# Data Collection

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Collection of accurate performance records is critical to the success of genetic evaluation and selection programs. Throughout the life cycle of a beef animal, there are several points where data need to be recorded and reported to your genetic evaluation provider (breed association or company; GEP) to ensure the most complete and accurate genetic evaluation possible. In this chapter, the life cycles of a heifer, steer, and bull are examined to determine the records that need to be collected, how those records can be adjusted, and how to interpret these data. First, it is important to discuss several considerations when collecting and interpreting data.

## Contemporary Grouping

Before collecting data, it is important to have an understanding of proper contemporary grouping. Both genetic merit and the environment to which a calf is exposed can have an effect on how well a calf performs for all economically important traits. By using contemporary grouping, we are better able to separate genetic and environmental effects. A contemporary group for a traditional, within-breed genetic evaluation is defined as a set of same-sex calves that were born within a relatively short time interval and have been managed the same. In multiple-breed genetic evaluation, calves in the same contemporary group can have different breed makeup. Regardless of the evaluation type, every calf in the contemporary group should receive an equal opportunity to express its genetic merit by receiving the same management. Once an animal has been separated from its contemporaries, it can never be put into that group again.

For example, a producer may decide to select one particular bull calf to put into a fall or winter sale. He pulls that calf and his mother into a separate pen, where they have access to shelter and the calf gets creep feed. When weaning weights are collected on the group of bull calves, the selected calf has the highest weight. However, we don't know if that calf was genetically superior for weaning weight, or if his extra growth was due to feed and shelter. Thus, he must be placed in a separate contemporary group because he received different management and had a different opportunity to express his genetic potential. This is an extreme example, but anything that is different in the environment or management between groups of calves necessitates them being placed in different contemporary groups. Improper contemporary grouping can lead to biased and inaccurate Expected Progeny Differences (EPD). See page 19 for more information.

As an illustration of this concept, look at panel A in Figure 1. When a contemporary group is formed correctly, the environmental differences will be minimized among all animals. Thus, any differences in performance are more likely due to differences in genetic merit (light gray bars). This information is used in the generation of EPD. Figure 1 Panel B illustrates that the animal with the best genetic merit might not always have the best performance. When contemporary group information (along with pedigree) is included in EPD prediction, the resulting EPDs allow for comparison of animals across multiple environments, which was impossible with the phenotypic information alone. For more information about contemporary grouping, see the BIF Guidelines (BIF Guidelines, 2020).

## Adjusting Records

Calf age and cow age are two environmental factors that are not accounted for by contemporary grouping. These effects are predictable from year to year and herd to herd, so the records can be adjusted to account for that variation. For example, all calves in the herd should not be weaned and weighed when they are exactly 205 days of age because then each calf would be in its own contemporary group. As it is important to keep contemporary groups as large as possible, this scenario is not ideal let alone feasible from a management perspective. Single-animal contemporary groups do not provide any useful information for genetic evaluation. However, when all calves are weighed on the same day (when the average of the group is close to 205 days old) in the previous scenario, the younger calves will be at a disadvantage compared to the older calves. To compare them fairly, the raw weights of calves weighed on the same day will be adjusted to the same age, in this case 205 days. Basically, the adjustment uses each calf's average daily gain to predict what they will weigh (or did weigh) when they are (or were) exactly 205 days old.

The second adjustment applied is for age of dam. First-calf heifers have calves that are lighter at birth than calves from older cows,

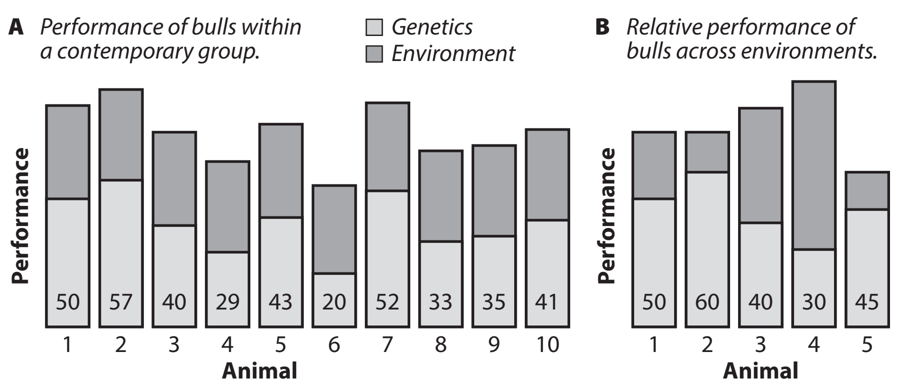



**Figure 1.** Variation in performance is due to variation from both genetic and environmental sources. Panel A shows a group of 10 bulls in the same contemporary group, where variation due to environment has been minimized. In panel B, one can see that EPDs (representing genetic differences) allow comparison of bulls across multiple environments to find those with the most superior genetic merit, regardless of phenotypic performance. The bull with the best phenotype is not always the bull with the best genetic merit due to the influence of environment.

and they also produce less milk throughout lactation than older cows, leading to lower weaning weights. These are not genetic factors of the calf, yet they disadvantage the calf's performance. Thus, weights for calves of first-calf heifers are adjusted to account for these effects.

The Beef Improvement Federation (BIF, 2010) publishes adjustment factors and procedures. These are general adjustment factors that are appropriate for commercial cattle. Beef Improvement Federation factors and procedures are used for illustration in this publication. Most breed associations or GEP have developed adjustment factors using their breed data. Purebred producers should use the adjustment factors and procedures derived by their respective GEP.

## Ratios

One way to compare calves within the same contemporary group is to use ratios. Ratios are calculated by dividing a calf's adjusted record by the average record of his contemporary group and multiplying by 100. This means that the average performing calf in the group will have a ratio of 100, poorer calves will be below 100, and better calves will be above 100 for traits where bigger is better. For traits where smaller is better, like birth weight, better (lighter) calves will be below 100, and poorer (heavier) calves will be above 100. Ratios measure an animal's deviation from the average of its contemporary group as a percentage.

$$\text{Ratio} = \frac{\text{Individual Adj. Record}}{\text{Contemporary Group Average}} \times 100$$

Because of differences in management and mean genetic level between herds, ratios should not be used to compare animals across contemporary groups. To compare the genetic merit of animals of the same breed across contemporary groups and herds, EPDs and selection indices derived from EPD are the only appropriate tools.

## Whole Herd Reporting

Some breeders choose to report performance data only on calves that they want to register. However, this is not in the best interest of either the producer or their customers as this practice leads to biased and inaccurate EPDs. Complete reporting of every animal in the herd is critical to obtain the best estimates of genetic merit. By only reporting the best calves, producers are inadvertently penalizing their highest-performing calves. In the following example (adapted from BIF Guidelines 9th ed., 2010), we will use weaning weight ratios to illustrate the effect of only reporting the best calves. Suppose we have 10 calves with an average adjusted weaning weight of 625:

| | Weaning weight | |
|---|---|---|
| Calf | Adjusted | Ratio |
| 1 | 742 | 119 |
| 2 | 694 | 111 |
| 3 | 655 | 105 |
| 4 | 643 | 103 |
| 5 | 639 | 102 |
| 6 | 606 | 97 |
| 7 | 605 | 97 |
| 8 | 578 | 93 |
| 9 | 562 | 90 |
| 10 | 524 | 84 |

group average = 625

Now suppose that the producer only reports the top 5 calves, which means the new average adjusted weaning weight is 675:

| | Weaning weight | |
|---|---|---|
| Calf | Adjusted | Ratio |
| 1 | 742 | 110 |
| 2 | 694 | 103 |
| 3 | 655 | 97 |
| 4 | 643 | 95 |
| 5 | 639 | 95 |

group average = 675

Incomplete reporting has the same effect on EPDs that it does on ratios. Therefore, the highest performing calves (calves 1 and 2) now receive much lower ratios, and subsequently EPDs, than if they had been compared to their entire contemporary group. Calves 3, 4, and 5 were once above average (ratios of 102-105) but are now below average and receive ratios below 100, which will result in lower EPDs than if they were compared to the entire group.

Another reason to use complete reporting, sometimes referred to as whole herd reporting, is to provide the data necessary to perform genetic evaluations for cow stayability and fertility. For these traits, it is important to report data on all potential dams to determine if they are productive members of the herd and to report culling and disposal codes when they leave the herd so that an accurate and complete herd inventory is maintained and the appropriate data can be utilized for genetic evaluation of these critical maternal traits. As new genetic predictions of cow efficiency, maintenance, and fertility are developed, providing accurate lifetime performance records on all cows to the GEP will be more critical than ever.

## Trait-specific Data Collection

### Birth Data

The first records to collect in a bull or heifer's life are birth weight and calving ease scores. Factors to consider when assigning contemporary groups are herd, year, season, sex, breed composition, management group, and embryo transfer or natural calf.

**Birth weight** should be collected as soon as possible after birth and needs to be adjusted for age of dam before being included in a genetic evaluation. The age of dam adjustment will compare all calves on a mature cow equivalent basis. Most GEP ask that breeders submit the raw data, and they will make the appropriate adjustments, using their own breed-specific adjustment factors. If you do not submit your data to a GEP, use the BIF adjustments.

| Age of dam at birth of calf | Birth weight adjustment |
|---|---|
| 2 | +8 |
| 3 | +5 |
| 4 | +2 |
| 5-10 | 0 |
| 11 and older | +3 |

(BIF Guidelines, 2010)

This is an additive adjustment, so:

Adjusted BW = Actual BW + Age of dam adjustment

(BIF Guidelines, 2020)

The following is an example using BIF adjustments:

| | | | Birth weight | | |
|---|---|---|---|---|---|
| Calf | Sex | Age of dam | Actual | Adjusted | Ratio |
| 1 | B | 2 | 78 | 86 | 100 |
| 2 | B | 6 | 85 | 85 | 99 |
| 3 | B | 4 | 76 | 78 | 91 |
| 4 | B | 11 | 90 | 93 | 108 |

group average = 86

Remember, for birth weight, a lower number is associated with less calving difficulty, so animals 2 and 3 have the most favorable weight ratios. After breeders submit actual weights, the GEP adjusts the weights and uses them to calculate EPDs for birth weight and calving ease. It is important to note that calving ease is the economically relevant trait, not birth weight. Because calving ease EPDs include birth weight information, it is more comprehensive and a more appropriate tool for selection.

**Calving ease.** To record calving ease, use the scale recommended by your GEP when reporting data, or the BIF recommended scale if you are a commercial producer.

1 No difficulty, no assistance
2 Minor difficulty, some assistance
3 Major difficulty, usually mechanical assistance
4 C section or other surgery
5 Abnormal presentation

(BIF Guidelines, 2020)

Both birth weights and calving ease measurements are used to calculate calving ease direct and calving ease maternal EPDs. Calving ease is the economically relevant trait and should be used in selection. Considering both birth weight and calving ease EPD double counts birth weight in the selection program.

## Weaning Weight

The next data to collect on a bull, heifer, or steer is **weaning weight**. A group of calves should ideally be weighed when the average of the group is near 205 days of age. Beef Improvement Federation recommends that all calves be between 160 and 250 days old, or they need to be split into two contemporary groups and weighed on two different days. When splitting groups because of age range, it may be useful to try and weigh calves when the average age of the animals in each group is close to 205 days. However, each GEP's particular guidelines for age at weaning may be slightly different. Any calf that is outside the prescribed range when weighed will be in its own contemporary group and its data will not contribute to the genetic evaluation. It is beneficial to hold animals off feed and water overnight to prevent gut fill from biasing weight measurements. Contemporary groups for weaning data should be formed using the criteria used for birth weight, plus birth-to-wean management code (which includes creep versus no-creep), date weighed, and sex (some calves that were bulls at birth may be steers by weaning). Because of this, the weaning contemporary group of a calf can never be larger than its birth contemporary group. Weaning weight should be adjusted for age of dam and for age of calf. Most GEP have their own age of dam adjustments, but if those are not available, the BIF adjustments are:

| Age of dam at birth of calf | Weaning weight adjustment for: Male calf | Female calf |
|---|---|---|
| 2 | +60 | +54 |
| 3 | +40 | +36 |
| 4 | +20 | +18 |
| 5-10 | 0 | 0 |
| 11 and older | +20 | +18 |

(BIF Guidelines 9th ed., 2010)

The formula to adjust weaning weight is:

$$\text{Adj 205-d WW} = \frac{\text{WW} - \text{Actual BW}}{\text{Wean Age (days)}} \times 205 + \text{Actual BW} + \text{Age of Dam Adj}$$

(BIF Guidelines, 2020)

Following is an example using BIF adjustments:

| Calf | Sex | Age of dam | Actual BW | Weaning age (days) | Weaning weight Actual | Adjusted | Ratio |
|---|---|---|---|---|---|---|---|
| 1 | B | 2 | 78 | 186 | 515 | 620 | 107 |
| 2 | B | 6 | 85 | 232 | 580 | 522 | 90 |
| 3 | B | 4 | 76 | 200 | 520 | 551 | 95 |
| 4 | B | 11 | 90 | 191 | 560 | 614 | 106 |

group average = 577

Weaning weights are used by GEP to calculate weaning weight, maternal milk, and total maternal EPDs. The genetic correlation between weaning weight and other weight traits make it possible to use weaning weights to help calculate EPDs for the other weight traits.

## Yearling

At a year of age, many records can be collected on bulls, steers, and heifers. It is important to collect data when the average age of the group is near 365 days. Check with your GEP for the acceptable range of ages to take yearling measurements. In general, BIF recommends that all animals within the group be between 320 and 410 days when yearling data are taken. If animals fall outside of the range determined by the GEP, the group should be split into two successive yearling dates so that all animals are within the range on the day of measurement. Contemporary grouping should include the birth and weaning criteria, plus yearling/feeding management code, date weighed, and sex. It is beneficial to hold animals off feed and water overnight to prevent gut fill from biasing weight measurements.

**Yearling weight** should be collected on all animals, and adjusted for animal age and age of dam. However, using the BIF adjustments, there is no separate age of dam adjustment. It incorporates adjusted weaning weight to account for age of dam. The formula to adjust yearling weights is:

$$\text{Adj 365-d YW} = \frac{\text{Actual YW} - \text{Actual WW}}{\text{\# Days Between Weights}} \times 160 + \text{205-d Adj WW}$$

(BIF Guidelines, 2020)

Example using BIF adjustments:

| Calf | Sex | Weaning weight Actual | Adj | Days between | Yearling weight Actual | Adj | Ratio |
|---|---|---|---|---|---|---|---|
| 1 | B | 515 | 620 | 168 | 1150 | 1225 | 111 |
| 2 | B | 580 | 522 | 168 | 1024 | 945 | 86 |
| 3 | B | 520 | 551 | 168 | 1031 | 1038 | 94 |
| 4 | B | 560 | 614 | 168 | 1175 | 1200 | 109 |

group average = 1102

Adjusted yearling weights are used to calculate yearling weight EPD. Depending on the GEP, yearling weight may also be used as an indicator trait to help calculate other EPDs, such as mature weight. Many animals that have birth and weaning records go into the feedlot and will not contribute a yearling weight record. This could lead to selection bias for yearling weight EPDs. However, most GEP use a multiple trait animal model that includes birth, weaning, and yearling weights. This approach uses genetic correlations between the trait to account for selection and avoid bias.

## Hip Height

Hip height is a measurement that describes skeletal size. Many producers choose to measure hip height when collecting yearling weights because of convenience and because hip height can be used by GEP to calculate EPDs for mature weight or height. Check with the GEP for acceptable age ranges for submission of data.

## Scrotal Circumference

Scrotal circumference (SC) EPD has a relationship with age at puberty; a larger SC is associated with younger age at puberty for the bull and his daughters. Measurement of SC should be at its maximal diameter, and size is often directly related to age. Contemporary group and age of measurement requirements are the same as those for yearling weight. Scrotal circumference measurements need to be adjusted for age with a breed-specific adjustment factor.

Adj. 365 day SC = actual SC + [(365 – days of age) x age adj factor]

(BIF Guidelines, 2020)

| Breed | Age adj factor |
|---|---|
| Angus | 0.0374 |
| Red Angus | 0.0324 |
| Charolais | 0.0505 |
| Gelbvieh | 0.0505 |
| Hereford | 0.0425 |
| Limousin | 0.0590 |
| Simmental | 0.0543 |

(BIF Guidelines, 2020)

Example using BIF adjustments:

| Calf | Breed | Age (days) | Scrotal circumference Actual | Scrotal circumference Adjusted | Scrotal circumference Ratio |
|---|---|---|---|---|---|
| 1 | Angus | 354 | 36.2 | 36.6 | 101 |
| 2 | Angus | 400 | 38.5 | 37.2 | 103 |
| 3 | Angus | 368 | 34.6 | 34.5 | 95 |
| 4 | Angus | 359 | 36.5 | 36.7 | 101 |

group average = 36.3

Many GEP use scrotal circumferences to calculate EPDs for scrotal circumference and may use it as an indicator trait for heifer pregnancy EPDs.

## Pelvic Area

Pelvic area can be measured on bulls and heifers at yearling time. While most GEP are not calculating EPDs for pelvic area at this time, it can be a useful culling tool within a herd. Heifers with small pelvic areas are more likely to experience calving difficulty. As with yearling weight, pelvic measurements should be taken between 320 and 410 days and adjusted to 365 days.

## Reproductive Tract Score

An experienced technician can palpate a heifer to determine the maturity of her reproductive tract and to determine if she has begun cycling. This information isn't currently used in national genetic evaluations, but can be a useful management tool. Heifers with immature reproductive tracts should be culled before the breeding season. (BIF Guidelines, 2020)

## Carcass Data

Steers and cull heifers can be used to provide carcass data. Carcass data must be collected by trained personnel or a camera installed at a packing plant. Many GEP have structured carcass tests in place that do much of the groundwork for producers. Contemporary grouping for carcass data includes weaning contemporary group, feeding management group, and slaughter date. Data should be adjusted to an age-constant or weight-constant basis. Each GEP has their own guidelines to accomplish this.

Data collected usually includes hot carcass weight, marbling score, 12-13th rib fat thickness, ribeye area, and percent kidney, pelvic and heart fat. Marbling score measures the quality grade of the carcass. Marbling score is related to quality grade as follows:

| Quality grade | Marbling amount | Score | IMF% |
|---|---|---|---|
| High prime | Abundant | 10.0-10.9 | |
| Average prime | Moderately abundant | 9.0-9.9 | |
| Low prime | Slightly abundant | 8.0-8.9 | 10.13 |
| High choice | Moderate | 7.0-7.9 | 7.25 |
| Average choice | Modest | 6.0-6.9 | 6.72 |
| Low choice | Small | 5.0-5.9 | 5.04 |
| Select | Slight | 4.0-4.9 | 3.83 |
| High standard | Traces | 3.0-3.9 | 2.76 |
| Low standard | Practically devoid | 2.0-2.9 | |

(adapted from BIF Guidelines, 2020)

Most GEP report EPDs for carcass weight, marbling, REA, and fat. In addition, they may include an EPD for yield or percent retail product. These EPD are intended to indicate the amount of lean meat in the carcass.

Most GEP use ultrasound data collected on bulls and heifers as indicator traits in the carcass trait genetic evaluation. Each GEP has its own specifications for when data should be collected. In general, bulls on gain test should be measured around a year of age. Some GEP will use data from forage-raised bulls that are measured later than one year of age. Developing replacement heifers are typically scanned between 12 and 15 months of age. Contact your GEP to get their requirements for age of scanning. Different GEP have different requirements for ultrasound contemporary grouping. If scanning is done at the same time as other yearling measurements, contemporary grouping is often the same as for yearling weight. If done at a different time, contemporary group criteria may include weaning weight contemporary group, yearling management group, and scan date. Check with a particular GEP for their contemporary grouping guidelines. The BIF Guidelines (2020) recommend that all calves in a scanning contemporary group be within 60 days of age with each other, but some GEP may allow a wider age range. Ultrasound data need to be adjusted to a common endpoint of either age or weight. Each GEP has determined their own endpoints and adjustment factors. Some may include steer ultrasound data in their genetic evaluations. Check with your GEP for specific recommendations regarding scanning steers. It is important to use a certified technician to scan cattle if that data is to be included in a national genetic evaluation. Genetic evaluation providers have a list of certified technicians from whom they will accept data. Measurements taken at scanning include scan weight, ribeye area (REA), 12-13th rib fat thickness, rump fat thickness, and percent intramuscular fat (IMF). Expected Progeny Differences for scan weight, REA, fat thickness, and IMF are produced from those measurements. Ribeye area and fat are indicators of the amount of carcass red meat yield. Percentage intramuscular fat is highly correlated with the amount of marbling in the carcass. Measurements of 12-13th rib fat thickness and rump fat thickness are combined to develop an EPD for fat. Some GEP combine weight, fat, and ribeye area into an EPD for yield or percent retail product.

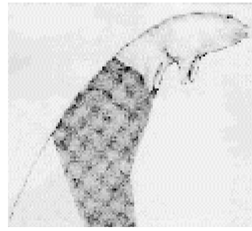
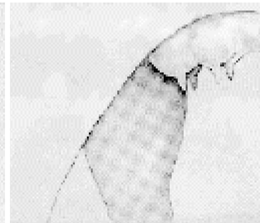
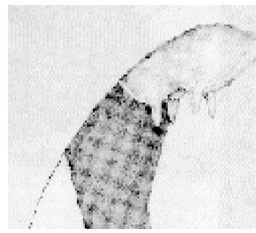
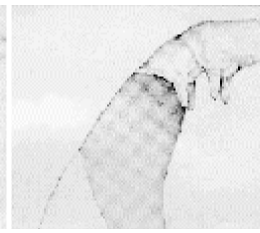
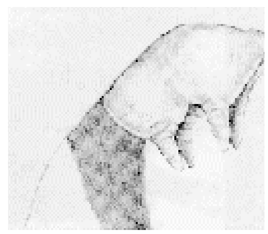
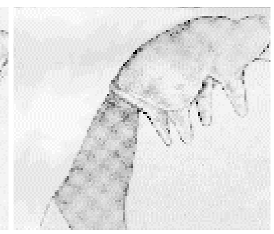
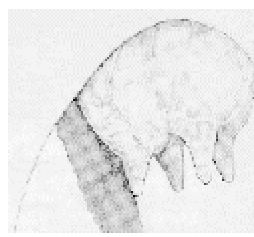
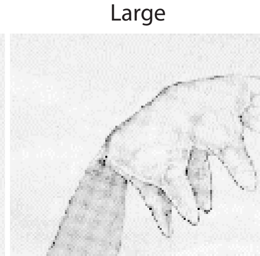
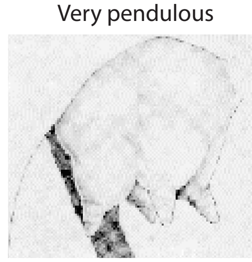
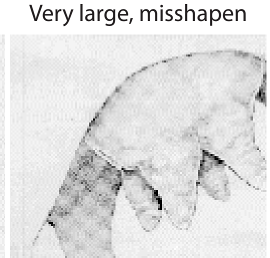
## Yearly Cow Herd Measurements

Once a female makes it into the breeding herd, there are several records that should be collected every year. All replacement heifers and cows should be pregnancy checked after the breeding season. Besides being a management tool to cull open females, some GEP are now collecting pregnancy data on heifers and cows to calculate heifer pregnancy EPD or cow fertility EPD. At calving, birth dates, birth weights, calving ease scores, and udder scores (Figure 2) should be recorded. These are necessary to document calf performance (as discussed previously) but also to document cow performance.

It is important to record AI or exposure dates of the breeding herd. Currently there are few measures of genetic merit for reproduction, but GEP are working to provide producers with EPD for fertility traits. Having complete breeding records will allow a producer to take advantage of these EPD as soon as they are developed. At weaning, cow weight and body condition score should be collected along with calf weaning weight (Figure 3).

Depending on the GEP, cow weights can be used to calculate mature cow weight EPDs. Also, cow weight and body condition are important components of the new EPDs being developed for cow efficiency and maintenance.

**Figure 2.** Udder scoring system for beef cattle.

| | Description | |
|---|---|---|
| **Score** | **Udder Suspension** | **Teat Size** |
| 9 | Very tight | Very small |
| |  |  |
| 7 | Tight | Small |
| |  |  |
| 5 | Intermediate | Intermediate |
| |  |  |
| 3 | Pendulous | Large |
| |  |  |
| 1 | Very pendulous | Very large, misshapen |
| |  |  |

American Hereford Association; BIF Guidelines, 2020

## DNA Sample Collection

With the expanded use of genomic technologies in the beef industry, many producers may wish to collect a DNA sample on animals. These samples may be used for a variety of genomic testing purposes (parentage testing, SNP chip testing for development of genomic-enhanced EPD, and/or genetic defect testing) or for archival purposes.

There are many different methods for collecting DNA samples, but certain samples may be preferred by testing companies or with the labor, storage method, and supplies available. It is important to determine which sample types are accepted by your preferred testing company before collecting your sample.

We will review the most common sample types. First, blood samples may be used for DNA extraction. Blood samples can be collected and submitted using vacutainer tubes containing anticoagulant (Figure 4, Panels A and B), but are more commonly collected using FTA cards (Figure 4, Panels C and D), which bind the DNA to paper so that it is stable at room temperature. When using FTA cards, it is important not to oversaturate the card and to let it dry completely before closing the cover.

Hair samples have historically been quite common but have fallen out of favor for many companies due to the labor required in the DNA extraction process. Hair samples are collected from the switch of the animal, and the root bulb (containing the DNA) is placed on the sticky surface of the collection card (See Figure 5). Finally, the sample is sealed on the card with a clear strip of plastic and then they are ready to mail or store.

Tissue sampling tags are one of the newer options for DNA sample collection but are increasing rapidly in popularity (Figure 6). This method involves taking an ear punch while tagging the animal, which is then immediately sealed to prevent contamination. The advantage of these

**Figure 3.** Description of body condition scores (BCS).

**Thin Condition**

1. Emaciated—Emaciated with no detectable fat over backbone, hips, or ribs. All ribs and bone structures easily visible.
2. Still emaciated but tailhead and ribs are less prominent. Backbone still sharp but some tissue on it.
3. Ribs still identifiable but not as sharp to the touch. Backbone still highly visible.

**Borderline Condition**

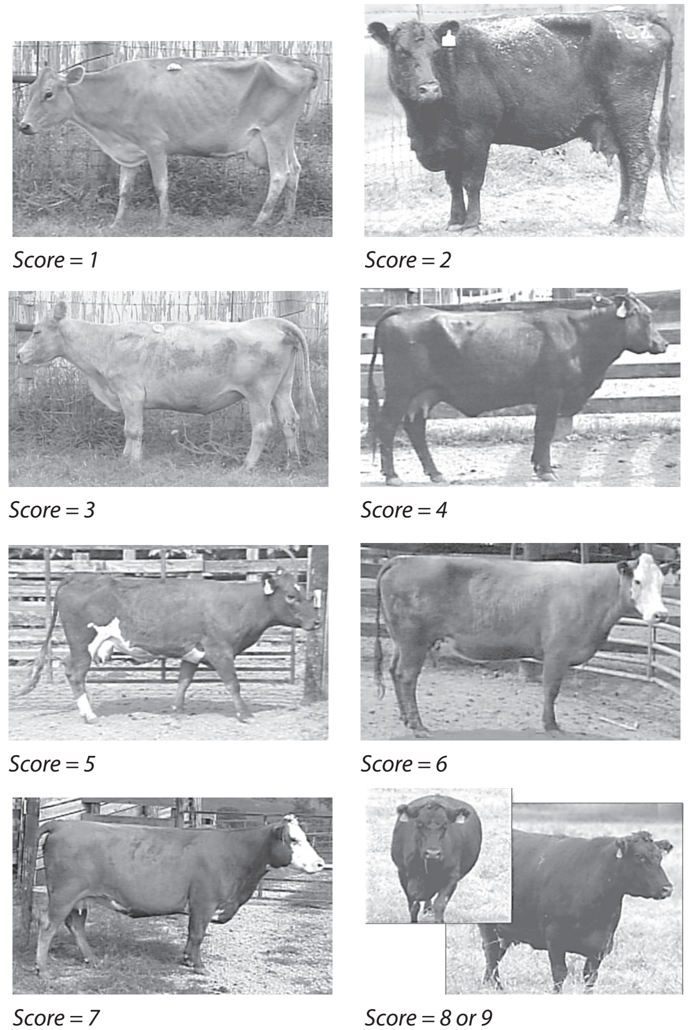
4. Borderline—Individual ribs no longer obvious. Foreribs not noticeable. However, 12th and 13th ribs may still be noticeable, particularly in cattle with big spring of rib. The backbone is still prominent but feels rounded rather than sharp.

**Optimal Condition**

5. Moderate—Good overall appearance. The 12th and 13th ribs are not visible unless the animal has been shrunk. Fat cover over the ribs feels spongy. Area on each side of the tailhead filled but not mounded. The transverse processes (see Figure 8-3) are not noticeable to the eye. Spaces between the processes can only be felt with firm pressure.
6. High moderate—A high amount of fat present over the ribs and around the tailhead. Noticeable sponginess over the foreribs and on each side of the tailhead. Firm pressure now required to feel the spinous processes.
7. Good—Cow appears fleshy and carries some fat. Spongy fat cover over the ribs and around the tailhead. Some "patchiness" evident around the tailhead.

**Fat Condition**

8. Fat—Fleshy and overconditioned. Bone structure disappearing from sight. Animal taking on a smooth, blocky appearance. Large fat deposits over ribs, around tailhead, below vulva. Patchy fat.
9. Extremely fat—Wasty, patchy, and blocky. Tailhead and hips buried in fat. Bone structure no longer visible. Animal's movement may be impaired.




systems is that the tissue sample is directly tied to the animal ID through barcoding and identification numbers, which helps prevent sample mix-ups. Be sure to follow all label directions for proper utilization of these collection products and direction from the testing lab for storing and submitting any tissue samples for testing.

For any DNA sample collection, it is important to remember the following tips: make sure the animal ID is clearly marked on the sample, make sure samples are not contaminated by manure, dirt, or tissue and/or blood from other animals, use a different needle and syringe for each animal to prevent sample contamination, and store samples properly according to the sample type. For example, do not store samples on a vehicle dashboard or other location where heat can damage the samples. More detailed information on DNA sample collection can be found at eBEEF.org (Rolf 2016).

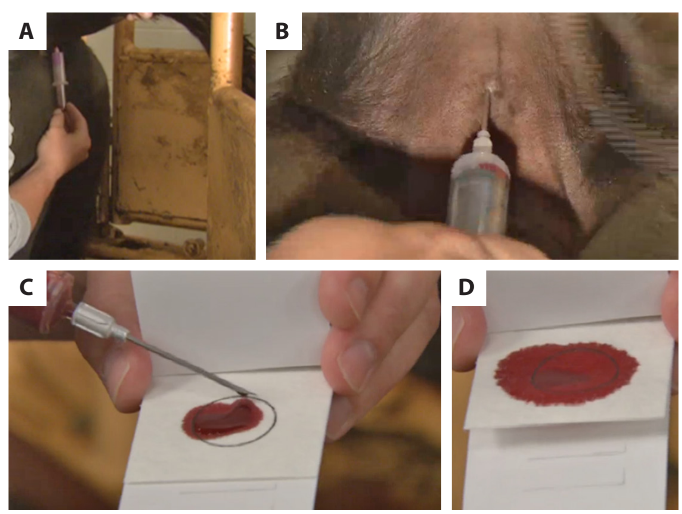



**Figure 4.** Blood samples collected using vacutainer tubes with anticoagulant (panel A and B) and on FTA cards (panels C and D).

## Summary

A successful breeding program depends on the accurate collection of performance records and the interpretation of those data. By maintaining proper contemporary grouping, adjusting the records correctly, and collecting data on every animal, beef producers can make more effective selection decisions and maximize genetic progress using available genetic selection tools.

## References

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**Figure 5.** Hair samples collected using a collection card. Note the root bulbs adhered to the surface of the card.


**Figure 6.** Example of tissue sampling tags. Note the red cap on the tube where the tissue sample is stored.