Virginia Cooperative Extension

Predicting Bull Fertility

W. Dee Whittier, Extension Veterinarian, Cattle, Department of Large Animal Clinical Sciences, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech
Thomas Bailey, Extension Veterinarian, Cattle, Department of Large Animal Clinical Sciences, Virginia-Maryland Regional College of Veterinary Medicine, Virginia Tech

Reproductive efficiency is a major determinant of cow-calf profitability. The bull's contribution to pregnancy rates is often overlooked. Breeding a large number of cows in a short breeding season requires fertile bulls. Fertility of the male is a major contributor to overall reproductive performance in mating systems that use natural service. Since beef cattle reproduction depends so heavily on natural service, assuring high bull fertility is crucial to successful breeding seasons with high pregnancy rates. Predicting the fertility of bulls is an area of research that has been active for some time and which is ongoing. Research and experience have identified a number of factors that influence bull fertility. The following is a list of factors that influence bull success in impregnating cows during limited breeding seasons:

- Sperm cell output (frequently estimated by measuring **scrotal circumference**)
- Percent normal sperm cells produced, also termed normal **morphology**
- **Motility** or ability for forward progressive movement of sperm cells
- A normal male **reproductive tract**
- **Physical normality** of the bull, general health and structural soundness
- Ability of the bull to complete an insemination successfully or **mating ability**
- **Libido** or sex drive of the bull
- **Social interactions** between bulls
- **Age** of the bull
- **Body condition** of the bull

To allow trained professionals to assess the potential for the reproductive success of a bull, a systematic approach to bull evaluation has been developed. This evaluation involves an assessment, performed in as objective a manner as possible, providing for the prediction of bull fertility. This procedure is termed the **Breeding Soundness Examination (BSE)** and has been formalized by the Society for Theriogenology(the study of reproduction in domestic animals) (SFT), whose members have standardized the bull evaluation.

Studies evaluating the value of breeding soundness examinations are difficult to perform because large numbers of cows and bulls must be used. **Table 1** is a summary of a study done on a very large ranch looking at the value of selecting bulls based on a scrotal circumference minimum and 80% or greater normal sperm cells. All of the bulls that were not controls had a scrotal circumference of at least 30cm. Note that in the first year of this trial conception rates were 7% higher and in a second year conception rates were 5% higher when bulls that were selected for fertility were compared with unselected control bulls.

The BSE is performed at a single examination, although repeated examinations may be required in some cases. It requires that bulls be restrained. It can, however, be performed with equipment that is relatively portable so that veterinarians often perform the evaluation on the farm. The BSE consists of the following procedures:

Table 1. Bulls Selected for semen quality at King Ranch

| | Multiple Sire Year 1 | | Multiple Sire Year 2 | | |
	Control	80% or >	Control	80% or >	70% or >
Number Exposed	572	656	1,179	522	769
Pregnant	86%	93%	85%	90%	91%

Taken From Wiltbank, N.J. (1983)

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Physical examination - The bull is examined in a systematic way for any problem that would hamper his ability to impregnate cows. This examination may be rather brief or more detailed if there is a reason to suspect that there is a problem with any body system. Common areas for problems are abnormalities of the feet and legs or the eyes. A bull cannot locate and mate cows unless his feet and legs are sound. Structural faults, such as sickle hocks and post legs, can cause sore feet and stresses on tendons and joints that affect the bull's mobility. Legs and joints should be free from any swelling or old injuries. Cracked hooves, corns and long hooves also slow the breeding ability of bulls. Long hooves and corns should be dealt with four to six weeks prior to the breeding season. This will give the bull time to recover and have sound feet before he is turned out for breeding. Eyes should be clear and free of injuries or diseases. Pink eye or cancer eye may hinder a bull's vision and reduce his breeding effectiveness. Such problems may also allow him to be dominated by other bulls and diminish his ability to cover the desired number of cows.

Any other tendency toward disease or sickness should be evaluated prior to turning bulls out for the breeding season. Lumpy jaw, poor teeth, or other factors that affect a bull's ability to eat greatly reduce his breeding potential. Respiratory problems also have a negative effect on breeding ability.

As part of the physical examination a body condition score is assessed. The system used is the 9-point-scale system. Bulls that are either overconditioned or underconditioned would be expected to have lower fertility.

Reproductive tract examination - The bull reproductive tract consists of the scrotum, testicles, penis, prepuce and their associated structures. These structures can be examined externally both visually and by manual palpation. However, examination of the penis and entire prepuce typically requires the extension of the penis using an electroejaculator. There are also a number of internal portions of the reproductive tract which require an exam per rectum. The arm of the examiner is inserted through the anus of the bull into the rectum. Because of the flexibility of the rectum the internal portions of the penis, the internal parts of the vas deferens, and the accessory sex glands (the prostate and seminal vessicles) can be manually examined. **Table 2** lists abnormalities and their numbers in field observations of 10,940 bulls. (Modified from Carroll et all. 1963.)

Table 2

Internal Genital Organs	% of all bulls
Enlarged seminal vesicles	3.10
Seminal vesiculitis	1.70
Scrotal hernia	.15
Enlarged inguinal rings	.10
Testicular Defects	
Reduced size and hypoplasia	8.80
Soft	7.40
Abnormal shape	.95
Fibrosis	.43
Cryptorchid	.13

Defects of Penis and Prepuce	% of all bulls
Deviation	1.70
Neoplasms including warts	.91
Persistent penile frenulum	.52
Lacerations	.24

Defects of the Epididymis	
Tumors, abscesses & granulomas	.47
Epididymitis	.36
Segmental aplasia and/or hypoplasia	.18

Defects of the Locomotor System	
Hoof trim needed	3.10
Interdigital fibroma (corns)	.84
Nonspecific lameness	.56
Foot rot	.34
Arthritis	.32
Luxations	.15

Measurement of Scrotal Circumference (SC) - Measuring scrotal circumference is a crucial part of the BSE. Scrotal circumference has been determined to be the measurement that best predicts the output of sperm cells for bulls when multiple collections by artificial vagina are not available. The measurement technique involves the use of a circular tape. This measure is useful because there is a correlation between the scrotal circumference and the volume of semen-producing tissue that the bull possesses. Since SC increases with the age and weight of the bull the circumference must be interpreted in light of the bull's age. **Table 3** shows the minimum circumference that the bull must possess to be classified as a satisfactory potential breeder according to SFT guidelines. It should be remembered that these are minimums and producers of bulls will generally want to produce bulls with scrotum that exceed these minimums. **Figure 1** shows that technique for measuring SC. It is very important that the testicles be confined closely in the bottom of the scrotum for the measurement to be accurate. It is also important that the tape be closed tightly, creating a small waist on the scrotum for measurements to be consistent between

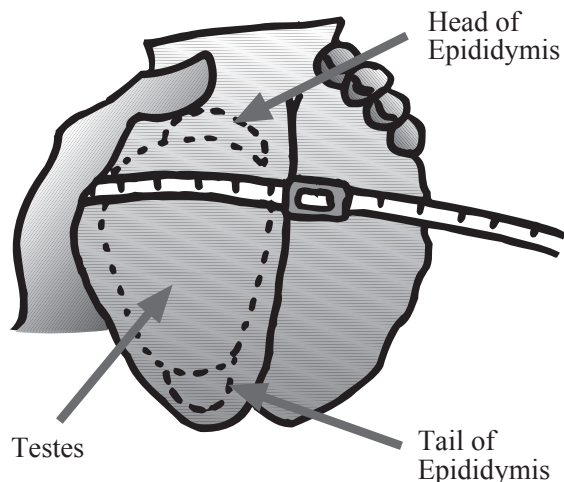evaluators. Scrotal Circumference has been determined to be the one of the best predictors of bull fertility.

Figure 1.
The technique for measuring scrotal circumference in the bull. Note that the hand restraining the testicles is placed behind the scrotum rather than to the side of it.

Semen collection and examination - Although semen could theoretically be collected using an artificial vagina, in most cases the difficulty in training bulls to use this system makes it impractical. Instead, the semen sample is collected using a device called an electroejaculator. This device employs a probe that is inserted rectally into the bull. The probe has electrodes that conduct tiny amounts of electricity to the nerves that run through the bottom of the bull's pelvis. This stimulation results in the bull achieving an erection and finally ejaculating semen. An experienced veterinarian or reproductive physiologist should determine semen quality. An examination of the reproductive tract may indicate possible abnormalities in semen quality. Bulls exhibiting normal physical capabilities may still be incapable of settling cows because of poor quality semen.

Volume:
Volume is important, but it varies with the age, size and breed of the animal, and with the collection methods.

Color:
Color also is an indication of semen quality. The semen should be milky in appearance and free of contaminates such as blood, urine, dirt or pus.

Motility:
Motility can be estimated by observing the mass movement of a concentrated sample of semen. Semen graded as very good has vigorous swirls; that graded good has slow swirls.

Poor semen motility indicates limited or no motility (see **Table 3** for the Society of Theriogenology scoring system for motility). Semen should have a minimum of 30 percent vigorous, motile sperm when diluted and viewed through the microscope. It is important that motility is not hindered prior to the motility score observation. Temperature, shock and other factors can greatly interfere with motility scores.

Morphology:
There is considerable evidence that increased abnormalities of sperm cells are associated with poor conception rates. Abnormalities are classified as primary and secondary conditions.

Primary abnormalities are generally defects of the head of the sperm cell. Secondary abnormalities are slight defects of the tails of the sperm cells, such as proximal and distal protoplasmic droplets (**Figure 2**). **Table 3** shows the Society for Theriogenology cut off for percentage of normal sperm cells for a Satisfactory Potential Breeder classification which is 70%.

Table 3 Requirements for being classified as a satisfactory potential breeder bull by the Breeding Soundness Examination system of the Society for Theriogenology.

Minimum Recommended Scrotal Circumference			Minimum Recommended Motility is 30% of Fair (F)	
Age	SC (CM)	Mass Activity (Gross)	Rating	Individual
< 15 Mo.	30	Rapid Swirling	Very Good (VG)	> 70%
>15 < 18 Mo.	31	Slower Swirling	Good (G)	50-69%
>18 <21 Mo.	32	Generalized Oscillation	Fair (F)	30-49%
>21 < 24 Mo.	33	Sporadic Oscillation	Poor (P)	< 30%
> 24 Mo.	34			

Minimum Recommended Morphology is 70% Normal Cells.

To be classified as a Satisfactory Potential Breeder requires a satisfactory Physical Examination and minimum values for Scrotal Circumference, Motility and Morphology. Any bull not meeting minimums is classified as either an Unsatisfactory Potential Breeder or classification may be deferred at the discretion of the evaluator.

Interpreting the results of the BSE

There are a number of other factors that influence bull fertility that are not easily measured in a single examination. Three of these include libido (sex drive), mating ability and reproductive diseases. These must be dealt with by each bull owner:

Libido - Tests for sex drive have been attempted for many years but no test has proven satisfactory for widespread usage. Owners must observe bulls to be sure that they follow cows that are in heat and show other signs of interest and activity indicating interest in breeding cows.

Mating ability - Since semen is collected using an electroejaculator for the BSE there is no opportunity to see a bull actually complete the breeding act. Some bulls have physical problems that prevent them from successfully mating. Some of these problems may develop as a result of an injury that has occurred during the breeding season. Bulls should be constantly observed to be sure that they are able to successfully breed cows. Any abnormality (swelling, bleeding, etc.) seen near the sheath opening should be investigated as these are frequently associated with an inability to mate. Likewise lameness often interferes with successful breeding.

Reproductive diseases - Of particular importance are the venereal diseases. These can be tested for but are not routinely tested for during the BSE. If bulls are purchased as virgins and not allowed to breed in a herd of unknown status, the likelihood of contracting a venereal disease is essentially nil. Otherwise, a specific examination for venereal disease may be requested from a veterinarian.

Bulls which fail to pass the BSE are assumed to be subfertile. Certainly they may sire some calves but would not be expected to perform well in a typical breeding setting. Bulls who fail the BSE at one point may later be capable of passing. Evaluators usually attempt to predict such outcomes and thus classify bulls as Unsatisfactory or a Deferred status.

Summary

The Breeding Soundness Examination is a system, based on extensive research, for predicting whether bulls will be fertile. While there are limitations to the system, it is a very valuable tool that should be used on a routine basis in beef herds to increase herd reproductive performance.

Figure 2

Normal

Spermatozos

Loose droplets

Primary Abnormalities

Head

Pyriform

Round

Elongated,carrow

Microcephalic

Macrocephalic

Double

Abnormal acrosmome

Midpiece

Kinked

Double

Swollen

Abaxial

Tail

Coiled

Secondary Abnormalities

Detached normal heads

Proximal protoplasmic droplet

Distal protoplasmic droplet

Bent tail

Detached galea capitis

Other Cells Occuring in Semen

Medusa Formation

Epithelial cells

Leukocytes

Erthrocytes

Primordial spermlogenic cells