

# Factors Affecting the Sale Price of Bulls Consigned to a Graded Sale

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## Abstract

Selection or replacement of a herd bull is an important decision for cow-calf producers. To justify the price paid for a bull, cattlemen may utilize several criteria. They must also determine if the specific selection criteria used add or detract from the value of a particular animal. The study reported here evaluated 13 years of data presented to bull buyers at a graded bull auction in Florida.

Results of this study indicated that buyers placed significant emphasis on the following criteria: grade of bull, age, birth weight, sale weight, breed and year of sale. Buyers paid more for a bull evaluated as having superior phenotype and breeding potential. Younger bulls were preferred to older bulls, and bulls with increasing birth weights were discounted. While expected progeny differences (EPD) data are considered a useful selection tool, observations from this study suggest that progeny information had little or no effect on buying decisions, and thus the value of a particular bull. There was, however, a significant effect of breed on sale price: Angus bulls were the preferred breed and sold at a premium compared to other breeds consigned. Year of sale affected the price paid for a bull, with some years more significant than others. In general, producers at this sale did not discount or show prejudice to bulls brought from out-of-state.

## Résumé

La sélection ou le remplacement du taureau dans un troupeau est une importante décision pour les producteurs vaches-veaux (bovins allaitants). Afin de justifier le prix payé pour un taureau, les producteurs bovins doivent utiliser plusieurs critères de sélection. Les producteurs doivent aussi déterminer si les critères de sélection spécifiques rajoutent de la valeur à un animal en particulier ou occasionnent des pertes. Notre étude examine 13 années de données présentées à des acheteurs de taureaux à un encan de taureaux classés de la Floride.

Les résultats de l'étude indiquent que les acheteurs mettent l'accent sur les critères suivants : le classement du taureau, l'âge, le poids à la naissance, le poids à la vente, la race et l'année de vente. Les acheteurs payaient plus chers pour des taureaux jugés supérieurs au niveau du phénotype et du potentiel de reproduction. Les jeunes taureaux étaient préférés aux animaux plus âgés alors que les taureaux plus lourds à la naissance étaient dépréciés. Bien que les données sur les écarts prévus dans la descendance soient considérées comme un outil de sélection important, les résultats de l'étude suggèrent que l'information sur la progéniture n'influçait peu ou pas les décisions d'achat et donc la valeur d'un taureau en particulier. Il y avait toutefois un effet significatif de la race sur le prix de vente : les taureaux de race Angus étaient préférés et se vendaient en priorité par rapport aux autres races présentes. L'année de vente influçait le prix payé pour un taureau et quelques années étaient plus significatives que d'autres. En général, les producteurs lors de cette vente ne dévaluaient pas les taureaux provenant des autres états.

## Introduction

Bull replacement for a beef herd is a major cost for cow-calf producers, and some sell for significantly more money than others. Two underlying factors must be considered when purchasing a bull. First is the capital cost per calf produced resulting from the cost of the bull. This is a function of the purchase price of the bull, management costs, salvage value and the number of calves he produces. The second economic aspect of bull management relates to the genetics contributed by the bull. Major financial and production benefits can be achieved by using bulls whose progeny have higher productivity through improved fertility, growth, temperament, survival and carcass attributes.<sup>16</sup>

Numerous studies have evaluated different characteristics for beef cattle, and the performance, reproductive or economic values associated with these characteristics.<sup>4,13,14,18,19,22</sup> Heritability is often mentioned when looking at animal breeding. Heritability is defined

as the percentage of a phenotypic trait affected by genetics, or the fraction of the variability in a trait caused by genetic differences. There are heritability estimates for traits associated with beef cattle. For example, estimates for the heritability of scrotal circumference, weaning weight and maternal weaning weight were reported as .46, .25 and .19, respectively.<sup>10</sup> Heritability for lifetime gain and 365-day weight have been reported as .2 and .5, respectively.<sup>19</sup> In another study heritability across different beef breeds for preweaning average daily gain (ADG), test-station ADG, height, fat thickness and scrotal circumference were .25, .44, .85, .49 and .53, respectively.<sup>6</sup> Reported heritability estimates for age of puberty ranged from 0.16 to 0.27.<sup>1,15</sup> Heritability estimates for carcass traits in Hereford bulls have been reported as .24 for fat thickness, .41 for slaughter weight, .31 for carcass weight, .28 for rib eye area, .33 for marbling, .24 for yield grade and .23 for cutability.<sup>11</sup>

Heritability estimates for Brahman cattle have also been reported,<sup>19</sup> and were similar to other reports. Relatively high heritability estimates greater than .40 were found for body weight at slaughter .59, rib eye area .50, quality grade .42, yield grade .46 and calpastatin enzyme activity .45. Moderate heritability estimates between .20 to .39 were obtained for feedlot ADG .33, back-fat thickness .36, marbling score .37, seven and 14-day shear force .29 and .20 and hump height .38. Low estimates for heritability less than .20 were found for skeletal maturity .10, lean maturity .00 and percent kidney, pelvic and heart fat .00.<sup>20</sup>

Genetic evaluation programs designed by purebred breed associations have resulted in a powerful tool, expected progeny differences (EPD), which provide information on genetic merit of a bull. An EPD predicts how future progeny of a sire can be expected to perform for selected traits compared to the breed average. EPD values are commonly published in a seedstock producer's sale catalogue. The intent is to provide information on a bull's genetic merit, and assist producers when evaluating bulls within a breed for the purpose of making sire selection decisions.<sup>5,7,8,20</sup>

The age of a bull is a consideration when selecting herd sires. Yearling bulls selected for breeding soundness have been shown, upon maturation, to produce pregnancy rates comparable to mature bulls.<sup>3,9,12,21</sup> In addition, there are economic and some herd health advantages to purchasing and maintaining yearling bulls instead of older bulls. Yearling bulls are less likely to transmit sexually transmitted diseases like trichomoniasis, and use of yearling bulls provides an opportunity to improve the growth, carcass characteristics and reproductive traits of beef cattle by shortening the generation interval.<sup>1</sup>

Scrotal circumference is often used as an indicator of a bull's fertility, and has been reported to be favorably

associated with female fertility.<sup>2</sup> The correlation between scrotal circumference and age at puberty for heifers has been reported to range from -0.15 to -0.30 for *Bos Taurus* cattle and -0.32 to -0.39 for Brahman cattle.<sup>1,15</sup> In an individual Angus herd, the correlation was reported to be -0.81 to -0.71.<sup>2,17</sup> These correlations indicate that as scrotal circumference for a bull increases, daughters of that bull will reach puberty at a younger age.

Many beef bulls available for purchase have been performance tested. Marlowe<sup>14</sup> looked at bull selection criteria and the sale price of Hereford and Angus bulls. Variables included herd from which the bulls originated, year of sale, order of sale, preweaning ADG, weaning grade, 365-day weight, 140-day test ADG, end of test final grade, ADG from birth to the end of test, sale weight, sale age, pedigree evaluation for dwarfism, flesh condition, masculinity development, tail setting and horned or polled condition of Hereford bulls. Some breed differences were observed to affect sale price. For Angus bulls, conformation, year of sale, lifetime ADG, age, sale order and dwarf status significantly affected sale price. For Hereford bulls, the 365-day weight, year of sale, herd of origin, feed test gain, preweaning ADG, age, polledness, dwarfism status and sale order significantly affected sale price. In a different study, age was reported to be the least important of several factors having a significant influence on the sale price of Hereford bull calves.<sup>14</sup> Warren reported that three factors accounted for 70% of the total variation in sale price for performance tested bulls sold in Alabama: ADG on test, conformation score and weight per day of age.<sup>22</sup> Breed has also been reported to affect a bull's performance during performance testing, and the performance difference due to breed can affect the value for different breeds of bulls. Breed effects have been shown for lifetime ADG, performance test ADG, yearling weight, end of test type score, feed efficiency, frame score and scrotal circumference.<sup>4,19</sup>

Commercial beef producers responding to a survey reported bull conformation, size and reputation of the breeder were the three most important factors considered when selecting a herd sire.<sup>18</sup>

Many variables affect the sale price of a bull. Not all buyers are looking for the same traits in an animal, as each herd has differing genetic needs and production goals. The purpose of this study was to determine which information provided to buyers at a graded bull sale was utilized by buyers to add or detract from the sale price of a beef bull. This study was limited to variables provided by the bull consignees in the annual sale catalogue.

## Materials and Methods

### *Data Description and Estimated Models*

Data were collected from 1995 through 2007. During the 13-year period, 1,899 bulls were sold through

the graded bull sale in middle Florida. Table 1 provides summary statistics for individual variable data. All bulls consigned were required to have a physical and breeding soundness examination prior to the sale and be accompanied by an official health certificate. The order of sale for bulls consigned each year was by breed and consignor, and was rotated from year to year.

An average of 146 bulls were sold each year, and the average yearly sales receipt was \$225,000. The highest yearly sales receipt for bulls sold was in 2007 (\$308,500), and the lowest yearly sales total was 2004 (\$102,400). Figure 1 provides yearly sales data. The average selling price per bull for all sale years was \$1,574. Sale data were recorded for 261 Angus, 127 Red Angus, 140 Braford, 24 Brahman, 126 Brangus, 191 Charolais, 712 Hereford, 198 Polled Hereford, 20 Simmental, 72 Gelbvieh and 28 bulls representing other breeds (Beefmaster, Limousin, Salers, Maine Anjou and Nellore). Figure 2 provides a breakdown by year and the sales trend for Hereford and Angus bulls.

Prior to sale, consigned bulls were graded by a committee of five experienced beef cattle producers; each committee member graded bulls for all 13 years of sale data collection. The grading committee evaluated each bull for eye appeal, conformation, frame size, weight on the day of sale and scrotal circumference on the day of sale. Each bull was assigned a numerical value by each member of the committee. The individual values were totaled, an average was calculated and a corresponding grade was assigned to each bull based on average score. A numerical score of 41-50 corresponded to Grade A, 31-40 to Grade B and 21-30 to Grade C. Any bull with a value less than or equal to 20 was not eligible to be sold during the sale. The bulls were evaluated as having superior (Grade A), good (Grade B) or average (Grade C) breeding characteristics. Of all bulls graded

and sold, 15% were graded A, 66% were graded B and 19% were graded C.

Individual data collected for each bull consigned included year of sale; sale price; birth date; breed; birth, weaning and yearling weight; sale weight; consignor; and EPD data regarding birth weight, weaning weight, yearling weight and maternal milk. The average age of bulls sold was 26 months, the youngest bull sold was 11 months and the oldest was 48 months of age. Scrotal circumference was measured the day of sale by placing a scrotal tape around the largest circumference of the intact scrotum of each bull and measured to the nearest centimeter. The average scrotal circumference was 38 centimeters, with a range from 32 to 47 centimeters. Bulls with a scrotal circumference less than 32 centimeters measured the day of sale were not eligible for sale. The minimum requirements for scrotal circumference were determined by the selection committee with input from the attending sale veterinarian.

Average birth weight, weaning weight and yearling weight during the years studied were 82, 608 and 1,001 lb (37, 276 and 454 kg). EPD data was provided by seedstock producers for 1,362 bulls, but was not provided for 556 bulls. EPD data were collected for birth weight, weaning weight, yearling weight and maternal milk. At least one category of EPD data had to be provided in order for that bull to be considered as an animal with EPD data provided.

Sale weight on the day of sale was collected on all bulls except for the year 2005. Sale weight was measured utilizing a manual chute with electronic load cells and an electronic scale head. The weight recorded on the day of sale was the value used as a bull's sale weight; gross weight was used and no shrink was calculated. The scale was zeroed between bulls. In 2005, the scale malfunctioned and individual bull weight was not col-

**Table 1.** Summary statistics for individual data variables for beef bulls sold in a graded bull sale in Florida—1899 observations.

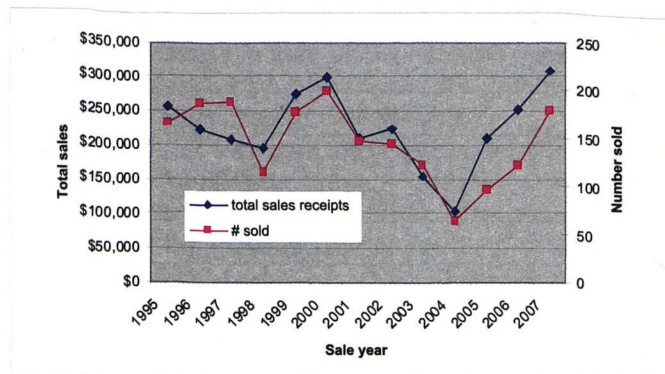
Variable	Mean	Median	Min.	Max.	Std. Dev.
Sale price <sup>a</sup>	\$1540	\$1450	\$480	\$5,200	\$560
Birth weight, lb	82	81	47	115	9.5
Weaning weight, lb	605	608	315	974	93
Yearling weight, lb	1003	1004	430	1529	156
Age, months <sup>b</sup>	26	25	11	48	4.7
Scrotal circumference, cm	37.7	37.5	33	47	2.37
Sale weight, lb <sup>c</sup>	1610	1600	1020	2505	195

<sup>a</sup> Total dollars per head

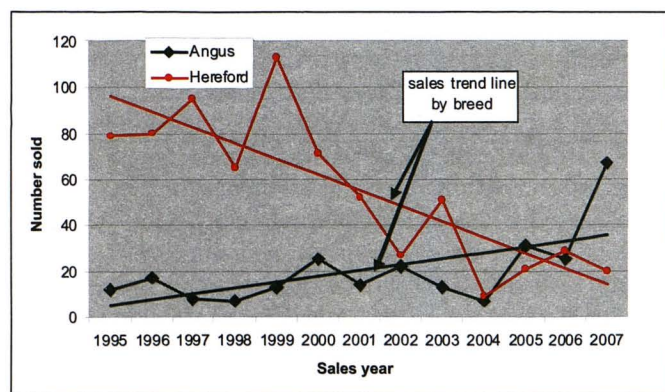
<sup>b</sup> Age in months for bulls sold

<sup>c</sup> Body weight for a bull the day of sale





**Figure 1.** Graded bull sales—number sold per year and total sales receipts.



**Figure 2.** Sales trend for Hereford or Angus bulls by number sold per year (1995-2007).

lected. To estimate sale weight for bulls sold in 2005, a linear regression sale weight model was developed utilizing data from the other 12 years of sales, including breed, age in months, scrotal circumference and grade of bull as independent variables, with sale weight as the dependent variable. The  $R^2$  for this model was .59.

Table 2 provides the estimated coefficients, reported t-statistic from a two tailed t-test, the corresponding probability ( $P$ ) values, and the F-statistic and its associated probability. A probability of less than 0.05 indicated that estimated coefficient was statistically significant when estimating the sale weight for a bull. The sale weight obtained utilizing the sale weight model was utilized as the sale weight for individual bulls in the 2005 sale. The average sale weight determined from the estimated sale weights for the 2005 bull group was 1,610 lb (732 kg); the average sale weight for all years, including or excluding the bulls sold in 2005, was also 1,610 lb.

Bulls originated from seedstock herds from 10 different states. The greatest number of bulls, 566 head, were consigned from Tennessee. Other states included 478 bulls from Florida, 465 from Georgia, 109 from Vir-

ginia, 107 from North Carolina, 57 from South Carolina, 50 from Kentucky, 50 from Mississippi, 11 from Alabama and six from Maine.

A linear regression model was used to evaluate the effect of independent variables on the sale price for a bull. The model was estimated, then evaluated by looking at the  $R^2$ , adjusted R-squared and the F-statistic and its associated probability. The estimated coefficients were analyzed by evaluating the sign on each estimated coefficient, a reported t-statistic utilizing a two tailed t-test and the associated probability or  $P$ -value associated with the t-statistic. The dependent variable was the sale price for a bull. The individual independent variables affecting the sale price for a bull included birth weight (BW), weaning weight (WW), yearling weight (YW), sale weight, age in months and scrotal circumference. Dummy variables included in the model were EPD data provided with no EPD data provided as the default, the breed of bull sold with Angus as the default, the state of origin with Florida the default and the year of sale with 2007 the default.

### Statistical and Model Analysis

EViews5 developed by Quantative Micro Software was utilized to perform the linear regression analysis, report  $R^2$ , an adjusted R-squared, a t-statistic with a corresponding probability  $P$ -value and a F-statistic and associated  $P$ -value. Coefficients with a probability ( $P$ -value) less than 0.05 were considered statistically significant when estimating the price paid for a bull.

When evaluating the estimated models,  $R^2$  was utilized to determine how much variability in the dependent variables sale price or sale weight was determined by the independent variables. The adjusted R-squared was evaluated for inclusion of redundant independent variables, the F-statistic and its associated probability was evaluated for significance of all independent variables included in the models. The t-statistic and associated probability was utilized to evaluate individual coefficients. The sign on each estimated coefficient was also evaluated to determine if that variable added to or detracted from the price paid for a bull.

### Results and Discussion

In this study, several variables had a statistically significant effect on the sale price of a bull. The grade or breeding characteristics assigned to a bull was highly significant when estimating the sale price. Grade A bulls sold for \$593 more than Grade C, and Grade B bulls sold for \$186 more than Grade C bulls. Bull buyers have confidence in the bull selection ability of experienced cattlemen when grading or evaluating a bull's breeding potential. The bull's birth weight and sale weight were also highly significant when estimating the sale price for



**Table 2.** Bull sale weight model, estimated weight coefficients (units in pounds), t-statistic, and associated probability for bulls sold in a graded bull sale in Florida—1801 observations.

Variable	<sup>a</sup> Est. Coefficient	Std. Error	t-Statistic	P-value
Age (months) <sup>a</sup>	15.80	0.64	24.79	0.00
Braford <sup>b</sup>	159.41	13.84	11.60	0.00
Brahman <sup>b</sup>	-37.44	27.88	-1.34	0.18
Brangus <sup>b</sup>	55.51	14.45	3.85	0.00
Charolais <sup>b</sup>	52.95	12.73	4.15	0.00
Gelbvieh <sup>b</sup>	74.62	16.98	4.39	0.00
Hereford <sup>b</sup>	59.73	9.77	6.11	0.00
Polled Hereford <sup>b</sup>	94.85	12.48	7.60	0.00
Red Angus <sup>b</sup>	-5.50	13.94	-0.39	0.69
Simmental	55.84	29.54	1.89	0.06
Other breeds	66.03	26.58	2.48	0.01
Grade A <sup>c</sup>	360.41	10.89	33.10	0.00
Grade B <sup>c</sup>	182.86	7.68	23.81	0.00
Scrotal circumference, cm	14.94	1.38	10.86	0.00
Constant (intercept)	409.29	52.63	7.78	0.00

<sup>a</sup>Age of bulls on day of sale by months.

<sup>b</sup>Breed of bull, default is Angus breed.

<sup>c</sup>Grade of bull determined by sales committee; Grade C is default.

R<sup>2</sup> = .59

Adjusted R-squared = .59

F statistic = 188.47

Probability (F-statistic) = 0.00

a bull. For each pound increase in the birth weight of a bull, the sale price decreased by \$4.86. This suggests that buyers understand the heritability for birth weight, and its relationship to dystocia. Analysis of the effect of sale weight on price showed that each pound increase in sale weight resulted in a \$0.94 increase in sale price.

The age of a bull in months was highly significant when determining the sale price for a bull. For each increase in month of age, the sale price was discounted by \$19. For example, keeping all other variables constant, an Angus bull 24 months of age would sell for \$228 more than a similar Angus bull that was 36 months old. These data suggest that bull buyers prefer younger bulls.

Bulls consigned to the sale were developed under different management regimes, which could have a significant impact on weaning weight and yearling weight. Bull buyers may have considered this when utilizing the weaning weight and yearling weight of a bull as selection criteria, because neither the weaning weight or yearling weight were significant variables affecting the sale price for a bull. From the data, the correlation between weaning weight and yearling weight was 0.59.

Not all bulls sold had EPD data provided. However, providing EPD data had no significant impact on the sale price of a bull. Bulls which had EPD data did not command a significantly higher price than bulls which had no EPD data provided. Producers either disregarded the EPD information provided for a bull, didn't understand how to use it, or chose to rely on other criteria such as grade, breed, age and phenotypic appearance.

Scrotal circumference was not a significant variable affecting the sale price for a bull. From the sale price model, the coefficient for scrotal circumference was 4.85. The mean scrotal circumference for all bulls was 38 centimeters, with a standard deviation of 2.4 centimeters. If the measured scrotal circumference for a bull was one standard deviation above the mean, that bull would sell for \$11.64 more than a similar bull with a scrotal circumference equal to the mean. The impact of scrotal circumference as a selection factor affecting the sale price for a bull may have been influenced by the grading committee parameters. Any bull consigned which did not have the minimum 32-centimeter scrotal circumference was not eligible for the auction. If bulls

with smaller testicular size had been sold, perhaps a significant decrease in sale price would have been estimated. The correlation between scrotal circumference and sale price was not highly correlated.

Breed of bull was associated with sales price. When the sale price for different breeds was compared to the sale price of Angus bulls, all other breeds except for Brahman and Simmental sold for significantly less. The difference in sale price received for Brahman and Simmental bulls compared to Angus bulls was not statistically significant, but economically there was a difference. Brahman bulls sold for \$682 less while Simmental bulls were discounted \$409. Table 3 provides the discounts for various breeds of bulls. From the data and estimated models, it appears that Angus cattle were the preferred breed in the graded sale. Bull buyers were willing to spend significantly more money to buy an Angus bull compared to a majority of the other breeds consigned.

When evaluating the state of origin and keeping all other independent variables constant, bulls from Alabama and Mississippi sold for significantly less money than bulls originating from Florida. Alabama bulls sold for \$508 less and Mississippi bulls sold for \$181 less than bulls originating from Florida. The sale price received for bulls originating from the other states when compared to Florida bulls was not significantly different. This discount for Alabama and Mississippi bulls could be related to the perception of quality of animals from the herd of origin rather than prejudice against a particular state of origin.

When comparing the year of sale to the 2007 sale year, sale prices received for a bull in years 1996, 1997,

**Table 3.** Discounts for breeds of bulls compared to the Angus breed sold in a Florida graded beef sale.

Breed of bull <sup>a</sup>	Premium or discount compared to Angus <sup>b</sup>	P-value
Braford	-\$760	0.000
Brahman	-\$682	0.069
Brangus	-\$127	0.043
Charolais	-\$372	0.000
Gelbvieh	-\$508	0.000
Hereford	-\$326	0.000
Polled Hereford	-\$879	0.000
Red Angus	-\$473	0.000
Simmental	-\$409	0.267
Other breeds	-\$458	0.000

<sup>a</sup>All bulls were purebred animals.

<sup>b</sup>Dollars per head discounted compared to Angus bulls as the default variable.

1999, 2000, 2001, 2002, 2003 and 2005 were significantly different than the price received in 2007, while prices in years 1995, 1998, 2004 and 2006 were not significantly different. Table 4 shows premiums or discounts for the sale price for a bull in differing years compared to 2007. Reasons for this effect were beyond the scope of this study, but could be reflective of the cattle cycle, and an individual herd's management needs, the price of weaned calves, price of feeders or fed cattle, price of feed, interest rates, the preferred color of cattle currently in vogue, land values, the price for substitutes, national and global economy, food safety issues and more.

## Conclusions

When beef cattle producers bid for bulls at this graded auction, significant criteria were identified that impacted a bull's value. Grade, age, birth weight, sale weight, breed of bull, and to some extent the year in which the sale was conducted, significantly impacted the sale price for a bull. Veterinarians working with seed stock producers should understand the economics behind bull selection, know what factors may add value to breeding bulls and provide their clients with this information to enhance the value of bulls offered for sale.

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**Table 4.** Premium or discount in sale price for bulls sold in a Florida graded bull sale from 1995-2006 as compared to prices in 2007.

Sale year <sup>a</sup>	Premium or discount compared to 2007 sale year	P-value
1995	\$96	0.20
1996	-\$389	0.00
1997	\$397	0.00
1998	-\$48	0.54
1999	-\$166	0.02
2000	-\$337	0.00
2001	-\$295	0.00
2002	-\$259	0.00
2003	-\$497	0.00
2004	-\$143	0.06
2005	\$269	0.00
2006	\$78	0.28

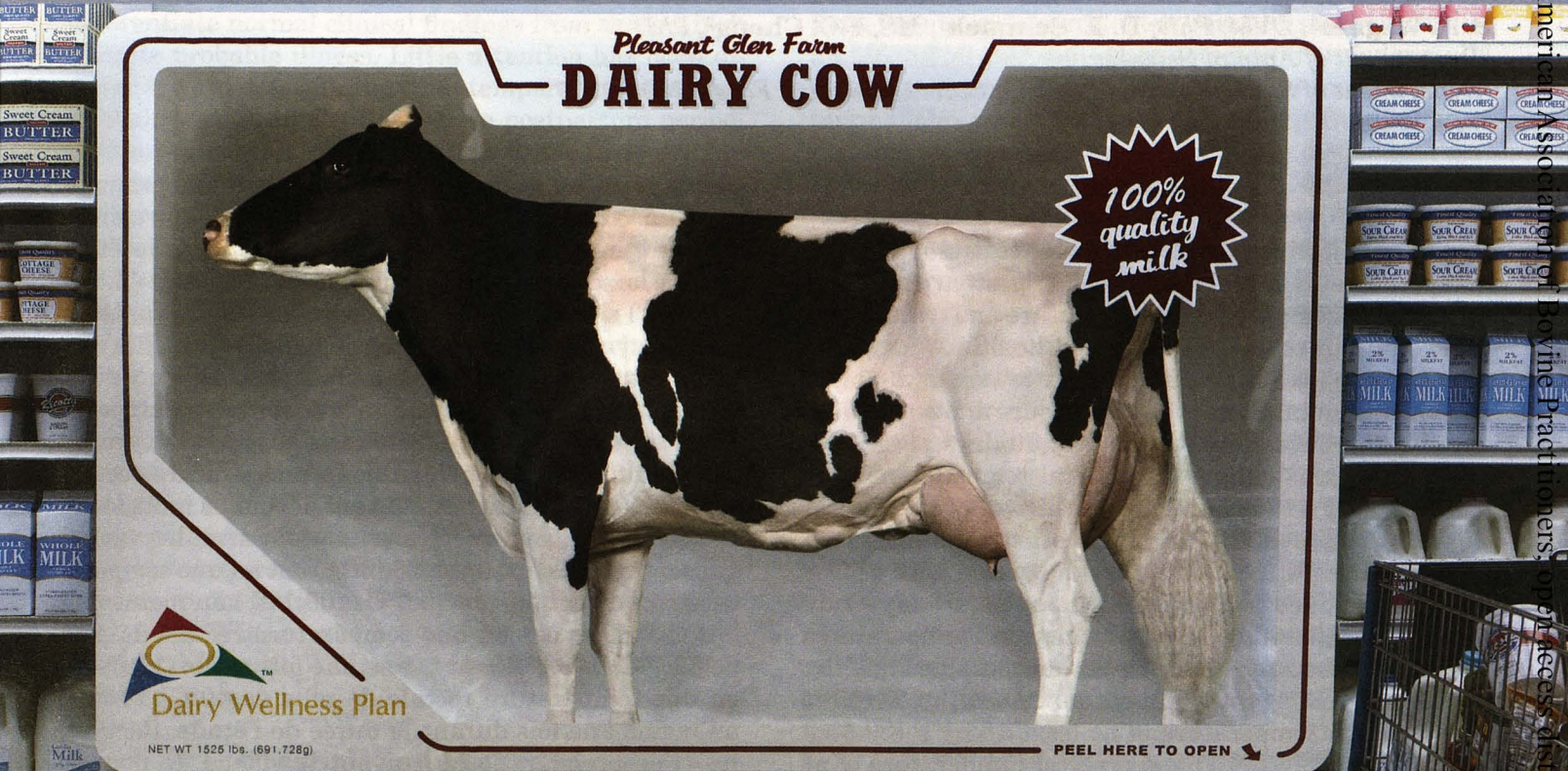
<sup>a</sup>Year in which the bull was sold, default year is 2007.

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