1138	3	3
07/1049	3	2
07/1147	3	3
07/1108	3	2
07/1105	3	3
07/1020	3	3
07/1109	3	3
07/1118	3	3
07/1045	3	3
07/1011	3	3
07/1155	3	2
07/104	2	3
07/1131	2	3

4. Discussions

Statistical analysis have confirmed these findings as the coefficient of correlation of the experiment results was R = 0.5328 (P <0.0001), while that of the control results was R = 0.4414 (P<0.0001) (Figure 1). Furthermore, the linear regression model showed that there is a direct correlation between the number of horn rings and the parity. The linear regression indicated 95% confidence between parity and horn growth rings. From this study it was found that predicted parity or horn growth ring number could be obtained knowing one of the parameters by using the formula below;

EXPERIMENT	y = 0. 85769 + 0.61154 (x)
CONTROL	y = 0.39207 + 0.70913 (x)

Where Y is the parity and X is the number of horn rings. The slight difference noted between the study results as compared to the control might be explained by the fact that data obtained for the study were not 100% accurate. Among the influencing factors are the absences of recorded data from farmers on cow parity while most data obtained were based on estimations. In addition, abortions mostly early and also late caused by non-infectious or infectious causes (Merck, 2005) might have happened on the farm and no records were kept and remained unnoticed by the farmer. Contrasting reports have been made regarding the accuracy of the horn ring method in determining age. Cockrill (1974) and Rudge (1972) had reported that horns are unreliable indicators of age due to pronounced sexual dimorphism; inconsistent ring formation of double rings; failure of horns to grow for several years; omission of growth of horn rings in some years; and lack of sharp seasonal variation in climate and food supply. The finding of this study are in agreement with the results obtained by Jermais et al. (2010) who in their study on the determination of parity of Bali cattle (*Bos sondaicus*) cows in West Timor, Indonesia Based also found similar results. The difference seen between their results as compared to this study might be explained by the factors mentioned above such as climatic conditions, cattle breed, feeding and farming system. As mentioned in this study mixed breed were used while in their study Bali Cattle were used. In addition Indonesia is a tropical and forest country with rich vegetation and feed for animals while this study was done in a semi-arid area (Mafikeng) with high temperatures and low rain falls and lack of sufficient grass for animal grazing. Other factors which could have influenced the results between the study and the control are that sampled animals for the study were cross breed while the control animals were pure Afrikaner breed. In addition, variations in size and spacing of horns as

well as clarity of horn rings have also been observed (Villegas, 1970; Cockrill, 1974), not only in relation to age but also to sex (Dyce et al., 1987) and breed (Sission and Grossman, 1975; Limcumpao, 1983; Dyce et al., 1987). It is important to mention that other factors such as climatic conditions might have influence on the appearance or not of horn growth rings. This has not yet been proven however Jacobson et al. (2004) confirmed that climatic conditions such as winter or summer might have influence on the quality of horns.

Results obtained from this study may not be applied to other species because of late or absence of growth of horns in other female species such as sheep (Elbroch, 2006).

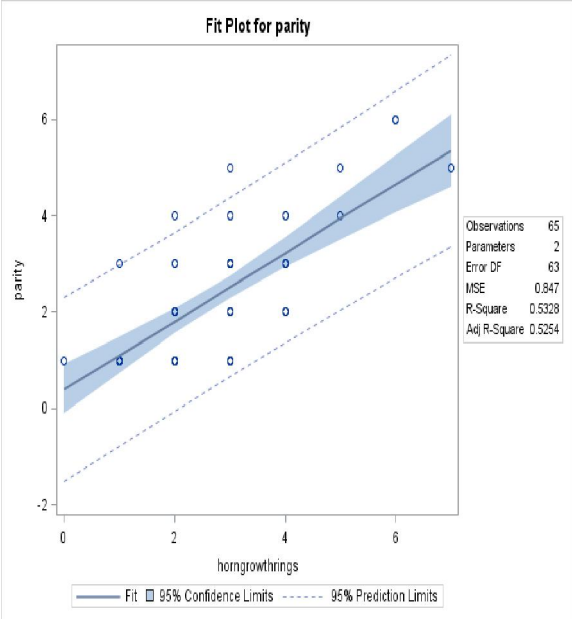

Figure1 Fit plot for parity vs horn growth rings with R^2 = 05328

This study has validated a traditional method of estimating cow's parity by comparing horn growth rings using 65 randomly selected horn cows of mixed breeds and 57 Afrikaner breed cows taken from the record keeping farmer and the number of rings. Results obtained agreed with the one of other studies done in Indonesia and has shown it's novelty which will be a tool for farmers, animal health technicians veterinarian on the estimation of parity by reading the numbers of horn growth rings mostly on farms or auctions when there is no availability records. It is therefore conclude that parity and horn growth rings method can be used to validate a traditional method of estimating parity in horned cow using growth rings on horns.

Conclusion

This study has validated a traditional method of estimating cow's parity by comparing horn growth rings using 65 randomly selected horn cows of mixed breeds and 57 Afrikaner breed cows taken from the record keeping farmer and the number of rings. Results obtained agreed with the one of other studies done in Indonesia and has shown it's novelty which will be a tool for farmers, animal health technicians or veterinarian on the estimation of parity by reading the numbers of horn growth rings mostly on farms or auctions when there is no availability records. It is therefore conclude that parity and horn growth rings method can be used to validate a traditional method of estimating parity in horned cow using growth rings on horns.

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