12-1994

Perceived importance of herd bull selection criteria of Tennessee beef producers

Dale Carter Rose

To the Graduate Council:

I am submitting herewith a thesis written by Dale Carter Rose entitled "Perceived importance of herd bull selection criteria of Tennessee beef producers." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agricultural and Extension Education.

Randol G. Waters, Major Professor

We have read this thesis and recommend its acceptance:

Roy Lessly, James Neel

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

TO THE GRADUATE COUNCIL:

I am submitting herewith a thesis written by Dale Carter Rose entitled "Perceived Importance of Herd Bull Selection Criteria of Tennessee Beef Producers." I have examined the final copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Agriculture and Extension Education.

Randol G. Waters

Randol G. Waters, Major Professor

We have read this thesis
and recommend its acceptance:

Jana B Neel

Loy L Lentz

Accepted for the Council

Associate Vice Chancellor
And Dean of the Graduate School

STATEMENT OF PERMISSION TO USE

In presenting this thesis for partial fulfillment of the requirements for a Master's Degree at the University of Tennessee, Knoxville, I agree that the Library shall make it available to borrowers under rules of the Library. Brief quotations from this thesis are allowable without special permission, provided accurate acknowledgment of the source is made.

Permission for extensive quotation from or reproduction of this thesis may be granted by my major professor or, in his absence, by the Head of the Interlibrary Services when, in the opinion of either, the proposed use of the material is for scholarly purposes. Any copying or use of the material in this thesis for financial gain shall not be allowed without my written permission.

Signature Dale C. Rose

Date 12-1-1994

PERCEIVED IMPORTANCE OF HERD BULL SELECTION CRITERIA OF TENNESSEE BEEF PRODUCERS

A Thesis

Presented for the

Master of Science Degree

The University of Tennessee, Knoxville

Dale Carter Rose

December 1994

ACKNOWLEDGMENTS

The author wishes to express sincere appreciation for the patience, understanding, support and leadership of his Graduate Committee Chairman, Dr. Randol G. Waters, Professor of Agriculture and Extension Education, for without his professional guidance, the study would have been impossible to complete. The author also wishes to thank the remaining members of his Graduate Committee, Dr. Roy Lessly and Dr. James Neel, for their suggestions and guidance.

Appreciation is expressed to Dr. Warren Gill for providing information useful to the study.

The author is indebted to Mioko Oliver for relaying phone calls and messages in addition to uplifting the spirits of the researcher during the graduate school process.

A special gratitude is extended to Dr. John Hodges, III, Mr. Jackie Martin, and the farm crew at the Agriculture Experiment Station for allowing the author the opportunity to further his education , as well as gain valuable experience during the process.

A special appreciation is expressed to his mother, Dorothy Carter Rose, and his brother, David Alan Rose, for their support, love, dedication and encouragement that made this study become a reality.

Finally, appreciation is expressed to his father, Donald David Rose, and his brother, Duane Delton Rose, for their encouragement and support.

ABSTRACT

The purpose of this study was to evaluate the perceived importance of herd bull selection criteria of Tennessee beef producers. This study considered factors important in herd sire selection and respondents rated their importance in selecting and purchasing bulls. The objectives of the study were to (1) describe the respondents demographically, (2) determine the most important criteria used in herd sire selection by Tennessee beef producers who attended the Performance Bull Test Sales from 1992 to 1994, (3) determine if type of farmer, age, type of producer, occupation, size of operation or sale attended relates to the perceived importance of identified selection criteria.

This was a descriptive/correlational study which was Ex Post Facto in nature. Secondary data already collected as an on-going experiment by the Animal Science Extension Specialist, Dr. Jim Neel, were utilized.

The majority of the respondents were owners and were over the age of 30. The largest percentage of them were commercial cow-calf producers only or cow-calf purebred producers. The respondents indicated that the highest percentage of producers were farming and also that a high percentage of producers had 61 or more breeding females in their herd.

Respondents who attended the Performance Tested Bull Sales from 1992-1994 concluded that skeletal soundness was perceived to be a very important selection criteria and the breeder of the bull was rated least important. The respondents also indicated that all selection criteria were important to consider when selecting a herd sire. Scores for the set of criteria were arranged on a Likert-type scale ranging from one, "not important" to five, "very important". Respondents expressed the degree of importance of each selection criteria.

No reason exists to indicate a substantive difference between type of farmer, age, type of producer, occupation, size of operation, or sale attended and respondents' perceived importance of identified selection criteria.

A beef producer's perceived importance of selection criteria is an important factor to consider when selecting a breeding animal. The data compiled in this study concludes that all selection criteria were considered important by the respondents. As a result, it is apparent that in the future, beef producers may select for a balance or combination of traits to meet their goals.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

CHAPTER I

INTRODUCTION

Beef is one of America's most nutritious and preferred foods. The role of the beef industry is quite challenging then, since it must provide all the beef Americans would like to consume at a price they can afford and of a quality they would prefer (Minish & Fox, 1982). To do this, the beef industry must improve total efficiency of the herd through breeding while reducing production costs. Thus, sire selection is important.

According to Minish and Fox (1982), only two mechanisms are available to breeders to control the inheritance of their cattle: selecting and determining which animals shall be mated among those selected. Selection or choice of parents is the common element of all breeding programs, and it is the major means through which continual improvement is made.

Selection represents the major directional force available to the beef producer for creating genetic change. "Herd sire selection alone will determine more than 85 percent of the total improvement made through selection decisions. Fifty percent of the genes in a herd come from the last bull used, 75 percent from the last two, and more than 85 percent from the last three" (Minish & Fox, 1982).

Mumford (1908) stated that perhaps no other important factor connected with beef production is disregarded as often as that of the selection of bulls to head the herd. He believes that the bull is half the herd if he is a choice individual backed by good ancestry.

According to Startsev and Burlakov (1961), sire selection was recognized as an important method of improving breeds even in ancient times. Since then, however, methods of selection have undergone a continuous process of improvement. They have gone from simple selection based on external appearance to a complex evaluation of the origin of the animal, its production characteristics, and the merits of its progeny.

This research study will take a close look at some of the methods of sire selection.

Need for the Study

Since effective bull selection will contribute 80-90 percent of genetic improvement to a herd (Minish and Fox, 1982), it follows that "selection represents the major directional force available to the beef producer for creating genetic change."

Mumford (1908) agreed that sire selection can and usually will account for 75 to 90 percent of the genetic progress made from selection, whereas Curl (1978) believed a herd sire accounts for as much as 85 percent of the breeding influence in a herd. Consequently, as long as beef producers use herd bulls for natural service, there will always be a need for sire selection.

Statement of the Problem

The purpose of this research project was to evaluate criteria Tennessee beef producers are using to select herd bulls. This study will capitalize on factors important in herd selection and will rate their importance in selecting and purchasing a bull for natural service in a herd. Additionally, it will compare how different people involved in different types of operations select factors more suited to their needs and operations.

To further explain the purpose of this study, the following specific objectives were developed:

1. To describe the respondents demographically
2. To determine the most important criteria used in herd sire selection by Tennessee Beef Performance Bull Test Sales from 1992 to 1994
3. To determine if type of farmer, age, type of producer, occupation, size of operation or sale attended relates to the perceived importance of identified selection criteria

Operational Definitions

The following terms were used in this study, and their definitions are provided in an effort to add clarity and understanding:

Accuracy (Acc).-- The degree of confidence placed in the EPD value. Higher accuracy means the data are more certain or reliable and will change less with additional progeny.

Arthrogryposis-- The palate-pastern syndrome, crippled calf syndrome, etc. Affected calves usually have a cleft palate, a curved spine and extreme flexion and extension of the rear limbs. Most affected calves are born dead.

Birth Weight EPD-- Calculations expressed in pounds showing the average increase or decrease in birth weight from the average sire. The EPD value indicates calving ease.

Breed-- A group of animals that possess certain distinguishing characteristics and that reproduce these characteristics in their offspring with reasonable regularity.

Color-- A pattern of pigment which varies with different breeds.

Condition-- Portrays the amount of fat cover. The amount of condition on bulls and females should be enough to improve the general appearance and bloominess.

Dam-- Mother of a calf

Dwarfism-- A hereditary defect in cattle whereby cattle may be either short-headed or long-headed. Both are characterized by failure of the affected animal to develop normally.

EPD (Expected Progeny Difference)-- A prediction of how future progenies of a sire are expected to perform in a given trait that one may be using to select a herd sire for.

Frame-- Size of the animal measured as "hip height" for age which can be scaled from 1-10, known as frame score.

Hydrocephalic-- Occurs when the calf has an excessive amount of fluid in the cranial cavity. Most affected calves are dead at birth or die shortly thereafter.

Libido-- The willingness and eagerness of a bull to attempt to mount and service.

Mating ability-- Refers to the bull's ability to perform and complete service of a female.

Milk EPD-- A rating in pounds of a sire's daughter's ability to match milk production to a genetic potential.

Muscle Expression-- An expression of muscling as indicated by natural width between the rear and front legs, as well as muscle expression in the top, forearm, and stifle.

Pedigree-- A lineage of ancestry of an animal.

Performance Test-- Measure of individual performance, specifically the rate and efficiency of growth and carcass traits.

Pre Potency-- The ability of an animal to transmit its own qualities to its offspring.

Scrotal Circumference-- The circumference of testicular development of bulls. A good estimate of fertility usually measured in centimeters.

Sire-- Paternal parent of a calf

Skeletal Soundness-- Refers to correct body and skeletal structure. Animals should have ample bone, move freely on their feet and legs, and possess strong pasterns. Any fault that would reduce useful life of the animal is unsoundness.

Weaning Weight EPD-- Calculations (in pounds) of the average increase or decrease in weaning weight from the average sire in this breed.

Yearling Weight EPD-- Calculations of the average increase or decrease in yearling weight from the average sire in this breed. The EPD value expressed in pounds is the best estimate of total growth.

CHAPTER II

REVIEW OF LITERATURE

History: The Beginning of Selection

The movement toward sire selection to improve a herd is not new. According to Williams (1941), cattle are not native to the Western Hemisphere. Columbus in 1493 brought cattle with him on his second voyage to the West Indies. The Spaniards introduced them to Florida, Mexico, and the West Indies in the 16th century. Settlers on the eastern coast brought with them from Europe the kind of cattle they were growing in the countries from which they came. Thus, different breeds of cattle developed.

Beginning with the American Revolution and extending through the war of 1812, there was great movement of cattle westward. Immediately after the war between the states, although cattle were abundant in the Southwest, no market outlet existed. Thus was started the tremendous cattle trailing movement, the most adventurous and romantic period in all the cattle history of the world. As many as 600,000 cattle were driven annually to shipping points hundreds of miles away. It made possible a great expansion of cattle business of the West (Williams, 1941).

Williams (1941) added that after a few bad years and the terribly severe winter of 1886-87, growers began to realize they must recognize the futility of overstocking and destroying the range, and they must make every possible effort to improve cattle.

Then in 1875, the use of barbed wire made it possible for cattlemen to keep their cattle separate from other producers, thus creating an incentive for

the improvement of ranges and pastures and encouraging the use of better bulls for improving herds (Williams, 1941).

Wentworth (1923) stated that the first improver of beef cattle was an Englishman, a resident of Leicestershire named Robert Bakewell. He worked with the old longhorn stock of Central England and, being a skilled anatomist, was able to appreciate the means whereby changes in external form would affect the carcass. He selected for increased thickness of the loin, rib and quarter, for more fattening qualities and for early maturity. By mating related animals, he fixed these traits so strongly that his cattle became known all over England, while his sheep, improved by similar means, were so well known that George Washington imported rams of Bakewell breeding for use on his Mount Vernon estates.

From a careful study of Bakewell's methods, the Colling brothers and the Booth and the Bates families established Shorthorn cattle, and a few years later, the Thompkins, Prices, and Hewers founded the Herefords (Wentworth, 1923).

Three or four decades after this, the foundation of the Aberdeen-Angus was securely laid by Hugh Watson in the north of Scotland (Wentworth, 1923).

It is estimated that 65 or more different breeds of beef cattle now exist in the United States. There is tremendous pressure, therefore, to identify the strong points and maximize these strengths through sound selection programs. With the diversity of cattle types available, the producer literally can mold the kind of cattle he wants to produce (Wiley, 1986).

Sire Selection

Just as no two people are alike, so no two breeders look at their herd in the same way. Digging (1952) said the building of a good herd of breeding

cattle is a long-time proposition. Many breeders have spent a lifetime without ever having reached their goal. He added that if the goal is the establishment of a high quality herd, it is better to buy a few good animals than a large number of poor ones.

Jim Leachman, noted worldwide as a master at marketing seed stock and range bulls, stated, "A bull is the greatest variable in a cattle operation. Cows are at a 'fixed' genetic point. Genetic progress is a function of selection pressure. In three to five generations, 87 percent or more of the genetic variation in a cow herd is determined by the bulls used" (Bingman, 1991).

Jenkins (1989) concurred with this statement. In a herd situation using natural mating, he said the bull has great genetic consequences. The bull is responsible for half of the offspring genetic make-up. One bull can significantly affect the gene pool of an entire breed. "In the beef cattle industry, there is no production without reproduction" (Jenkins, 1989). Williams (1941) agreed, "...the bull, from a breeding standpoint, is one half the herd he produces and added, "...the calves produced are the best indicator of the value of the bull".

Cattlemen should know their stock well and be efficient in recognizing improvement or decline in their own herd as well as being quick to implement changes where indicated by comparison with others (Yeates and Schmidt, 1974).

According to Nebraska cattleman, Frank Padilla (Field, 1993), "Developing a sense of direction and goals should be a top priority before any bull is turned into pasture." Even with a direction defined and set forth, it takes commitment and decision making to make goals become reality. Padilla also stated that he selects breeds and individuals within these breeds to develop animals that would lead toward his goals. "In other words," Crouch added

(1989), "the bull you decide to use should match the situation that exists in your operation."

Neuman (1986) agreed that the breeder must identify the traits that are important for his breed, determine how to measure these traits, and choose a breeding program to maximize improvement of these traits. Neuman added that trying to select for too many traits at one time results in little improvement in any one trait. On the other hand, selection for a single trait, to the exclusion of all others, can indirectly damage other important productive traits. An example of this occurred when breeders selected for yearling weight and discovered that birth weights increased significantly. A well thought out breeding program must be based on sound genetic principles.

Snapp (1952) believed much consideration should be given to each of the following items: (1) individuality, (2) breeding and production periods, (3) pedigree, (4) age, (5) freedom from disease, (6) guarantee made by the owner as to health and breeding ability, and (7) cost delivered. One should not consider any animals that fail to meet these qualifications. "Remember sire selection is the single most important step in producing a set of quality replacements" (Snapp, 1952).

Mumford (1908) believed that the major reasons sire selection can and usually will account for most of the genetic progress from selection are as follows:

1) Bulls are usually more intensely selected than heifers;
2) Sires are generally more accurately evaluated by producing more offspring in a shorter period of time than cows; and
3) Sires can be practically replaced by new sires faster than cows.

To be effective, breeders should select animals in a specific manner rather than at random. The breeder can select on ancestry, family relatives, individual performance or the performance of progeny or a combination of all these factors (Preston, 1974).

Minish and Fox (1982) suggested selecting a bull with two or more generations of selection behind them. A bull from a herd with generations of known selection pressure will more likely turn out favorably.

Bourdon and Brinks (1990) believed that one needs to select bulls that are sexually mature, capable of breeding and settling cows, and whose calves will not have heavy birth weights.

According to Thomas (1986), the major genetic decision that a beef breeder makes is the selection of a sire. Since sire selection can account for 80-90 percent of the progress made in a breeding program, the breeder wants a sire that does the following: finds and impregnates cows in heat, sires calves of high value, works successfully over several breeding seasons, requires little extra care or management, and has a high salvage value.

A sire and a dam are essentially of equal importance in determining the inheritance of a single offspring. Their relative importance in a herd is determined by the number of progeny each parent produces. Therefore, sire selection is the most important factor affecting the herd level. It follows that the more progeny an individual bull produces, the greater his impact in the herd. Recognizing the importance of individual sires to overall herd merit, a breeder should consider carefully both a bull's soundness and his records before final selection (O'Mary and Dyer, 1978).

Another decision beef producers must make is whether to use artificial insemination (A-I) or natural services. Bingman (1991) believed a large portion

of the beef production sector will continue to rely on natural service through herd bull selection because of economic factors or because their particular operation is not suited for an A.I. program that would meet management needs. A. B. "Buddy" Cobb, a reputable and veteran cattleman in Montana, as well as a recognized national leader in beef bull production in the Charolais breed, shared the following advice, "Let nature take its course. You get a better calf crop in a shorter time. For a commercial man, natural service is superior."

Traits

In choosing an ideal herd sire, one should consider physical traits, such as fertility, frame, structure, composition, and body capacity. Fertility traits are those one can notice from a visual stand point, such as sight and good eyes. Also important are good feet and legs and correct skeletal structure for longevity. Furthermore, even corns, prolapsed soles, or a slight founder can effect a bull's ability to breed enough cows during a given breeding season (Minish and Fox, 1982).

Preston (1974) believed the first stage of any genetic improvement plan is to determine which traits are of economic importance. Their order of precedence will depend, in part, on geographic location in the sense that characteristics important in one area of the world may be of little value in another. Certain characteristics, however, such as fertility, livability, fast growth and efficient feed conversion, are fundamental. A number of traits to consider in sire selection are calving interval, birth weight, weaning weight, cow maternal ability, feedlot gain, pasture gain, and carcass traits.

O'Mary and Dyer (1978) cautioned that most breeders tend to select too many traits without regard to heritability. Options range from single-trait selection to an index of traits weighed by heritability and economic importance.

Minish and Fox (1982) encouraged breeders to keep the number of selection traits to a minimum and use each trait to make a profitable contribution to the herd.

Kirkpatrick (1993) stated that "when selecting a prospective herd sire, determine what trait or traits need the most improvement in your herd and select the bull that has the most improvement to offer for that trait or traits without losing progress in other economically important traits. "

"The seed stock producer sells genotypes, and the commercial producer phenotypes, so the genetic make up or breeding value is the major consideration in selling or buying herd sires. The traits that should receive major emphasis are those that are economically important and highly heritable" (Minish and Fox, 1982).

Factors in Herd Bull Selection

There are several factors that beef producers consider in herd bull selection. These include breed, pedigree, color, frame, skeletal soundness, muscle expression, reproductive soundness, cost, breeder of bull, age of bull, epd's, birth epd's, yearling weight epd's, and milk epd's. The following is a brief description of each of these items:

Breed: Selection of a sire's breed is a function of overall planning for the beef cattle breeding program. Each breed has characteristics that average above or below certain other breeds. Mature weight, growth rate, milking ability, and carcass quality differences are illustrations. In a crossbreeding program,

ire selection should be for the trait or traits for which his breed is superior (O'Mary and Dyer, l978).

Pedigree: Pedigree and visual appraisal were the only methods of selection of beef cattle until performance and progeny records came into common use. Pedigree records are useful in selecting against undesirable genes, since they list performance data along with the identification of immediate ancestors. This approach can be an important aid to accurate sire selection (O'Mary and Dyer, l978).

Performance information from close relatives, especially carcass data from steer progeny and mothering ability of daughters, is extremely useful in determining breeding value of a sire. Pedigrees can also help in selecting against such genetic abnormalities as dwarfism and "double muscling." When using pedigree information, however, only the closest relatives (progeny, half siblings, sire, and dam) should receive much consideration (Thomas, 1986).

An important use of pedigrees is to identify potential carriers of such genetic defects as dwarfism, mule foot, hydrocephalus, etc. Staying within a bloodline, may mean essentially shutting out the good cattle in the rest of the breed. Beware of the temptation to place too much emphasis on a simple ancestor several generations back in a bull's pedigree. One distant ancestor contributes very little to the bull's genetic make-up (Minish and Fox, 1982).

Color: Pigmentation and color are considerations in selecting both sire and breed. Absence of pigmentation is a predisposing factor for cancer eye. Uniformity of color usually has some economic advantage in the market place, even though it is completely unrelated to performance (O'Mary and Dyer, 1978).

Frame: According to Minish and Fox (1982), frame size is always an important trait in sire selection. "Visual appraisal of frame size is highly heritable." Frame size is of great importance in identifying the physiological pattern of cattle on the growth curve. The frame size of the bull selected should relate to the frame size of the cow herd, breed of the herd, and the purpose for the progeny in the commercial industry. One can determine the frame score from 1-10 by measuring the bull at the hip in inches combined with the bull's age.

A recent study by Northcutt and Wilson (1993) suggested that a mature size selection tool may assist the beef industry in making decisions about cattle size. Commercial cow--calf producers can use the mature size expected progeny differences in bull selection decisions to search for individuals that sire replacement heifers to function efficiently under their production and management environment.

Increasing frame size of breeding stock can result in unfavorable correlated responses in delayed reproductive maturity and greater mature size. Height should be considered with other performance information in making selection decisions (Thomas, 1986).

Skeletal Soundness: According to Minish and Fox (1982) "Unsound structure can cause bulls to physically break down under breeding conditions and sometimes the breeder will have to cull the daughters from the herd early." Structure problems are readily passed on to growing and finishing cattle; these unsound characteristics and poor performance appear to be related.

O' Mary and Dyer (1978) stated that structural soundness is an aspect of conformation for which visual appraisal has been almost the only method of

evaluation. Feet and legs are perhaps the most important determinants of structural soundness, now presumed to be a contributing factor to longevity.

"Structure traits are difficult to measure in a quantitative manner although experience has taught us that a hereditary tendency is clearly evident" (Minish and Fox, 1982).

Muscle Expression: A beef producer can't afford excess or double muscle due to its relationship to low fertility and lack of marbling. "In the beef business a primary objective is to produce muscle, and animal breeding specialists will agree that it should be contributed from the sire" (Minish and Fox, 1982).

Reproductive Soundness: Bourdon and Brinks (1990) suggested that, "To improve reproductive potential in female offspring, yearling scrotal circumference of prospective herd sires should receive special attention."

Measurement of scrotal circumference with a scrotal tape gives a relatively accurate estimate of the semen-producing ability of a young bull. Scrotal circumference is highly correlated with weight of testes and sperm output in growing bulls (Thomas, 1986).

According to Bourdon and Brinks (1990), "Research has shown that sires with above average scrotal circumference as yearlings should produce heifers with earlier puberty and better subsequent reproduction."

Scrotal circumference has been reported to be a highly heritable trait. There appear to be breed differences, however, as well as considerable variability among bulls within breeds. The relatively high heritability coupled with large within-breed variation indicates that selection would be effective in increasing scrotal circumference as well as in changing traits genetically as they correlate with scrotal circumference. Scrotal circumference has been shown to

be a more accurate indicator of sexual maturity than either age or weight, regardless of breed or breed cross of bulls, as stated by Lunstra (1982).

Curl (1978) suggested that the person who wants to select breeding animals that function at peak efficiency must know what highly fertile animals look like. In highly fertile animals, the male sex hormones directly affect muscle growth and muscling; the bull forms muscle, not fat; and these hormones determine how he acts and sounds. These hormones also determine bone growth. Animals which do not reach sexual maturity continue their bone growth. As a result, the low fertile or sterile animal gets taller and poorly proportioned.

Studies in Texas and Colorado, involving over l2,000 bulls of service age, have demonstrated that approximately one in every five beef bulls is a questionable or unsatisfactory breeding bull. There is no accurate way to predict that a bull will settle 50% or 80% of the cows exposed to him.; however, through a breeding soundness examination prior to the breeding season, those bulls of questionable or unsatisfactory breeding potential can be identified. A complete breeding soundness evaluation consists of the following: physical examination, scrotal measurement, and semen evaluation. In addition to these factors, some assessment should be made, if possible, of the bull's desire and ability to breed a female in heat, as reported by Thomas (1986).

Pope (1989) proclaimed that apart from injury, disease, or physical barriers, the reproductive performance of breeding bulls is determined by his relative ability to (a) produce semen of good quantity and quality, (b) exhibit good libido and mating ability, and (c) avoid inhibition due to domination by other animals in the breeding pasture.

The evidence is strong that bull libido is a measurable trait, largely under genetic control, that significantly influences bull performance (Pope, 1989).

O'Mary and Dyer (1978) stated that ultimately, fertility is measurable only in terms of percent of calves produced. No absolute method exists to predict or assure pregnancies, either by physical examination and fertility testing of the bulls or inspection of ampoules of semen. Because of the economic penalty of a reduced calf crop, most bull buyers seek reliable breeders of proven integrity.

Cost: So many variables exist for determining sire costs per calf that development of a pricing formula is impossible. Many Extension specialists love the quote, "The cheapest bull to buy is the most expensive to own" (Henderson, 1993).

In general one can expect to pay at least two to three times the value of a market steer. Thus, if a finished steer is worth $700.00 at l5 months of age, a producer should expect to pay at least $l400.00 to $2l00.00 for a performance tested bull of the same age that will noticeably improve his herd (Thomas, 1986).

After conducting a bull to heifer ratio trial, Colorado State University recommended one bull for every 50 cows. "One of the biggest challenges facing cow/calf producers today is cutting their cost of production," says Garth Boyd, the CSU Extension cow/calf specialist who headed up the bull/heifer ratio study. "Making more efficient use of bulls is one of the quickest ways a producer can cut costs. Bulls are probably more fertile than ever because the industry has put selection pressure on reproductive traits such as scrotal circumference and semen quality", Boyd says. "Most people use one bull for 15 to 30 cows in most herds. Many producers run extra bulls as an insurance policy against a bull getting hurt or lazy", Boyd notes. A producer needs to understand the environment he is operating in and how to manage the least number of bulls he can get by with (Miller, 1990).

Beef bulls have been sold traditionally as "guaranteed breeders," with liability limited to an option to select a replacement of equivalent value should a bull's performance be unsatisfactory. Bulls of exceptional value are sometimes sold under more specific conditions(O'Mary and Dyer, 1978).

Breeder of Bull: In sire selection, considerations other than price should include depth of performance records, number of bulls available, time available for evaluation, and, of course, general merit of the source herd (Pope, 1989).

Purchasing directly from a breeder provides the most common source of bulls. This method has several advantages. In the first place, it is usually possible to inspect their sires, dams, and immediate relatives. Secondly, there is adequate time for evaluation. Perhaps the most important advantage of buying directly from the breeder is that the bulls generally have been exposed to the same environment from birth and can be compared on their performance without environmental differences (Pope, 1989).

Another source is a central test station. The obvious method of purchasing from this method is the opportunity to compare bulls from various herds that were tested under the same environment.

Consignment sales provide a third source of bulls. Their advantage to the purchaser is one of convenience and purchase price. However, they provide little basis to compare growth rates of the bulls consigned.

Age of Bull: Yearling bulls did not differ from older bulls in the number of services performed or the percent estrus females serviced. Differences occurred with the number of mounts, probably indicating inexperience. More importantly, differences occurred in the percentage of females pregnant overall, in estrus and/or serviced. Thus, yearling bulls were as sexually active as older bulls but less fertile (Pope, 1989).

EPD's: According to Crouch and Wilson (1989), expected progeny difference is a prediction of how future progeny of a sire is expected to perform in various traits. EPD information can come from several sources: the animal's own performance, ancestor records, paternal and maternal half-sibs and progeny records. "The sire's own performance and the performance records of his progeny become the major determination of the EPD." Accuracy values that accompany an EPD indicate the reliability of this value.

Knop (1993) stated that everyone in the seed stock business must keep in mind that EPD's must have integrity for seed stock to have integrity. Submitting accurate records is the most important factor to keep the EPD system strong. "You gain through having a more objective picture of your breeding program and through the predictability of your cattle in the breeding programs of others". "It takes accuracy to make EPD's complete".

An EPD is up to nine times more accurate for across herd selection than a performance ratio, according to Hough and Middleton (1992).

Doubet (1993) stated in order to increase the accuracy of EPD's, it's important for breeders to report all information on all calves correctly. Furthermore, EPD's should be used in conjunction with visual appraisal to account for physical traits, such as muscling and structural correctness. They are a tool, just as visual appraisal is a tool.

O'Mary and Dyer (1978) reported that expected progeny differences are determined by considering heritability of the trait involved and number of progeny tested. As the number of progeny of a sire increases, the reliability of the test improves.

Crouch and Wilson (1989) stated that if the genetic trend for a trait has a steady increase, the breed average will also increase. Therefore, an EPD for a

particular sire may show somewhat of a decrease each year when the breed advances. "Another reason for changes on EPD results from incorrect reporting procedures with respect to combining calves from different management treatments."

"It should be noted the actual EPD values are relatively unimportant, but differences between sires are important and should be given primary consideration" (Crouch and Wilson, 1989). Inadequate sampling and distribution of offspring across herds for a given sire can also cause changes in EPD values.

Hough and Middleton (1992) stated that "EPD's provide for comparison of individual bulls, but can also be used to determine how a bull ranks within a population."

Some bulls today are priced according to their EPD's. EPD's have the potential to make improvements in a herd for calving ease, growth performance, and maternal values in females for replacement (Curl, 1978).

Pope (1989) said that knowing how an individual bull's progeny will grow, milk, and calve has resulted in steady improvement of our nation's cow herd and fed calf performance. The use of Expected Progeny Differences has proven so successful that cattlemen want to know more about the progeny and breeding patterns .

Hough and Middleton (1992) believed that the demand has increased dramatically for EPD's and educational material related to performance evaluation and EPD's. "Use of EPD's is not a total answer to a selection and breeding program. Breeders should use EPD's as a genetic risk management tool. There are many traits that are important in the beef cattle industry. Unfortunately, EPD's are available on only a portion of these traits. All breeders

should examine the facts, use good judgment and common sense, and consider many traits and factors before making selection decisions."

"An EPD is always the best estimate of an animal's genetic worth, given the data available for analysis." A great deal of recent research concludes that EPD's are a better sectional tool than anything previously available (Hough and Middleton 1992).

Kirkpatrick (1993) stated, "There usually is no one best bull for all situations and that is what makes the use of EPD's so valuable."

Birth EPD: Knop (1993) stated that bull buyers face numerous challenges. They need bulls for heifers only, heifer/cow bulls, and bulls for high quality replacements. It is reassuring to see both seed stock and commercial breeders reacting thoughtfully to their challenges. Many bull buyers will give away some pay weight to get calving ease which is called a trade off.

Birth weights and calving assistance records should be considered, particularly when selecting a bull from one of the large breeds to be used on young, small cows.

Minish and Fox (1982) stated that heritability of birth weight is 0.48, meaning selection pressure can be applied to this trait and that light birth weight and heavy yearling weight are negatively corrected. Birth weight is highly related to calving difficulty.

Thomas (1986) agreed that the heritability for birth weight is high (48%), and birth weight is positively correlated with future growth rate. Therefore, future growth rate can be increased by selecting cattle for heavier birth weight. Birth weight is highly related to calving difficulty, however, and selection for heavier calves to increase growth may increase incidence of dystocia. Ideally, breeders should select bulls with moderate birth weight and rapid post natal growth.

Heritability for weaning weight is 30 percent and primarily a maternal trait. The environment can play a significant role in differences in this stage of growth and should receive minor consideration in sire selection for growth potential (Minish and Fox, 1982).

Yearling Weight EPD: Yearling weight is a highly heritable trait at 60 percent. A bull's own performance record is a good indicator of his breeding value for yearling weight. This is the most valuable indicator for predicting the genetic growth potential of a herd sire. Bulls that excel in growth to this point will sire commercial calves that grow more rapidly and efficiently to desired slaughter weights (Minish and Fox, 1982).

Thomas (1986) agreed that yearling weight is the most valued trait for predicting the genetic growth of a herd sire because of its high heritability (40-50 percent) and, therefore, should receive major emphasis in bull selection programs.

The 365-day adjusted weight combines adjusted weaning weight and post weaning gain into one measurement. It has the highest heritability (60%) and is the most reliable statistic for measuring growth in a group of bulls raised under the same environmental conditions from birth to the conclusion of the post weaning period (O'Mary and Dyer, 1978).

Since growth rate is correlated positively with most desirable traits in beef cattle, the 365 day adjusted weight is probably the most important single measurement of the estimated value of a beef bull (O'Mary and Dyer, 1978). This measurement should have first priority in the selection of a sire when growth rate is the primary consideration.

Milk EPD: One can not overemphasize the importance of sire selection for producing females. "The first step in sire selection is to determine the

mature size and level of milk production. To ensure optimum values, sires with highly accurate EPD values for growth and milk (or their sons) should be used. Determining appropriate size and milk levels for an environment is not simple" (Bourdon and Brinks, 1990).

Results of the study by Marshall and Long (1993) suggested that industry breeders who use sire milk and total maternal expected progeny difference values as selection tools should expect such selection to be effective, on average, but should also expect that a substantial proportion of individuals or smaller groups will not rank as predicted.

Cattlemen's Preferred Selection Criteria

Texas Tech University conducted a survey (Figure I) that suggested reproductive soundness was the most important trait beef cattle producers selected for. More that 300 purebred and 700 commercial producers valued this trait very highly. Trait rankings were somewhat similar between purebred and commercial producers, except for structural soundness. Structural soundness was valued higher by purebred breeders, while growth potential was emphasized by commercial producers. Texas Tech animal scientists conducted the survey to help characterize the Southwestern United States Beef industry, and the results are shown on the following page (Bible, I993):

FIGURE I. Texas Tech University Survey Findings

TRAIT	RANK	% of respondents ranking trait high in performance
Reproductive Soundness	1	73.6
Body composition (muscling, fat)	2	69.6
Growth Potential	3	68.1
Calving Ease	4	66.2
Structural Soundness	5	60.8
Genetic Predictors (EPD's)	6	51.0
Disposition	7	49.1
Show ring Record	8	6.5

Source: Bible 1993.

Kansas State University (Figure II) conducted a survey in 1993 of 312 commercial cattle producers to determine the importance of selection criteria used in buying bulls. Calving ease had the highest percentage of importance among producers. They also considered individual performance more than expected progeny differences (EPDS). Live evaluation emphasized structural soundness, length, and muscling as shown on the following page.

This survey displayed a shift from a similar survey conducted in 1981 (Cattleman's Day, 1982) where growth rates received major consideration (Simms, 1994).

FIGURE II. Kansas State University Study Findings

Factor	First Criterion, %	Included in First 3 Criteria, %
Calving ease score	25	49
Birth weight	12	20
Frame score	11	39
Conformation/visual appraisal	11	24
Expected progeny differences	9	23
Disposition	7	31
Breeder reputation	5	13
Weaning weight	4	32
Yearling weight	4	19
Structural soundness	4	16
Price	3	12
Color	1	5
Dam's functional traits	1	4
Pedigree	1	4
Polled/horned	0	5

Source: Simms, I994.

In another study (Nichols, 1985), there were 162 Angus, 136 Polled Hereford, 52 Charolais, and 87 Simmental bulls on which data were collected over a four year period, 1982-1985, as part of a program conducted by the Kentucky Central Bull Test.

These bulls were part of a 140 day test where they were fed ad libitum a completely mixed ration. After the 140 day test was completed, the bulls were weighed, hip heights recorded, and a fat thickness measurement was taken between the 12th and 13th ribs. Average daily gain and weight per day of age were calculated from this information. This performance information, plus hip height and fat thickness, was made available for prospective buyers of yearling bulls. Ninety eight percent of the 437 bulls involved in the study were estimated to be purchased by commercial cattle producers.

Angus and Polled Hereford bull buyers paid more dollars for the taller bulls, meaning hip height was the most important performance trait that influenced sale price.

Charolais and Simmental bull buyers paid more dollars for bulls with more desirable weight per day of age, meaning WPA was the most important performance character.

This study explained the importance of individual performance and visual appraisal.

In a master's study conducted at the University of Tennessee, Steelman (1993) reported that producers who purchased bulls at the Breeder's Performance Bull Sales (1982 to 1992) perceived "descriptive criteria" more important than "performance criteria" and "birth weight" as the single most important selection criteria. Respondents in this study perceived all criteria to be important.

Some Final Thoughts about Sire Selection

According to Williams (1941), cattle were the first animals domesticated by man for purely agricultural purposes. Their first use was for meat and hides. Later they were milked and finally they were used for draft purposes. As a result of these uses, different types of cattle have been developed.

"Changes in the market over the next decade will demand commercial cattlemen focus on balanced traits, muscling, moderation of size, earlier maturity, growth, and the health of their cattle" (Henderson, 1993).

Mallinocrodt (1993) said, "The fundamental truths of cattle breeding are:

1. There is no one best animal or breed,
2. Start by setting goals,
3. Base selection on EPD's,
4. Select for traits with real economic values."

CHAPTER III

PROCEDURES AND METHODOLOGY

Population of the Study

The population was made up of 390 Tennessee beef producers who attended Performance Tested Bull Sales between 1992 and 1994. The survey was distributed at the Performance Tested Bull Sales where beef producers were usually looking for bulls. These secondary data had already been collected as part of an on-going experiment being conducted by the UT. Animal Science Extension Specialist, Dr. Jim Neel.

A convenience sampling technique was used. The surveys were handed out randomly to participants of the performance tested sales. Surveys were also stationed at visible locations around the sale site. Participants who purchased a bull could turn the survey in when they paid for the bull. Respondents who did not purchase a bull, could drop the survey in one of the collection boxes that were available. This sampling method is not perfect and has limitations due to the fact some producers chose not to participate and did not return the completed survey.

Identification of Variables to be Measured

The variables to be measured were:

A) The type of beef production, commercial or purebred (independent variable).

B) Criteria for selecting and purchasing bulls for natural service (dependent variables).

C) Age and occupation of beef producer (independent variables).

D) Number of breeding females in the producer's herd (independent variables).

Scales of Measurement

The scale of measurement for the independent variables was nominal. The scale of measurement for the dependent variables was interval because producers rated criteria on an attitudinal scale.

Data analysis was performed using the Statistical Package for the Social Scientist (SPSS Release 4.1) which is available on the IBM 3081 mainframe computer at the University of Tennessee Computing Center. Frequency distribution, means, and standard deviations were used to report findings related to the objectives of the study.

Design of Study

This was a descriptive\correlational study which was Ex Post Facto in nature. A design or control group would be difficult to utilize. Secondary data already collected as an on-going study by the Extension Animal Science Specialist, Dr. Jim Neel, were utilized in the study.

Reliability and Validity of Instrument

The instrument was designed to be simple for respondents to complete while maintaining a high level of reliability. An effort was made to list factors that were important in the selection and purchase of a bull. All available design techniques were used to insure face validity. A review of the survey by a panel of experts was completed prior to its administration.

CHAPTER IV

PRESENTATION OF DATA AND FINDINGS

The purpose of this chapter was to present findings related to the objectives of the study. The data were analyzed and organized according to the objectives which are:

1. To describe the respondents demographically
2. To determine the most important criteria used in herd sire selection by Tennessee Beef Producers who attended the Performance Bull Test Sales from 1992 to 1994
3. To determine if type of farmer, age, type of producer, occupation, size of operation or sale attended relates to the perceived importance of identified selection criteria

Objective I

The first objective of the study was to describe the respondents demographically. The demographic data are reported in Table I. The questions which pertained to the demographic data are:

1. Type of farmer
2. Age of respondent
3. Type of producer
4. Occupation
5. Number of breeding females
6. Location and date of sale

TABLE I. Demographic Characteristics of Respondents

Characteristics		Number	Percent
FARMER TYPE			
Owner		317	82.1
Partner		45	11.7
Manager		24	6.2
	TOTAL	**386**	**100.0**
AGE			
Under 30		21	5.4
31-40		81	21.0
41-50		112	29.0
51-60		87	22.5
61 plus		86	22.1
	TOTAL	**387**	**100.0**
TYPE OF PRODUCER			
Comm. cow-calf only		168	43.4
Comm. cow-calf/background		60	15.5
Purebred		48	12.4
Cow-calf purebred		111	28.7
	TOTAL	**387**	**100.0**
OCCUPATION			
Farming		198	51.3
Off-farm employment		127	32.9
Retired/now farming		61	15.8
	TOTAL	**386**	**100.0**
# BREEDING FEMALES			
Less than 30		64	16.6
31-40		46	11.9
41-50		54	14.0
51-60		26	6.7
61 plus		196	50.8
	TOTAL	**386**	**100.0**
LOCATION-DATE OF SALE			
Performance Tested Bull Sale 12-92		50	12.8
Senior Bull Test Sale 1-93		133	34.1
Junior Bull Test Sale 11-93		51	13.1
Junior Bull Test Sale 1994		55	14.1
Performance Tested Bull Sale 12-93		44	11.3
Senior Bull Test Sale 1-94		57	14.6
	TOTAL	**390**	**100.0**

*In some cases totals will not add up to 390 because respondents chose not to answer all questions.

The first question dealing with the demographics of the respondents was the type of farmer. The choices were owner, partner, and manager. Three hundred eighty-six producers responded to this question, and an analysis of the data indicated the following: 317 (82.1 percent) were owners, 45 (11.7 percent) were partners, and 24 (6.2 percent) were managers.

The next question asked respondents to indicate their age. Three hundred eighty-seven producers responded to the question. Twenty-one (5.4 percent) were under the age of 30, 81 (21.0 percent) were from 31--40 years of age, 112 (29.0 percent) were from 41--50 years of age, 87 (22.5 percent) were from 51--60 years of age and 86 (22.1 percent) were 61 years of age, or older.

The respondents were then asked to identify the type of producer they were. Of the 387 responses to this question, 168 (43.4 percent) were commercial/cow--calf producers only, 60 (15.5 percent) were commercial/cow--calf and background producers, 48 (12.4 percent) were purebred producers and 111 (28.7 percent) were cow--calf and purebred producers.

The respondents were asked to indicate their occupations. With 386 responses, 198 (51.3 percent) were farming, 127 (32.9 percent) had off farm employment and 61 (15.8 percent) were retired and now farming.

The respondents were also asked to indicate the number of breeding females in the herd. Three hundred eighty-six producers responded to this question. Sixty-four (16.6 percent) had less than 30 breeding females, 46 (11.9 percent) had 31--40 breeding females, 54 (14.0 percent) had 51--60 breeding females, 26 (6.7 percent) had 51--60 breeding females, and 196 (50.8 percent) had 61 plus breeding females.

The researcher also included location and date of sale. Analyzing 390 surveys, 50 (12.8 percent) were from the Performance Tested Bull Sale in December 1992, 133 (34.1 percent) were from the Senior Bull Sale in January 1993, 51 (13.1 percent) were from the Junior Bull Sale in November 1993, 55 (14.1 percent) were from the Junior Bull Sale in 1994, 44 (11.3 percent) were from the Senior Bull Test Sale in January 1994.

In summary, the majority of the respondents were owners and were over the age of 30. The largest percentage of respondents were commercial cow-calf producers only or cow-calf purebred producers. The researcher found that the highest percentage of producers were farming and also that a high percentage of respondents had 61 plus breeding females in their herd.

Objective II

The second objective of the study was to determine the most important criteria used in herd sire selection by Tennessee beef producers who attended the Performance Bull Test Sales from 1992 to 1994.

The respondents were asked to indicate the perceived importance of selection criteria by rating factors important in herd bull selection when selecting or purchasing a bull for natural service in the herd. The respondents were given five choices on a Likert-type scale with one being unimportant and five being very important. The results of this analysis are reported in Table II.

The researcher found that skeletal soundness with a mean score of 4.22 and a standard deviation of 1.12 was perceived to be a very important selection criteria. Producers rated temperament as the second most important, with a mean score of 4.13 and a standard deviation of 1.21. They also rated muscle expression third, with a mean score of 4.10 and a standard deviation of 1.04.

Respondents rated breeder of bull to be the least important selection criteria with a mean score of 3.04 and a standard deviation of 1.29.

In summary the researcher found that respondents who attended Performance Tested Bull Sales in Tennessee from 1992-1994 rated skeletal soundness as a very important selection criteria and breeder of bull an unimportant selection criteria. Respondents perceived most selection criteria were important to consider when selecting a herd bull. Nine factors had a mean score of 4.00 or above.

TABLE II. Perceived Importance of Selection Criteria

Selection Criteria	Number*	Mean**	S.D.
Breed	386	4.06	1.33
Pedigree	382	3.63	1.24
Color	376	3.66	1.30
Frame	386	4.03	1.11
Skeletal Soundness	383	4.22	1.12
Muscle Expression	379	4.10	1.04
Condition	379	3.75	1.04
Scrotal Circumference	380	3.92	1.06
Temperament	381	4.13	1.21
Cost	372	3.53	1.19
Breeder of bull	375	3.04	1.29
Age of bull	378	3.25	1.14
Birth EPD	380	4.04	1.24
Weaning wt. EPD	382	4.09	1.11
Yearling wt. EPD	381	4.02	1.07
Milk EPD	385	4.09	1.17

*In most cases numbers will not add up to 390 because respondents chose not to answer some questions.

**The values for each item ranged from (1) being unimportant to (5) being very important.

Objective III

The third and final objective of the study was to determine if type of farmer, age of farmer, type of producer, occupation of producer, size of operation or sale attended relates to the perceived importance of identified selection criteria.

There were no inferential tests used in this analysis, because participants were assumed to be a population rather than a sample. However, differences in mean ratings from the respondents were analyzed in the findings. According to Morrison and Henkel (l973, p. 177-181), "substantive difference" is of equal importance to "statistical difference". Actually, substantive difference is a matter of considered opinion. Morrison and Henkel (p. 179) state that two attitude scores calculated from sub-groups of a population may be considered substantively different if their values fall upon opposing sides of the mathematical middle (or undecided) category for the overall group.

When sub-group scores of the various groups within the levels of each independent variable fell on opposing sides of the mathematical middle score, they were considered substantively different in this study.

Table III illustrates a comparison between type of farmer and the perceived importance of selection criteria. As indicated in Table III, there is no substantive difference between type of farmer and the dependent variables.

The comparison between age and the perceived importance of selection criteria is illustrated in Table IV. There was very little substantive difference between age and any of the dependent variables.

The comparison between type of producer and the perceived importance of selection criteria was reported in Table V. Table V reported no substantive differences between type of producer and any of the dependent variables.

TABLE III. Perceived Importance of Selection Criteria by Farmer Type

Selection Criteria	Farmer Type							
	owner		partner		manager		Overall	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Breed	4.04	1.35	4.20	1.22	4.04	1.30	4.06	1.33
Pedigree	3.62	1.27	3.68	1.09	3.58	1.21	3.62	1.25
Color	3.66	1.30	3.84	1.27	3.25	1.36	3.66	1.30
Frame	4.02	1.10	4.04	1.19	4.08	1.10	4.02	1.11
SK. Soundness	4.20	1.16	4.37	0.90	4.21	1.10	4.22	1.13
Mus. Expression	4.09	1.06	4.13	0.87	4.04	1.12	4.10	1.04
Condition	3.76	1.05	3.68	0.93	3.79	1.10	3.75	1.04
Sc. Circum.	3.90	1.07	3.95	1.03	4.04	1.07	3.92	1.07
Temperament	4.13	1.22	4.25	1.08	3.92	1.38	4.13	1.21
Cost	3.50	1.19	3.67	1.22	3.65	1.15	3.53	1.19
Breeder of Bull	3.03	1.31	3.14	1.20	3.00	1.25	3.04	1.29
Age of Bull	3.24	1.13	3.39	1.20	3.13	1.22	3.25	1.14
Birth EPD	4.00	1.27	4.33	1.09	4.13	1.19	4.04	1.24
W. Wt. EPD	4.06	1.14	4.25	0.89	4.13	1.08	4.09	1.11
Yr. Wt. EPD	3.99	1.10	4.32	0.86	3.83	1.05	4.02	1.08
Milk EPD	4.08	1.18	4.30	1.05	3.79	1.28	4.09	1.18

Three hundred eighty-six respondents identified their status on this variable. Three hundred seventeen were owners, 45 were partners, and 24 were managers. Although some respondents may have failed to answer every question, numbers remained relatively constant for each selection criteria.

TABLE IV. Perceived Importance of Selection Criteria by Age of Respondents

Selection Criteria	Age of Respondents											
	Under 30		31--40		41--50		51--60		61 plus		overall	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Breed	3.90	1.26	3.95	1.31	4.15	1.33	4.07	1.31	4.07	1.40	4.06	1.33
Pedigree	3.76	0 .77	3.49	1.28	3.75	1.15	3.69	1.25	3.51	1.39	3.63	1.24
Color	3.62	1.24	3.48	1.28	3.70	1.36	3.69	1.32	3.73	1.25	3.65	1.30
Frame	4.10	0.77	3.89	1.08	3.93	1.17	4.24	1.04	4.02	1.17	4.02	1.11
SK. Soundness	4.33	0.97	3.93	1.21	4.29	1.11	4.43	0.96	4.13	1.22	4.21	1.13
Mus. Expression	4.19	0.93	3.85	1.03	4.18	1.10	4.21	0.92	4.08	1.08	4.10	1.04
Condition	3.81	0.98	3.61	0.97	3.79	1.03	3.79	1.02	3.76	1.14	3.75	1.04
Sc. Circum.	3.90	0.83	3.73	1.05	3.89	1.17	4.17	0.87	3.87	1.15	3.91	1.06
Temperament	4.00	1.10	3.87	1.27	4.17	1.16	4.25	1.05	4.20	1.38	4.12	1.21
Cost	3.62	0.97	3.70	1.07	3.45	1.26	3.43	1.25	3.53	1.22	3.53	1.19
Breeder of Bull	3.86	1.11	2.79	1.16	3.13	1.31	3.05	1.36	3.20	1.34	3.04	1.29
Age of Bull	3.43	1.08	3.00	1.06	3.14	1.03	3.42	1.23	3.41	1.24	3.25	1.14
Birth EPD	3.95	1.12	3.92	1.24	3.96	1.28	4.27	1.11	4.06	1.33	4.04	1.24
W. Wt. EPD	4.14	0.96	3.94	1.06	401	1.10	4.23	1.03	4.04	1.29	4.09	1.11
Yr. Wt. EPD	4.29	0.85	3.79	1.08	4.00	1.10	4.13	1.03	4.07	1.13	4.02	1.08
Milk EPD	4.19	0.87	3.99	1.21	4.10	1.14	4.10	1.23	4.12	1.21	4.09	1.18

Three hundred eighty-seven respondents identified their status on this variable. Twenty one were under 30, 81 were from 31-90, 112 were from 41-50, 87 were from 51-60, and 86 were 61 plus. Although some respondents may have failed to answer every question, numbers remained relatively constant for each selection criteria.

TABLE V. Perceived Importance of Selection Criteria by Type of Producer

Selection Criteria	Type of Producer									
	Com\CC\only		Com\CC\Bkgrnd		Purebred		CC Purebred		Overall	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Breed	3.87	1.34	4.15	1.16	3.89	1.59	4.36	1.22	4.06	1.33
Pedigree	3.36	1.24	3.45	1.28	3.80	1.28	4.04	1.11	3.63	1.25
Color	3.63	1.19	3.57	1.28	3.32	1.62	3.90	1.30	3.66	1.30
Frame	4.14	1.07	4.12	0.90	3.46	1.34	4.05	1.11	4.02	1.11
SK. Soundness	4.17	1.11	4.39	0.97	4.08	1.32	4.25	1.15	4.22	1.13
Mus. Expression	4.09	1.01	4.15	0.97	3.96	1.24	4.13	1.03	4.10	1.04
Condition	3.81	1.08	3.77	0.96	3.51	1.12	3.77	0.98	3.75	1.04
Sc. Circum.	3.91	1.10	3.97	0.91	3.81	1.10	3.95	1.09	3.92	1.07
Temperament	4.09	1.27	4.02	1.13	4.28	1.26	4.17	1.15	4.12	1.21
Cost	3.68	1.19	3.59	0.98	3.18	1.34	3.44	1.20	3.54	1.19
Breeder of Bull	3.02	1.26	2.88	1.22	2.94	1.24	3.22	1.38	3.05	1.29
Age of Bull	3.34	1.18	3.46	0.93	2.89	1.05	3.16	1.20	3.25	1.14
Birth EPD	4.08	1.26	4.12	1.05	3.72	1.31	4.08	1.26	4.04	1.24
W. Wt. EPD	4.10	1.09	4.03	0.96	3.90	1.24	4.19	1.15	4.09	1.11
Yr. Wt. EPD	4.04	1.03	4.10	0.86	3.67	1.31	4.11	1.13	4.02	1.08
Milk EPD	4.07	1.20	4.08	1.00	3.88	1.35	4.21	1.14	4.09	1.18

Three hundred eighty-seven respondents identified their status on this variable. One hundred sixty-eight were commercial cow-calf only, 60 were commercial cow-calf background, 48 were purebred and 111 were commercial cow-calf purebred. Although some respondents may have failed to answer every question, numbers remained relatively constant for each selection criteria.

The comparison between occupation and the perceived importance of selection criteria is reported in Table VI. There was very little substantive difference between occupation and any of the dependent variables.

The comparison between the number of breeding females and the perceived importance of selection criteria is reported on Table VII, which again indicated little substantive differences between number of breeding females and the perceived importance of selection criteria.

The comparison between location/date of sale and the perceived importance of selection criteria was reported in Table VIII. There was very little substantive difference between the location/date of sale and the perceived importance of selection criteria.

TABLE VI. Perceived Importance of Selection Criteria by Occupation

Selection Criteria	Occupation							
	farming		off farm emp.		retired--farming		Overall	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Breed	4.04	1.31	4.01	1.39	4.25	1.22	4.06	1.32
Pedigree	3.62	1.29	3.65	1.15	3.66	1.28	3.63	1.24
Color	3.76	1.32	3.50	1.23	3.68	1.32	3.66	1.29
Frame	4.10	1.12	3.83	1.08	4.22	1.03	4.03	1.10
SK. Soundness	4.26	1.13	4.03	1.17	4.48	0.89	4.22	1.12
Mus. Expression	4.17	1.05	3.92	1.03	4.29	0.92	4.10	1.03
Condition	3.81	0.99	3.58	1.07	3.95	1.05	3.76	1.04
Sc. Circum.	3.99	1.03	3.76	1.07	4.07	1.09	3.93	1.06
Temperament	4.14	1.23	3.93	1.20	4.49	1.04	4.13	1.20
Cost	3.62	1.18	3.38	1.20	3.54	1.21	3.53	1.19
Breeder of Bull	3.09	1.26	2.89	1.28	3.20	1.38	3.04	1.29
Age of Bull	3.29	1.11	3.10	1.12	3.47	1.24	3.26	1.14
Birth EPD	4.08	1.21	3.88	1.30	4.31	1.13	4.05	1.23
W. Wt. EPD	4.10	1.09	3.94	1.15	4.46	0.97	4.10	1.10
Yr. Wt. EPD	4.02	1.07	3.86	1.13	4.42	0.79	4.03	1.07
Milk EPD	4.08	1.17	3.99	1.21	4.38	1.06	4.10	1.17

Three hundred eighty-six respondents identified their status on the variable. One hundred ninety eight were farming, 127 had off-farm employment, and 61 were retired and now farming. Although some respondents may have failed to answer every question, numbers remained relatively constant for each selection criteria.

TABLE VII. Perceived Importance of Selection Criteria by Number of Breeding Females

Selection Criteria	Number of Breeding Females											
	Under 30		31--40		41--50		51--60		61 plus		overall	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Breed	4.13	1.44	3.96	1.38	4.43	1.02	3.96	1.28	3.98	1.34	4.07	1.32
Pedigree	3.68	1.27	3.64	1.18	3.77	1.06	3.48	1.45	3.60	1.28	3.63	1.24
Color	3.63	1.31	3.52	1.45	3.81	1.28	3.50	1.27	3.69	1.27	3.67	1.30
Frame	3.84	1.19	4.07	1.18	4.19	0.95	4.20	0.82	4.02	1.12	4.03	1.10
SK. Soundness	4.13	1.17	4.07	1.42	4.49	0.81	4.04	0.79	4.24	1.12	4.22	1.12
Mus. Expression	4.06	0.94	3.93	1.14	4.35	0.86	4.04	0.98	4.10	1.07	4.10	1.03
Condition	3.54	1.06	3.75	1.22	3.92	0.95	3.46	1.07	3.81	1.00	3.75	1.04
Sc. Circum.	3.74	1.02	3.98	1.01	4.17	0.94	4.04	1.04	3.88	1.11	3.92	1.06
Temperament	3.95	1.28	4.09	1.22	4.37	1.07	4.35	0.89	4.10	1.24	4.13	1.20
Cost	3.37	1.33	3.70	1.15	3.53	1.14	3.50	0.91	3.55	1.21	3.53	1.19
Breeder of Bull	3.15	1.30	2.98	1.45	3.10	1.15	3.16	1.28	2.99	1.28	3.04	1.28
Age of Bull	3.00	1.09	3.23	1.38	3.46	1.02	3.19	1.13	3.28	1.12	3.24	1.14
Birth EPD	3.94	1.27	3.98	1.37	4.33	0.88	3.92	1.16	4.03	1.30	4.04	1.24
W. Wt. EPD	3.98	1.20	4.13	1.08	4.34	0.88	3.92	1.15	4.08	1.12	4.10	1.10
Yr. Wt. EPD	3.85	1.20	3.91	1.12	4.25	0.81	3.77	0.90	4.08	1.08	4.03	1.07
Milk EPD	3.97	1.20	4.07	1.34	4.26	0.86	4.00	1.13	4.11	1.20	4.10	1.17

Three hundred eighty-six respondents identified their status on this variable. Sixty-four had fewer than 30 breeding females, 46 had 31-40 breeding females, 54 had 41-50 breeding females, 26 had 51-60 breeding females and 196 had 61 or more breeding females. Although some respondents may have failed to answer every question, numbers remained relatively constant for each selection criteria.

TABLE VIII. Perceived Importance of Selection Criteria by Location--Date of Sale

Selection Criteria	Location Date of Sale													
	PTB Sale 12--92		SRBT Sale 1--93		JRBT Sale 11--93		JRBT Sale 1994		PTB Sale 12-93		SRBT Sale 1--94		overall	
	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.	Mean	S.D.
Breed	4.08	1.12	4.06	1.40	3.98	1.29	4.36	1.21	4.07	1.35	3.79	1.04	4.06	1.33
Pedigree	3.82	1.07	3.72	1.24	3.32	1.25	3.63	1.25	3.55	1.28	3.60	1.34	3.63	1.24
Color	3.48	1.27	3.58	1.37	3.70	1.30	3.89	1.17	3.67	1.29	3.70	1.30	3.66	1.24
Frame	4.10	0.97	4.05	1.17	4.06	0.95	4.13	1.02	3.77	1.38	3.98	1.07	4.03	1.11
SK. Soundness	4.33	1.03	4.28	1.15	4.18	1.12	4.20	1.02	4.02	1.27	4.16	1.17	4.22	1.12
Mus. Expression	4.36	0.90	4.12	1.09	4.02	1.03	4.07	.93	3.98	1.13	4.00	1.06	4.10	1.04
Condition	3.86	1.12	3.81	0.97	3.92	1.09	3.58	1.15	3.61	1.08	3.62	0.87	3.75	1.04
Sc. Circum.	4.02	0.98	3.95	1.08	3.84	1.09	3.91	0.91	4.02	1.19	3.78	1.14	3.92	1.06
Temperament	4.16	1.08	4.20	1.23	4.45	1.06	3.96	1.12	3.82	1.48	4.06	1.20	4.13	1.21
Cost	3.65	1.18	3.60	1.22	3.98	1.08	3.30	1.28	3.20	1.19	3.33	1.00	3.53	1.19
Breeder of Bull	3.02	1.24	3.05	1.34	2.90	1.12	3.17	1.25	2.80	1.32	3.23	1.38	3.04	1.29
Age of Bull	3.23	1.12	3.29	1.16	3.31	1.14	3.19	1.08	3.44	1.10	3.05	1.19	3.25	1.14
Birth EPD	3.96	1.17	4.07	1.26	4.15	1.27	4.05	1.13	4.09	1.41	3.93	1.22	4.04	1.24
W. Wt. EPD	4.18	0.98	4.18	1.11	4.00	1.21	4.00	1.11	4.02	1.19	4.02	1.09	4.09	1.11
Yr. Wt. EPD	4.14	0.99	4.05	1.14	4.08	1.05	4.02	1.05	3.98	1.02	3.82	1.09	4.02	1.07
Milk EPD	4.26	0.88	4.11	1.24	4.22	1.01	3.96	1.17	4.02	1.36	3.93	1.23	4.09	1.17

There were 390 valid cases for selecting criteria by location-date of sale. Fifty were at the Performance Tested Bull Sale I2-'92, I33 were at the Senior Bull Sale - I-'93, 51 were at the Junior Bull Sale 11-'93, 55 were at the Junior Bull Sale I994, 44 were at the Performance Tested Bull Sale 12-'93, and 57 were at the Senior Bull Test Sale - 1-'94.

CHAPTER V

SUMMARY OF MAJOR FINDINGS

The purpose of Chapter V is to provide a general overview of the need, purpose, and methodology of the study as well as to discuss major findings, conclusions and recommendations for improvement.

Need for the Study

The role of the beef industry has become quite challenging. It must continually improve total efficiency of the herd through breeding while reducing production costs.

Mumford (1908) stated that perhaps no other important factor connected with beef production is disregarded so often as that of the selection of bulls to head the herd. Minnish and Fox (1982) concur that "Selection represents the major directional force available to the beef producer for creating genetic change."

Consequently, there will always be a need for sire selection as long as beef producers use herd bulls for natural service.

Purpose and Objectives of the Study

The purpose of this research project was to evaluate criteria Tennessee beef producers used to select herd bulls. The study was based upon respondents' ratings of important factors used when selecting bulls for natural service herds.

The objectives of the study were to (1) describe the respondents demographically; (2) determine the most important criteria used in herd sire selection by Tennessee beef producers who attended the Performance Bull Test Sales from 1992-1994; and (3) determine if type of farmer, age, type of producer, occupation, size of operation, or sale attended relates to the perceived importance of identified selection criteria.

Review of Literature

The literature section attempted to review the history of the cattle movement and to determine the importance of criteria for sire selection.

According to Williams (1941), cattle are not native to the Western Hemisphere. Columbus in 1493 brought cattle with him on his second voyage to the West Indies. The Spaniards introduced them to Florida, Mexico, and the West Indies in the 16th century. Beginning with the American Revolution and extending through the War of 1812, a great number of cattle moved westward. Many years of breeding, selecting, and raising cattle evolved due to these movements.

Today, it is estimated that there are more than 65 different breeds of beef cattle in the United States. There is tremendous pressure, therefore, to identify the strong points and maximize these strengths through sound selection programs. With the diversity of cattle types available, the producer literally can mold the kind of cattle he wants to produce (Wiley, 1986).

Digging (1952) said the building of a good herd of breeding cattle is a long-time proposition. One needs to establish a goal for the breeding program and then use selection criteria for purchasing a bull that has the potential to reach those goals. Crouch (1989) concurred, "The bull you decide to use should

match the situation that exists in your operation." In other words, cattlemen should know their herd well and be able to efficiently make changes for improvement where needed.

Neuman (1986) stated that the breeder must identify the traits important for his breed, determine how to measure these traits, and choose a breeding program to maximize improvements of these traits. Neuman added that trying to select for too many traits at one time might result in little improvement in any one trait. On the other hand, selection for a single trait, to the exclusion of all others, can indirectly damage other important productive traits.

Great transition is taking place in the beef industry today. Therefore, evaluation of many criteria to meet specific needs in a producer's program is important. Success in the beef industry depends on being efficient and profitable. All selection criteria need to be analyzed and utilized as they are needed in a specific breeding program.

Methodology

Identification of the Population: The population for the study was 390 beef producers who attended the Tennessee Performance Tested Sales from 1992 to 1994. The survey was distributed at the Performance Tested Bull Sales where beef producers are usually looking for bulls. The secondary data had already been collected as an on-going study by the UT. Extension Animal Science Specialist, Dr. Jim Neel.

A convenience sampling technique was used. The surveys were handed out randomly to participants of the performance tested sales. Surveys were also stationed at visible locations around the sale site. Participants who purchased a bull could turn the survey in when they paid for the bull. Respondents who did

not purchase a bull could drop a survey in one of the collection boxes. The sampling method was not perfect and had limitations due to the fact that some producers chose not to participate and did not return the completed survey.

Instrumentation: The instrument was a survey handed out to participants at the Performance Tested Sales in Tennessee from 1992-1994.

A Likert-type attitudinal scale was utilized in rating perceived importance of selection criteria. The survey was designed to be easy for respondents to answer while maintaining a high level of reliability.

Data Analysis: Data analysis was performed using the Statistical Package for the Social Scientist (SPSS Release 4.1) which is available on the IBM 3081 mainframe computer at the University of Tennessee Computing Center. Frequency distribution, means, and standard deviations were used to report findings related to the objectives of the study.

Major Findings

The first objective was to describe the respondents demographically. Results from the study concluded that 317 (82.1 percent) were owners, 45 (11.7 percent) were partners, and 24 (6.2 percent) were managers. The researcher found that 21 (5.4 percent) were under the age of 30, 81 (21.0 percent) were from 31-40 years of age, 112 (29.0 percent) were from 41-50 years of age, 87 (22.5 percent) were from 41-60 years of age, and 86 (22.1 percent) were 61 or more years of age. The respondents indicated that 168 (43.4 percent) were commercial/cow-calf producers only, 60 (15.5 percent) were commercial/cow-calf and background producers, and 111 (28.7 percent) were cow-calf and purebred producers. The researcher discovered that 198 (51.3 percent) were farming,

127 (32.9 percent) had off-farm employment, and 61 (15.8 percent) were retired and now farming.

The replies of respondents indicated that 64 (16.6 percent) had fewer than 30 breeding females, 46 (11.9 percent) had 31-40 breeding females, 54 (14.0 percent) had 41-50 breeding females, 26 (6.7 percent) had 51-60 breeding females, and 196 (50.8 percent) had 61 plus breeding females.

Location and date of sale was included, and 50 (12.8 percent) were from the Performance Tested Bull Sale in December 1992, 133 (34.1 percent) were from the Senior Bull Sale in January 1993, 51 (13.1 percent) were from the Junior Bull Sale in November 1993, 55 (14.1 percent) were from the Junior Bull Sale in 1994, 44 (11.3 percent) were from the Performance Tested Bull Sale in December 1993, and 57 (14.6 percent) were from the Senior Bull Sale in January 1994.

The second objective was to rate the most important criteria used in herd sire selection by Tennessee Beef Producers who attended the Performance Tested Bull Sales from 1992 to 1994. The researcher found that skeletal soundness with a mean score of 4.22 and a standard deviation of 1.12 was perceived a very important selection criteria. Producers rated temperament second with a mean score of 4.13 and a standard deviation of 1.21. They rated muscle expression third with a mean score of 4.10 and a standard deviation of 1.04. The respondents indicated that breeder of bull was rated the least important selection criterion with a mean score of 3.04 and a standard deviation of 1.29.

The third and final objective of the study was to determine if type of farmer, age, type of producer, occupation, size of operation or sale attended relates to the perceived importance of identified selection criteria.

Findings from the study indicated little or no substantive difference in respondents' perceived importance of any of the selection criteria as related to type of farmer, age, type of producer, occupation, size of operation, or sale attended. However, the respondents considered all criteria to be important. The selection criteria perceived least important was breeder of bull (overall mean score of 3.04) which was still interpreted to be slightly above average importance on the rating scale.

Implications

The Tennessee Performance Tested Bull Sales provide a bi-annual gathering of beef producers who are interested in purchasing a bull to improve their breeding program. A beef producer's perceived importance of selection criteria is an important factor when selecting a breeding animal. Most every producer has a different opinion as to what is the single most important selection criteria. The reason for this is that different breeding programs have different goals, so while some producers select for EPD's, others select for frame, or muscling, etc. In the future, beef producers may select for a balance or combination of traits to meet their goals in the challenging beef industry.

This study indicated that skeletal soundness was rated the most important selection criteria for producers.

Texas Tech University conducted a survey in 1993 that suggested reproductive soundness was the most important trait beef cattle producers selected for. Body composition (muscling fat) was ranked second in importance and growth potential was ranked third. Show ring record was considered the least important selection criteria. More than 300 purebred and 700 commercial producers were involved in that study.

Kansas State University conducted a similar survey in 1993 of 312 commercial producers to determine the importance of selection criteria used in buying bulls. Calving ease had the highest percentage of importance among producers. Birth weight ranked second while frame score tied conformation/visual appraisal for third rank. This survey displayed a shift from a similar survey conducted in 1981 (Cattleman's Day, 1982) where growth rates received major consideration (Simms, 1994).

In a Master's Study conducted at the University of Tennessee, Steelman (1993) reported that respondents at the Breeder's Performance Bull Sale perceived "descriptive criteria" more important than "performance criteria" and "birth weight" as the single most important selection criteria. Respondents in Steelman's study perceived all criteria to be important. That study examined individuals who participated through the Breeder Performance Testing Program from 1982 to 1992.

Comparison of these studies indicated that geographic location and date the study was conducted relate to the perceived importance of selection criteria. Preston (1974) believed the order of precedence will depend, in part, on geographic location in the sense that characteristics important in one area of the world may be of little value in another.

Another implication to consider is the lack of substantive difference between type of farmer, age, type of producer, occupation, size of operation, or sale attended and the perceived importance of selection criteria. Nonetheless, beef producers implied that all criteria were important. Therefore, all selection criteria should be considered when selecting a herd sire.

Selection of the breeding stock is an important element in the breeding program, and that is where beef producers need to make continual improvement.

Recommendations for Further Study

The following factors may affect the results of additional studies:

1. Further research is needed to determine if respondents at the Tennessee Performance Bull Sales actually understood the importance of all selection criteria to utilize in selecting a herd sire to improve their breeding programs.
2. Further study would be in order to determine the interrelationship between level of education and the perceived importance of selection criteria.
3. This study should be replicated every two years to determine how beef producers rate identified selection criteria as trends in the beef industry change.

Recommendations for Improvement

The following factors should be considered to bring about improvement:

1. Derive positive relationships between successful breeding programs that utilize selection criteria to make their programs efficient and profitable.
2. Provide continuing educational programs for beef producers containing information geared toward making improvements and focusing on trends that are occurring in the beef industry.
3. Evaluate the survey each year, making continual improvements to aide in understanding all questions on the survey.
4. Make the survey available state wide. Allow opportunity to get responses from all livestock events in Tennessee in order to get a better overall population involved in the study.

LIST OF REFERENCES

Literature Cited

Bible, E. (Ed.). (1993, April). *Cattlemen value Reproductive Soundness.* Polled Hereford World, p. 142.

Bingman, E. & Bingman, Judy. (Ed.). (1991, February). *Natural vs. A.I.* Angus Topics, p. 16.

Bourdon, R. M. & Brinks, J.S. (1990, February). *Sire Selection vital for Replacement Production.* Limousine World, p. 108.

Cook, B.R., Tess, M. W., & Kress, D. D. (1993, March). *Effects of Selection Strategies using Heifer Pelvic area and Sire Birth Weight expected Progeny Difference in Pystocia in First Calf Heifers.* Journal of Animal Science, 71, p. 607.

Crouch, J. & Wilson, Doyle. (1989, Fall). *With a Young Angus Breeder Regarding National Cattle Evaluation.* American Angus Association Sire Evaluation Report, pp. 1-3.

Curl, T. (1978) Beef Cattle Book. Alabama: Oxmoor House, Inc. Digging, R., Bundy, C.E., & Christensen, V. (1984). Beef Production. New Jersey: Prentice Hall, Inc.

Doubet, Jim (1993, November). *Performance Survey Results.* American Salers, p. 15.

Fichte, B.E. (1965). The Progressive Farmer's Beef Cattle Book. Georgia: Progressive Farmer Company.

Field, T. & Morgan, B. (1993, Spring). *Pick Cows to Produce Kind of Cows Desired.* Beef, pp. 36-38.

Henderson, G. & Suther, S. (1990, July). *Sire Selection-Most Important Decisions.* Beef Digest, pp. 3-4.

Henderson, G. (1993, February). *Do You Really Need a Bull?* Drover's Journal. 121, pp. 14-15.

Holland, M. (1990-91). *Research Shows High Accuracy Birth Weight EPD's Pay Off.* Cattlemen's Polled Hereford Bull Guide, *p.1.*

Hough, J., Dr., & Middleton, B., Dr. (1992, Fall). *Forward.* American Polled Hereford Sire Summary, p. 2.

Hough, J., Dr., & Middleton, B., Dr. (1992, Spring). *Finding Herd Sires.* American Polled Hereford Sire Summary, p. 15.

Jarriage, R. & Beranger, C. (1992). Beef Cattle Production. New York: Elsevier.

Jenkins, J.T. (1989, June/July). *Gene Pool-Testes in Bulls Predict Fertility Ails.* Beef Week, p. 23.

Kirkpatrick, F. David, Dr. (1993, Winter). *Selecting the Best Bull.* Beef Cattle Time, (Available from the University of Tennessee, Knoxville, TN).

Knop, F. (Ed.). (1993, October). *Help Keep the EPD System Strong.* Drover's Journal. 121, p. 48.

Knop, F. (Ed.). (1993, May). *Insights into the Big EPD Tradeoff.* Drover's Journal. 125, p. 31.

Lane, C. D., Jr., Dr. (N.A.). *Selection and Management of the Herd Sire.* Tennessee Beef Cow-Calf Handbook, p. 1053, (Available from the University of Tennessee, Knoxville, TN).

Mallinokrodt, Craig, Dr. (1993, November). Breeding Made Simple. American Salers, p. 23.

Marshall, D. M. & Long, M. B. (1993, September). *Relationship of Beef Sire EPD to Maternal Performance of Crossbred Daughters.* Journal of Animal Science. 71. p. 2374.

Miller, B. (1990, November/December). *Spread out your Sire Power.* Beef Today, pp. 16-18.

Minish, G. L. & Fox, D. G. (1982). Beef Production and Management. Virginia: Reston Publishing Company, Inc.

Morrison, D.E. and Henkel, R.E. (1973). The Significance Test Controversy. Chicago: Aldine Publishing Company.

Mumford, H. W. (1908) Beef Production. U.S.A.: H. W. Mumford.

Neuman, A. L. & Lusby, K. S. (1986). Beef Cattle. New York: John Wiley and Sons.

Nichols, C.G., and others. (1985). 1985 Beef Cattle Research Report. Progress Report 291. pp. 22-24, (Available from the University of Kentucky, Lexington, KY).

Northcutt, S. L. & Wilson, D. E. (1993, May). *Genetic Parometre Estimates and Expected Progeny Differences For Mature Size in Angus Cattle.* Journal of Animal Science. 71, p. 1153.

O'Mary, C. C. & Dyer, I. A. (Ed.). (1978) New York: Lea and Febiger.

Preston, T. R. & Willis, M. B. (1974). Intensive Beef Production. New York: Pergamon Press.

Pope, L. S. (Ed.). (1989), Beef Cattle Science Handbook, p.23. Texas: Lang Printing, Inc.

Simms, D.D. and others. (1994). "Commercial Cattle Producers: Bull Selection Criteria. Cattleman's Day. pp. 56-59.

Snapp, R. R. (1952) Beef Cattle. New York: John Wiley and Sons, Inc.

Startsev, D. I. & Burlakov, N. M. (Eds.). (1961). Cattle Husbandry. Moskua: M. Fleischman.

Steelman, Thomas Bruce. (1993). Selection Criteria Used When Purchasing Bulls at the Breeders Performance Tested Bull Sale. TN: The University of Tennessee.

Taylor, R. (NA), *Bull Selection*. Southern Regional Beef Cow-calf Handbook. Colorado: Colorado State University.

Thomas, V. M. (1986). Beef Cattle Production, an Integrated Approach. Pennsylvania: Lea and Febriger.

Wentworth, E. N. (1923). Progressive Beef Cattle Raising. Illinois: Armour's Livestock Bureau.

Williams, D.W. (1941). Beef Cattle Production in the South. Illinois: The Interstaff Printers and Publishers.

Yeates, N. T. M. & Schmidt, P. J. (1974). Beef Cattle Production Canada: Butterworth and Co., LTD.

APPENDIX

HERD BULL SELECTION CRITERIA SURVEY

1. I am a farm (a) owner____ (b) partner____ (c) manager_____.
2. My age is (a) under 30____ (b) 31-40____ (c) 41-50_____ (d) 51-60_____ (e) 61 +_____.
3. Check the types of beef production that describe your operation. (a) Commercial cow-calf only____ (b) cow-calf and purebred____ (c) Commercial cow-calf & background_____ (d) Purebred_____
4. What is your primary occupation? (a) Farming____ (b) Off-farm employment_____ (c) Retired from a job, now farming_____.
5. What is the number of breeding females in your herd? (a) less than 30___ (b) 31-40___ (c) 41-50___ (d) 51-60___ (e) 61+___.
6. Factors important in Herd Bull Selection: Rate the following as being important to you in selecting and purchasing a bull for natural service in your herd. Rate these items on a scale of 1 to 5 with 1 not being important and 5 being very important.

A.	Breed	1 2 3 4 5
B.	Pedigree	1 2 3 4 5
C.	Color	1 2 3 4 5
D.	Frame	1 2 3 4 5
E.	Skeletal Soundness	1 2 3 4 5
F.	Muscle Expression	1 2 3 4 5
G.	Condition	1 2 3 4 5
H.	Scrotal Circumference	1 2 3 4 5
I.	Temperament	1 2 3 4 5
J.	Cost	1 2 3 4 5
K.	Breeder of Bull	1 2 3 4 5
L.	Age of Bull	1 2 3 4 5
M.	Birth EPD	1 2 3 4 5
N.	Weaning Weight EPD	1 2 3 4 5
O.	Yearling Weight EPD	1 2 3 4 5
P.	Milk EPD	1 2 3 4 5

VITA

Dale Carter Rose was born on October 19, 1964, to Donald David Rose and Dorothy Carter Rose of Gray, Tennessee, in Washington County. He attended Daniel Boone High School in Gray where he was active in 4-H and FFA clubs. In 4-H he exhibited livestock at various shows across Tennessee. Feeder pigs, market lambs, finished steers, and registered heifers were all a part of his livestock project. He was also the State High Individual in livestock judging, a member of the State Winning Livestock Judging Team, and a State Winner in Citizenship. In FFA he was runner-up on the Livestock Judging Team and received the State Farmer Degree. All of this was accomplished while growing up on the family farm.

He entered the University of Tennessee, Knoxville, in the fall of 1983 where he chose to major in Animal Science. While at UT, he served on four judging teams including UT Livestock Judging Team, UT Meats Judging Team, UT Aksarben Live-Animal Evaluation Team, and the UT Academic Quadrathelon Team. He served as UT Block N Bridle Club President, and Alpha Gamma Rho Secretary, and was student manager of Brehm Animal Science Arena. He was recipient of the Outstanding Junior Award in the College of Agriculture, the M. Jacob's Award in Animal Science, and the McNally Award for Livestock Judging. He received a Bachelor of Science Degree in Agriculture in December, 1987, with a major in Animal Science and a minor in Agriculture Business.

He was employed by the Agriculture Experiment Station in December, 1989, as a Research Assistant at the Blount Farm Beef Cattle Unit. While employed at UT, he served as advisor to the UT Block N Bridle Club and as Contest Superintendent for the Mid-South Fair Collegiate Livestock Judging Contest . In addition, he has judged various livestock shows across Tennessee.

In January, 1991, he enrolled in the Extension Winter School at the University of Tennessee, Knoxville. He completed his Masters degree program in November of 1994. In his spare time, he owns and runs a registered cattle and commercial cow-calf operation.