New and Not-So-New Concepts in Bull Evaluation and Management

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Introduction

Bulls vary greatly in their reproductive capabilities. This variation can have a marked effect on overall pregnancy rates as well as on the time period required for pregnancies to be achieved. This, in turn, affects weaning weights. Apart from disease, injury, or physical obstacles in the breeding pasture, this variation is due to one or more of three factors: a) semen quality and/or quantity; b) sex-drive (libido) and mating ability; and c) social interactions between animals.

Seminal Characteristics

Male fertility is influenced by a number of different factors of which seminal quality is but one. Consequently, the difficulty encountered in trying to predict reproductive performance from a single seminal characteristic (or even ejaculate) is not surprising. Various scoring systems, employing different criteria, have been used to aid in fertility prognosis in bulls. Carroll, et al. (1963), used one such system to assess 10,940 bulls and found 85.1% to be satisfactory, 10.7% questionable and 4.2% unsatisfactory. Wiltbank, et al. (1965), used similar assessment procedures to determine the relationships between spermatozoal motility and morphology of bulls and their subsequent breeding performance. These authors concluded that the average fertility of a group of bulls could be predicted with some accuracy but the prediction of individual bull fertility was subject to error.

Recently the Society for Theriogenology revised their breeding soundness examination (BSE) criteria for bulls. The new score is composed of scrotal circumference (≤40%), spermatozoal morphology (≤40%) and spermatozoal motility (≤20%). Both spermatozoal concentration and live/dead assessments have been deleted from the revised scoring system.

There was a need for the revised assessment procedures to be tested against the actual reproductive performance of bulls. Estrus synchronization provided a tool to do this. Bulls could be assessed, placed with different numbers of synchronized females, and be continuously observed through the mating period. In addition, with the aid of accurate palpation 30-60 days after the trials, assessment results could be related to the pregnancy rates achieved by the bulls during the trial period. In 1976 and 1977 eight such trials were conducted employing a total of 43 bulls and 1032 females.

Prior to each trial, the bulls received a breeding soundness examination (BSE) and a final score was calculated by the system recommended by the Society for Theriogenology (1976). In addition, each bull was given two tests for libido and serving capacity (Chenoweth, et al., 1977).

The heifers were treated with a 9-day ear implant regime (Syncro-Mate-B supplied by G.D. Searle and Co.). Approximately 27 hours after implant removal, bulls were placed with heifers in pens and observed continuously for the next 30-42 hours. All mounts, services and abnormal behavior exhibited by the bulls were recorded. Each bull remained with the original group of heifers with which he was placed for at least 96 hours. BFR's (bull-to-female ratios) tested with synchronized heifers were: 1:10, 1:15, 1:20, 1:25, 1:30, 1:35, and 2:40. Synchronization and service rates are shown in Table 1.

Approximately 95% of all treated females were observed exhibiting estrus during the synchronized period (Table 1). The bulls serviced an average 76.5% (33.3% to 100%) of those heifers observed in estrus. The overall pregnancy rate for those females observed

Table 1
Synchronization* and Service Rates
in Treated Females in Natural Breeding
Period (30 hrs. or 42** hrs.)

Trial No.	No. of females	No. (%) exhibiting estrus	No. (%) serviced of those in estrus
1	50	44 (88.0)	-
2	50	48 (96.0)	38 (83.3)
3	50	47 (94.0)	44 (93.6)
4	50	49 (98.0)	39 (79.6)
5	100	92 (92.9)	63 (68.5)
6	80	73 (91.3)	62 (84.9)
7	111	107 (99.1)	92 (86.0)
8	273	276 (97.1)	183 (76.5)
Total	764	725 (94.9)	521 (76.5)

*Slight discrepancies in numbers due to deaths, missing animals, etc.
**In Trial b, lactating females were observed for 42 hours.

to be serviced was 49.1% (34.9% to 78.9%). The overall proportion of heifers that became pregnant by individual bulls ranged from 5.5% to 100%.

Significant correlations ($P<0.05$) were observed between the pregnancy rates achieved by bulls and their scrotal circumference, spermatozoal motility and abnormal morphology ($r = 0.58$, 0.47, and -0.40, respectively) (Table 2).

Table 2
Correlations Between Bull BSE Values and Pregnancy Rates Achieved with Synchronized Females in 30- or 42-Hour Period

Category	Correlation (r) w/pregnancy rate
BSE Score	.33
Scrotal Circumference	.58*
Percent (%) Motility	.47*
Rate of Motility	.38
Primary Abnormalities	-.12
Secondary Abnormalities	-.37
Total Abnormalities	-.40*

*$P<0.05$

Pregnancy rates achieved by bulls of questionable or satisfactory BSE categories are shown in Table 3. The difference was not significant.

These results indicated that the revised assessment procedures were of value in predicting the breeding potential of bulls. The three criteria (scrotal circumference, spermatozoal motility and spermatozoal morphology) employed in the new scoring system recommended by the Society for Theriogenology were significantly correlated with the pregnancy rates achieved by bulls in natural service under *stressed* conditions. Although the composite BSE score did not show a significant relationship with pregnancy rate in these trials, it should be noted that the range of BSE scores in the bulls employed in this study (44-100) was restricted.

Table 3
Pregnancy Rates in Synchronized Females Serviced by Bulls of Questionable or Satisfactory BSE Categories in 30- or 42-Hour Period

BSE Category & Range of Scores	Number of Bulls*	% Females Pregnant
Questionable (44-58)	8	43.15
Satisfactory (60-100)	17	53.62

*Bulls used in 2:40 BFR's not represented.

However, it is considered that greater accuracy in bull assessment would be achieved if the BSE scoring system is not used as a quantitative prediction of bull reproductive performance; rather it should be employed as an aid to place bulls in satisfactory, questionable or unsatisfactory prospective breeder categories.

Finally, in this discussion of the relative value of the different breeding soundness components, mention should be made of an important genetic consideration. Brinks, et al. (1978), reported significant favorable estimated correlations between age at puberty in heifers and some BSE components in their half-sib brothers (Table 4).

This would seem to indicate that young bulls with above-average scrotal circumference and spermatozoal morphology should produce heifers with an earlier inherent age at puberty.

Sex-Drive (Libido) and Mating Ability

Table 5 shows the estrus detection and pregnancy rates achieved by bulls employed at different bull-to-female ratios (BFR's) in 21-day natural breeding trials at Nunn, Colorado (Rupp, et al., 1977). In general, single-bull breeding pastures were as efficient as multi-bull pastures in estrus detection. This was also true of pregnancy rates, except for two single-bull pastures where they were significantly depressed. As all bulls used in these trials had passed a breeding soundness exam, these depressed results were considered to reflect deficiencies in bull libido and/or mating ability.

Although beef bulls are often given a breeding soundness examination prior to use, other aspects of reproductive performance are seldom considered. This is particularly true of the assessment of libido and mating ability. Blockey (1975) illustrated the importance of including such an assessment when he submitted 548 bulls to both a normal BSE and to a serving capacity test (which he devised). He found 113 bulls unsound for breeding as shown in Table 6. Of these, 31 were detected as having clinical signs of abnormalities only when they served or attempted to serve in the serving capacity test. The abnormalities diagnosed included penile deviations, penis-prepuce adhesions, spondylosis deformans, and joint diseases. A further 17 bulls were culled on the basis of poor serving capacity. This resulted in 48 bulls which would have probably passed a normal BSE being eliminated from the breeding program as poor prospective breeders.

Over the past three years, yearling beef bulls at the San Juan Basin Research Center, Colorado, have been studied to further define sex-drive relationships. Some conclusions from this work are:

1. *Sex drive varies considerably between different lines of bulls* (Chenoweth, et al., 1977). This agrees with other work showing that sex drive in bulls is largely under genetic control. It indicates that we should be as critical of low sex drive in bulls used for AI as we are for bulls destined for natural service.

2. *There is very little relationship between estimates of sex drive and measures of semen quality and quantity* (Blockey, 1975; Chenoweth, et al., 1977). In other words, a bull with high sex drive may have low or poor sperm production and vice versa. Both factors should be assessed separately for optimal assessment of the breeding potential of bulls.

3. *A single measurement of testosterone of LH in peripheral blood is of little value in predicting sex drive in bulls* (Chenoweth, et al., 1977).

In the natural breeding trials which we conducted employing bulls with SMB-treated females, sex drive

Table 4. Estimated Genetic Correlations Between Reproductive Traits in Bulls with Puberty Age in Half-Sib Heifers

Heifers	Bull Traits				
	Scrotal Circ.	% Normal Sperm	% Primary Abnorm. Sperm	% Second. Abnorm. Sperm	Motility
Age at puberty	-.71	-.37	.36	.09	.33

Table 5. Single and Multiple Sire Breeding Trials 21-Day Breeding Season

Bull to Female Ratio	4:99	4:101	1:44	1:44	1:43	2:89	1:60	1:60	1:60	1:60
Heats detected %	97	95	95	98	88	96	92	98	95	98
Pregnancies %	78	70	64	73	19	62	40	72	63	68

Table 6. Breeding Soundness Examination and Serving Capacity Test of 548 Beef Bulls; Reasons for Rejection as Poor Potential Breeders

	Culled (total)	Physical exam.	Semen exam.	Serving capacity exam.
Locomotor abnormalities	54	38	-	16
Genital abnormalities	42	24	3	15
Poor serving capacity	17	-	-	17
Total	113	62 (55%)	3	48 (43%)

(Blockey, 1975)

measures were correlated with observations on bull performance (Table 7).

Neither of the libido or serving capacity scores was significantly correlated with the pregnancy rates achieved by the bulls during the trial period (Table 7). The use of bulls with a greater variation in sex drive may have shown more relationship between estimates of this trait and pregnancy rates. Sex drive estimates were, however, significantly related to the sexual performance of bulls during the trial periods. Both mean libido and mean serving capacity scores were correlated ($P<0.05$) with the number of services achieved and the number of females serviced.

Social Interactions

Social ranking of bulls can influence their reproductive activity when they are mated in groups. This was well illustrated in the data of Osterhoff (unpublished, cited by Blockey, 1975). This author blood-typed the calves born to cows mated as a herd to three or four bulls and followed these results for five consecutive years. These data (Table 8) showed that the oldest or second oldest bull in the group sired 60% or more of the calves each year, while the youngest bull sired 15% or fewer.

Table 7
Correlations Between Measures of Sex Drive in Bulls and Performance in 30- or 42-Hr. Breeding Periods with Synchronized Females

Sexual Performance in 30 or 42 hrs.	Correlations (r) with sex drive measures	
	Libido score	Serving cap. score
No. of services	.48*	.47*
No. of females served	.45*	.40*
Females pregnant of those available	.09	.09

*$P<0.05$

Rupp, et al. (1977), compared estrus detection and pregnancy rates in natural breeding trials employing bulls and heifers at single- and multi-sire BFR's of 1:25, 1:44 and 1:60 (ref. Table 5). In multiple-sire mating, 70%-plus of the heifers were bred by more than one bull at any given estrus. This breeding overlap was just as great in pastures employing two bulls as in pastures employing four bulls. Heifers marked by more than one bull did not have better pregnancy rates than those bred by a single bull. Social ranking among bulls influenced the number of heifers apparently bred by each bull.

Although studies have shown that dominant bulls sire more offspring or achieve more services than subordinate ones when they are placed together in groups with the cow herd, it is not known if the relative success achieved by the dominant bulls is due to a higher degree of fertility and/or sex drive than the subordinate bulls or due to other factors. Preliminary studies with yearling bulls at the San Juan Basin Research Center (Ologun, et al., 1978) give some in-

Table 8
Reproductive Performance of 3 or 4 Bulls Joined to a Group of Cows Over a 5-Year Period

Bulls used	Percentage of calves sired by each bull				
	1964	1965	1966	1967	1968
Oubaas	70.4 (10)+	76.0 (11)	12.2 (12)	0*	0*
Matie	16.7 (4)	18.0 (5)	63.4 (6)	72.5 (7)	25.1 (8)
Morena	7.4 (3)	6.0 (4)	12.2 (5)	12.5 (6)	62.5 (7)
Slinger	5.5 (2)	0* (3)	12.2 (4)	15.0 (5)	12.4 (6)

*Bulls absent from the herd.
+Age of bull in years.
(Osterhoff, cited by Blockey, 1975)

dication that: 1) there may be an inverse relationship between dominance (assessed as dominance value) and sex drive estimates; and 2) there may be an inverse relationship between performance test results (average daily gain and final test weight) and sex drive estimates.

If this preliminary data holds true, the possibility exists that the dominant bull in a multi-sire breeding pasture may not be the bull with superior production traits or even the one with the highest sex drive. Optimal usage of superior bulls may require single-sire pasture management.

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References

M.A. de B. Blockey (1975). Studies on the social and sexual behaviour of bulls. Ph.D. Thesis, Univ. of Melbourne, Victoria. - J.S. Brinks, M.J. McInerney and P.J. Chenoweth (1978). Relationship of age at puberty in heifers to reproductive traits in young bulls. Abst., Proc. Ann. Meet. Amer. Soc. for Animal Sci., West. Sect.: Pomona, Calif. June 14-16. - E.J. Carroll, L. Ball and J.A. Scott (1963). J. Am. Vet. Med. Assn.: 142, 1105. - P.J. Chenoweth, B. Abbitt, M.J. McInerney and J.S. Brinks (1977). Col. State Univ. Expt. Sta., Gen. Series 966. - A.G. Ologun, P.J. Chenoweth, M.E. Davis and J.S. Brinks (1978). Col. State Univ. Expt. Sta., Gen. Series 973. - G.P. Rupp, L. Ball, M.C. Shoop and P.J. Chenoweth (1977). J. Am. Vet. Med. Assn. 171: 7, 639-642. - Society for Theriogenology (1976). A compilation of current information on breeding soundness evaluation and related subjects journal. Vol. VII, 2nd ed. - J.N. Wiltbank, W.W. Rowden and J.E. Ingalls (1965). Univ. of Nebr., Res. Bull. No. 224.