BETTER BEEF BREEDING

Bull buying for the commercial beef breeder

beef+lamb new zealand GENETICS

Revised March 2017

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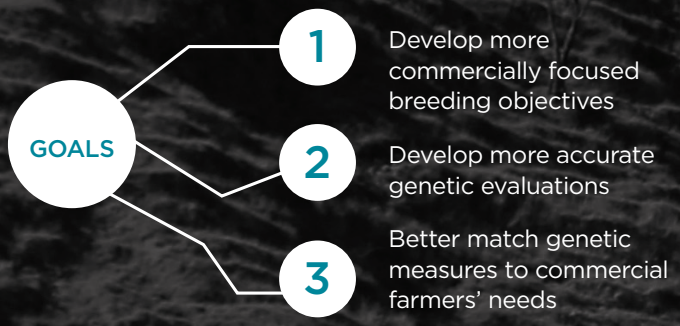
About Beef + Lamb New Zealand Genetics
B+LNZ Genetics is a subsidiary of Beef + Lamb New Zealand (B+LNZ) and consolidates the sheep and beef genetics research and innovation activity of Sheep Improvement Limited (SIL), the B+LNZ Sheep Central Progeny Test and Ovita.



Funding
B+LNZ Genetics' main funding is from:
- Sheep and beef levy payers (via B+LNZ)
- Ministry of Business, Innovation and Employment (the New Zealand Government)

It also has support from:
- Meat processors
- Breed societies and
- Commercial entities with an interest in sheep and beef genetics.

BREEDPLAN
BREEDPLAN is referred to throughout this document. It is the dominant genetic evaluation system for New Zealand beef breeds, but is not the only system.

Why bull selection is so important

In a commercial beef herd, without cow recording, the bull contributes about 80% of the herd's genetic improvement.

Key points:

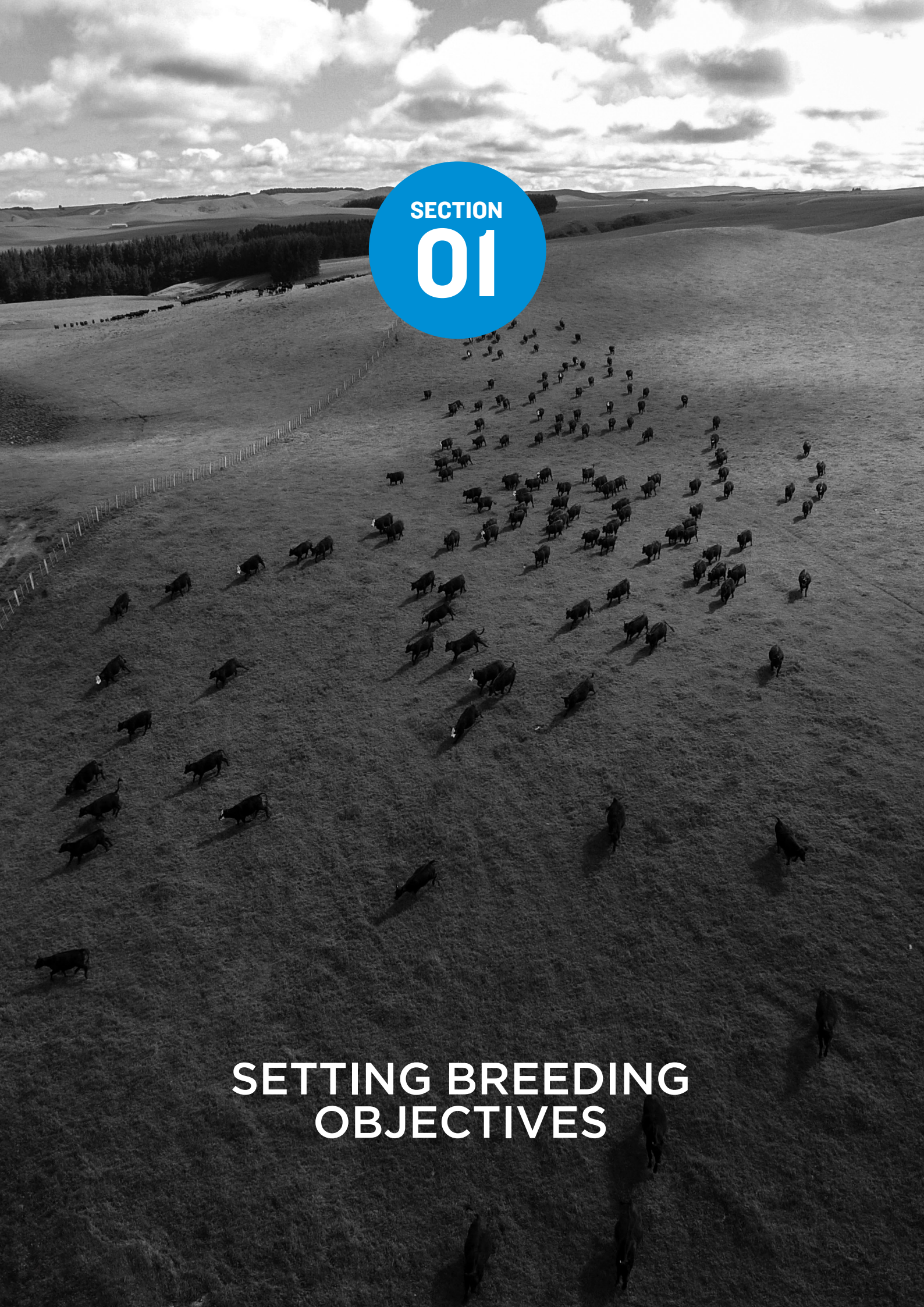
1. Before choosing a bull, you must first establish what your breeding objective is. This clarifies what the goals are for your beef herd.
2. Your genetic gain is underpinned by the progress being made by your bull breeder. Choose a progressive breeder, who has similar breeding objectives to you and can demonstrate the genetic gain they have made.
3. Assess the genetic information for the bulls presented for sale.
4. Assess bulls presented for sexual and structural soundness. No matter how good a bull's data is, if he can't serve a cow then he can't pass that on – and may in fact be introducing structural problems that will limit your herd's production.
5. Ensure your bull adjusts and settles into his new setting and is evaluated for soundness annually.

This booklet considers these steps in detail and guides you through the bull selection process.

Remember, a good bull decision today will still be directly affecting your herd in 15 years' time. So invest well.

Acknowledgments: BREEDPLAN, Massey University, Simmental Cattle Breeders Society of New Zealand, New South Wales Department of Primary Industries, Angus New Zealand Association

Summary and contents



SECTION
01

SETTING BREEDING OBJECTIVES

Which traits contribute to production and profitability? What emphasis should you place on each trait when selecting breeding stock?

Setting a breeding objective can be as simple as choosing a breed, or more sophisticated such as increasing weaning weight.

It is easier to make more progress in fewer traits than it is in many traits all at once. Likewise, it is easier to make faster progress in traits that are highly heritable. Keeping this in mind, a good breeding objective is simple but achievable, and it can be measured. For example "I put the emphasis on 200-day growth breeding value when buying a bull and my average weaning weights lifted".

The relative importance of different traits varies from farm to farm. Breeding herds are going to focus on different traits, compared to finishing operations. The importance of traits and their profitability can vary over time, according to changes in the market.

Breeding objectives appropriate to market requirements are discussed below in two sections: one relates to the productivity of the breeding cow (maternal performance); the other to post-weaning performance (terminal performance).

Summary

- When choosing a bull, prioritise and choose traits that will allow you to improve your system's production.
- The maternal influence – as measured by weight of calf weaned per cow joined – is the most important consideration for the cow herd.
- Cow size should be optimal for your environment, while maximising calf growth.
- Growth rate and carcass yield remain the two most important characteristics of the processed animal.
- Carcass quality is rewarded with market premiums and should therefore be considered in bull selection.

Setting your Breeding Objective: Guide

Answer the questions in each trait group and consider your five year goal. Does it need improving? Are you happy with your current performance compared to the industry benchmarks? Answering the questions under each trait group will allow you to establish your Breeding Objective and set you on the track to finding the right breeder and the right bulls to achieve your goals.

The maternal environment

The maternal environment is all about the breeding cow and her effectiveness at weaning a good calf every year.

The most important financial driver for a breeding cow farmer is the number of calves weaned to the number of cows mated. This is at least twice as important as growth and carcass characteristics. The breeding cow needs to be able to do this every year with a low cost of input, while getting in-calf quickly, year after year.

Up to 80% of genetic gain is achieved through the bull. Why? Because a bull is mated to 30-50 cows per year, so bulls can be selected much more intensely (you need fewer of them).

Reproduction

Reproductive performance is complex because it involves the cow getting in-calf at the planned time each year (preferably starting at 15 months of age) and producing a live calf which thrives through to weaning and beyond. Cows that get in-calf early are more fertile and wean heavier calves, giving them a higher value in the herd.

Good reproductive performance is of high economic importance, but its heritability is low, so it is slow to improve genetically. The environment has a large part to play in reproductive performance. Cow management, animal health, seasonality all creates a lot of variation, masking the influence (on reproductive performance) of genetics alone. New Zealand's national calving percentage has not changed for several years and experts believe genetics has a role to play in lifting percentages.

Culling cows which fail to breed or wean calves will improve the cow reproductive efficiency of your herd, but only moderately. Similarly, good management can help to improve reproductive performance. However the best tool available is **good bull selection**.

Mating heifers to calve at two years of age is a valuable way to improve reproductive efficiency, by rearing a calf when that heifer would otherwise be dry. It also reduces the interval between generations which leads to more rapid genetic improvement.

Reproduction

What is your average scanning percentage?
(% females conceived on exposure to bull)

.....

What is your five year goal?

.....

Industry benchmark: 93%

What is your average percentage of cows conceiving in the first cycle?
(% females conceived on exposure to bull - in first 21 days)

.....

What is your five year goal?

.....

Industry benchmark: 65%

Are you mating yearling heifers?

◯ Yes ◯ No

Industry benchmark: Yes (at 15 months)

Useful EBVs in bull selection:

- **Days to calving (DTC)** – a measure of calving interval. Cows that get in-calf early every year are more fertile and reproductive efficient. They also wean older, larger calves.
- **Rib fat (Rib Fat)** – related to increased heifer conception in that heifers with more rib fat at mating have an increased likelihood of conception. Like Scrotal size, it is a measure of heifer puberty and sexual maturity.
- **Scrotal size (SS)** – indicates bull maturity and is positively correlated to female fertility.

Mark on the line how you would describe your performance in reproduction

BELOW DESIRED | ACCEPTABLE | ABOVE DESIRED

Calving ease

A cow should calve unassisted. Having to assist a cow in giving birth is a health risk to the cow as well as being a labour cost. Cows who fail to calve unassisted should be culled.

What is your average percentage of assisted births in two year heifers?

.....

What is your five year goal?

.....

Industry benchmark: 3%

What is your average percentage of assisted births in mixed age cows?

.....

What is your five year goal?

.....

Industry benchmark: 1%

Useful EBVs in bull selection:

- **Calving ease direct (CED)** – is the ability of a sire's calves to be born unassisted.
- **Calving ease daughters (CEDtrs)** – the ability of a sire's daughters to calve at two years of age without assistance.
- **Gestation length (GL)** – the length of time from conception to calving. Longer GL's result in larger calves that may have calving difficulties.
- **Birth weight (BW)** – the weight of calf at birth. Heavy calves have an increased incidence of calving difficulties.

Mark on the line how you would describe your performance in calving ease

BELOW DESIRED | ACCEPTABLE | ABOVE DESIRED

Milk production (including mothering ability)

The simplest measure of a cow's mothering ability is the weight of its calf at weaning. It shows the calf's ability to grow and the dam's ability to care for it. But, to a large extent, it reflects the dam's milk production. Introducing dairy and dual purpose breeds to the breeding herd will progress milking ability.

Useful EBVs in bull selection are:

- **Milk (Milk)** – the amount of calf growth attributed to the cow.

There is evidence to suggest excessive milk production can result in decreased fertility. Cows that put a large amount of their energy into milking can fail to cycle and get in-calf at the time required. Body condition at mating is positively related to conception rate and this energy reserve can be spent when milking. Ultimately, milk/mothering ability should be optimised to accelerate calf growth and allow the cow to retain a fair condition.

Mark on the line how you would describe your performance in mothering ability

BELOW DESIRED | ACCEPTABLE | ABOVE DESIRED

Cow size

Moderate cows are more desirable on hill country. Larger cows are most likely to have higher maintenance costs and are more likely to cause soil damage. Keeping cow size moderate, while maximising growth, is the challenge. Increasing calf growth rate in your cow herd is expected to lift cow mature size. This, in turn, allows fewer cows to be run per hectare and therefore fewer calves are born in the herd annually – a key profit driver. This can reduce efficiency of the cow herd.

What is the average weight of cow in your herd?

.....

What is your five year goal?

.....

Industry benchmark: 530 kg cow (weaning 240 kg calf)

Useful EBVs in bull selection are:

- **Mature cow weight (MCW) –** weight of cow at three years or older.
- **600-day weight (600D)** – weight at 18 months.

Mark on the line how you would describe your performance in cow size

BELOW DESIRED | ACCEPTABLE | ABOVE DESIRED

Longevity

A cow which regularly produces good weaners over many years will be more profitable than a cow that leaves the herd early. A longer productive life increases financial return. However, younger females will be genetically superior, as a result of bull selection (based on your new breeding objective).

Post-weaning performance to slaughter

In the slaughter animal, the aim is to produce maximum kilograms of beef at the fastest rate whilst meeting market carcass specifications. However, carcass quality can reward finishers with premiums and should be considered a selection criterion.

Growth

Growth rate is the most important characteristic in the finishing animal. Most of the differences between animals in kilograms of meat produced are due to differing growth rates. With the predominant meat payment system in New Zealand being weight based, growth is the key economic driver. Growth rate can be easily measured in your herd.

What is your average weaning weight?

.....

What is your five year goal?

.....

Industry benchmark: 240 kg (at 7 months)

Useful EBVs in bull selection:

- **200 Day weight (200D)** – for calf growth to weaning.

What is your average mating weight (yearling heifers)?

.....

What is your five year goal?

.....

Industry benchmark: 300 kg

Useful EBVs in bull selection:

- **400 Day weight (400D)** – for growth to 12 months.

What is your average age at slaughter (steers bred on farm)?

.....

What is your five year goal?

.....

Industry benchmark: 18 months

Useful EBVs in bull selection:

- **400 Day weight (400D)** – for growth to 12 months.
- **600 Day weight (600D)** – for growth to 24 months.

Mark on the line how you would describe your performance in growth

BELOW DESIRED | ACCEPTABLE | ABOVE DESIRED

Carcass merit

For carcasses of a given weight, the quantity of saleable meat yield is the most important attribute. Carcasses must also have optimum fat deposition to avoid value deductions. Finally carcasses must achieve an Ultimate PH within the acceptable range – this is influenced by docility in bull selection and will also mean a carcass value deduction if isn't achieved.

What is your average carcass weight (steers bred on farm)?

.....

What is your five year goal?

.....

Industry benchmark: 300 kg

Useful EBVs in bull selection are:

- **Carcass weight (CW)** – to identify animals that will slaughter heavier relative to live weight.

What is your average Dressing out percentage?

.....

**Carcass weight as a percentage of live weight at slaughter*

What is your five year goal?

.....

Industry benchmark: 55%

Useful EBVs in bull selection are:

- **Retail beef yield (RBY)** – to identify animals with increased yield meat percentage of the carcass.

Are you seeing a significant percentage of animals not achieving an Ultimate PH < 5.8 at slaughter?

◯ Yes ◯ No

Industry benchmark: 5.8 < 5.3

Useful EBVs in bull selection are:

- **Docility** – quiet cattle at slaughter avoid dark cutting/high ultimate pH meat.

Are you struggling to finish animals or seeing a significant percentage of animals falling outside the Prime (P) fat grade at slaughter?

◯ Yes ◯ No

Industry benchmark: 3-12 mm rib fat

Useful EBVs in bull selection are:

- **Rib/rump fat** – select for optimum carcass fatness.

Mark on the line how you would describe your performance in carcass merit

BELOW DESIRED | ACCEPTABLE | ABOVE DESIRED

Carcass quality

Carcass quality has an economic value in some markets and so can reward the breeder in the slaughter animal.

Ossification (maturity at slaughter), eye muscle area, meat colour, fat colour and marbling are common measures in premium quality rewarded beef programmes – on top of standard carcass merit measures.

Are you supplying a beef programme awarding premiums for carcass quality? ◯ Yes ◯ No

What is your average % hit rate for this programme?

.....

What is your five year goal?

.....

Are you seeing significant percentages of animals failing due to:

Marbling ◯ Yes ◯ No **Ossification** ◯ Yes ◯ No **Meat colour** ◯ Yes ◯ No

Fat colour ◯ Yes ◯ No **Eye muscle area** ◯ Yes ◯ No

Useful EBVs in bull selection are:

- **IMF** – to lift marbling score.
- **600 Day Weight (600D)** – to reduce age and or maturity at slaughter.
- **Docility** – quiet cattle at slaughter avoid dark cutting (colour)/low ultimate pH meat.
- **Eye muscle area (EMA)** – loin cuts are the most valuable and result in more high value meat on the animal.

Mark on the line how you would describe your performance in carcass quality

BELOW DESIRED — ACCEPTABLE — ABOVE DESIRED

Conformation

'Conformation' of an animal has a variety of interpretations. It is used to describe 'type' characteristics, conformity and structural soundness.

Animals must be structurally and reproductively sound. Selection should be made against defects that reduce the animal's ability to move freely, graze efficiently or reproduce. Assessment of soundness can be carried out using the Beef Class Structural assessment system (see Section 06).

Selection on conformity has a value – as animals of a similar maturity pattern or 'type' is more likely to be ready for slaughter at a similar time. This makes feed budgeting easier and the spread of kill narrower.

Selection on conformation should be directed towards animals showing increased muscularity and against animals showing fat outside the acceptable market level.

In the slaughter animal, coat colour and markings have little importance. Selection for colour can reduce the progress made in other traits of economic value. However, in some branded beef programmes, colour is awarded premiums, providing the correct identification is in place.

Mark on the line how you would describe your performance in Conformation

BELOW DESIRED — ACCEPTABLE — ABOVE DESIRED

Establishing your Breeding Objective (into traits)

Dependant on the current performance of your breeding programme, you may choose to 'emphasise' some traits and 'maintain' others.

1. List the trait groups (on farm) in which you are currently performing at a level below acceptable. These will make up the trait groups you need to focus on and 'emphasise'. Aim for four groups and list the traits; in order of economic and productive importance to your system.
2. Beneath each trait group, e.g. Reproductive performance, select the 'useful EBVs for bull selection' that are of most relevance to your current on farm performance.

Traits to Emphasise

Trait Group 1 .....

Focus EBVs .....

Trait Group 2 .....

Focus EBVs .....

Trait Group 3 .....

Focus EBVs .....

Trait Group 4 .....

Focus EBVs .....

3. In an order of economic and productive importance relative to your system, list the trait groups (on farm) in which you are currently performing at a level above desired.

These will make up the trait groups that aren't necessary to 'emphasise' but instead 'maintain'.

Note: *This doesn't mean these traits should be ignored and left to decline, but rather be maintained at an acceptable level i.e. maintain at breed average (see Section 03).*

4. Beneath each trait group select the 'useful EBVs for bull selection' that is of most relevance to your current on farm performance.

Traits to Maintain

Trait Group 1 .....

Focus EBVs .....

Trait Group 2 .....

Focus EBVs .....

Trait Group 3 .....

Focus EBVs .....

Trait Group 4 .....

Focus EBVs .....

Congratulations! You now have a Breeding Objective. These are the traits that are of more and less importance to your herd. Effective bull selection will occur from a bull breeder that has a similar breeding objective to your own and is recording these same traits of importance to you.

SECTION
02

WHERE YOUR BREEDER GOES, YOU GO

Summary

- Set clear objectives for your herd.
- Identify a bull breeder with similar objectives.
- Determine whether the breeder is making genetic gain. Ask for a genetic trends graph.

Is the breeder making real progress?

The bull breeder's breeding programme should be clear, easily explained and backed up by good records and clear facts. It is important to ask questions to establish the genetic merit of the herd and whether genetic progress is being made in the traits that are of interest to you.

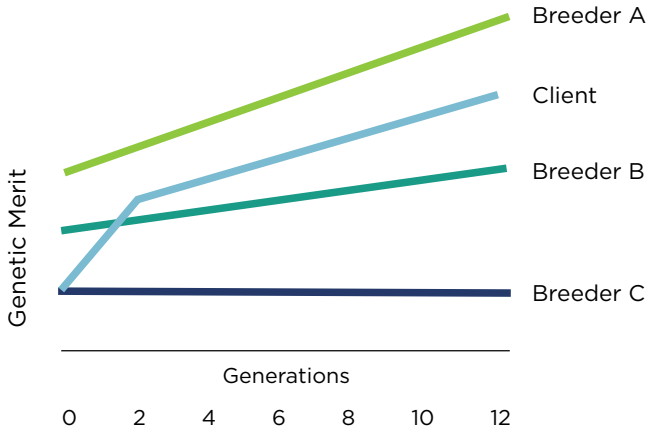
Eight important questions to ask a breeder before you buy a bull:

1. What are the breeding objectives for the breeder's herd and do they match yours?
2. Are they on BREEDPLAN or another recording system?
3. Can the breeder provide genetic trend graphs and do they show genetic gain?
4. What is the average genetic merit of the breeder's herd, in relation to the breed average?
5. Can the breeder supply you with dollar indexes that rank the bulls for sale?
6. Does the breeder mate yearling heifers and/or bulls?
7. Does the breeder keep dry cows?
8. Does the breeder assess animals using the Beef Class Structural Assessment and/or have a strong structural selection policy?

Choosing a bull breeder

An important factor when choosing a breeder is that their herd must have a higher genetic merit and rate of improvement than your herd – or your herd won't be improved. The bulls you have used in the past are a good indication of your genetic trend. It is also important there is an emphasis on structural soundness in your chosen bull breeder's herd..

Generation lag theory—the rate of genetic gain as determined by your breeder.



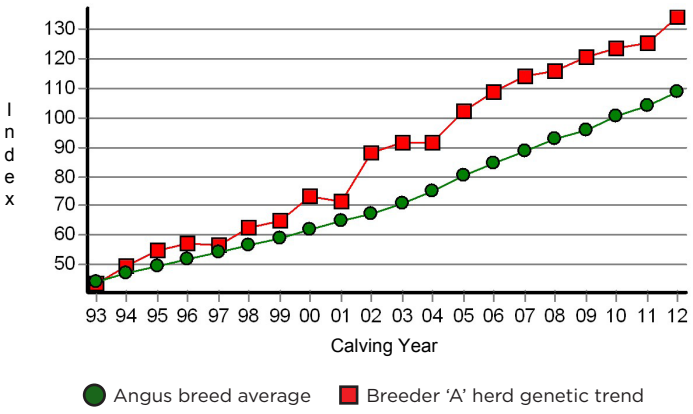
The diagram above shows the 'lag' between bull breeder and bull buyer in genetic trend over time. The buyer remains two generations behind the bull breeder in genetic trend. The bulls a buyer purchases are the easiest way to represent this trend.

As shown in this diagram, you will progress at a similar rate to Breeder A, but will remain two generations behind. If Breeders B or C were chosen, little or no genetic progress would be made.

The two-generation lag can be reduced by purchasing bulls annually, at a level above the average of the breeder's bulls.

Once you've decided on a shortlist of bull breeders, try to visit them in the six months leading up to bull buying time.

Angus Pure Index ($) Breeder 'A' herd genetic trend



This example herd is making good genetic gain on the Angus Pure Index. It is ahead of the breed average and would be a progressive herd to be seriously considered.

SECTION
03

SELECTING A BULL – GENETIC INFORMATION

Summary

- EBVs are in real units for several economically-relevant traits.
- Use the breed averages to compare the given bull's EBV for the trait you are looking at.
- Compare breed averages to the Percentile Bands Table to see where the bull ranks within its breed.
- If in doubt, use the EBV graph.
- Accuracy percentage is not of high value when selecting young bulls.

What is BREEDPLAN?

BREEDPLAN is a modern genetic evaluation system for beef cattle. It offers the potential to accelerate genetic progress, tighten up breeding operations, improve productivity and increase prices for cattle sold for breeding and slaughter.

It has been implemented as the national beef recording scheme in Australia, New Zealand, Namibia, Thailand and the Philippines, and its use is also increasing in the United States, Canada, United Kingdom, Hungary, South America and South Africa.

BREEDPLAN uses the world's most advanced genetic evaluation system (based on Best Linear Unbiased Prediction (BLUP) technology) to produce Estimated Breeding Values (EBVs) of recorded cattle for a range of important production traits (e.g. weight, carcass, fertility).

What is an EBV?

An animal's breeding value can be defined as its genetic merit for each trait. While it is not possible to determine an animal's true breeding value, it is possible to estimate it. These estimates of an animal's true breeding value are called EBVs (Estimated Breeding Values).

EBVs are expressed as the difference between an individual animal's genetics and the genetic base to which the animal is compared. EBVs are reported in the units which the measurements are taken (e.g. kilograms for the weight EBVs). So, a value of +12kg for 400-day weight means the animal is genetically superior by 12kg at 400 days, compared with the genetic base of the relevant cattle population. On average, half of this difference will be passed on to the animal's progeny.

EBVs take into account all information possible, to give an unbiased estimate of an animal's genetic merit for a given trait.

It is very difficult to compare bulls at a sale that have come from multiple breeders and farms. These bulls have different ages, sale-day weights and feeding backgrounds. However, EBVs take all these factors into account and allow you to make a fair comparison: not just what you see in front of you, but what you CAN'T see.

What EBVs are available?

BREEDPLAN produces EBVs for a range of economically-important traits, including:

Weight	Fertility/Calving	Carcass	Other
Birth Weight	Scrotal Size	Eye Muscle Area	Docility
Milk	Days to Calving	Fat Depth	
200 Day Weight	Gestation Length	Retail Beef Yield	
400 Day Weight	Calving Ease	Intramuscular Fat	
600 Day Weight	Maternal value	Carcass Weight	
Mature Cow Weight			

Can I compare EBVs between different breeds?

No. Different breeds have different genetic bases that they are compared against.

E.g. a 600-day weight EBV of +41 on a Hereford bull is not equivalent to a 600-day weight EBV of +41 on an Angus bull, or a 600-day weight EBV of +41 on a Limousin bull.

Only EBVs for animals within a particular BREEDPLAN analysis can be directly compared.

How can the performance of cattle in Northland be compared to cattle in Southland?

This is one of the most common questions asked. And the answer is "yes, they can be compared".

BREEDPLAN can tell you how sires ranked between two farms, providing there are sires that have been used on both farms. The progeny of these sires – and all of the rest of the calves born – can be compared across the two farms.

More often than not, a bull's calves will rank the same between farms. Providing all inputs are equal, then we can see how much of the way the sire's calves performed is genetic and how much is from management. When one sire is used over many environments, we can easily compare many groups of cattle and identify how much of the performance is genetic. The use of A.I has revolutionised this practice.

PART 1: Interpreting BREEDPLAN EBVs

At a bull sale, you are often presented with a detailed set of EBVs for a line of bulls. But how do you know which bull has the best set of EBVs for your needs?

To help understand the process, consider the following set of EBVs for a bull and refer back to this as you progress through this example.

	Gest. Length (days)	Birth Weight (kg)	Milk (kg)	200D Weight (kg)	400D Weight (kg)	600D Weight (kg)	Mature Weight (kg)
EBV	+0.1	+3.4	+3	+17	+33	+41	+48
ACC	59%	65%	58%	73%	72%	72%	63%

1. Compare with the current breed average

Most breeds have experienced significant changes in their genetic merit for most traits since the mid 1990s (i.e. their genetic base), so the first step when interpreting an EBV should be to compare it to the current breed average EBVs.

A set of breed average EBVs should be enclosed in all BREEDPLAN sale catalogues and will look similar to the table below.

Breed average EBVs for 2014 drop calves in the 2015 GROUP BREEDPLAN analysis

Gest Length (days)	Birth Weight (kg)	Milk (kg)	200D Weight (kg)	400D Weight (kg)	600D Weight (kg)	Mature Weight (kg)
EBV	+2.2	+3	+13	+20	+30	+31

If we consider the animal in the above example, comparison of its 600-day weight EBV of +41 with the breed average 600-day weight EBV of +30 indicates that the animal is genetically superior to the current genetic level of the breed. Taking this further, it can be calculated that the animal is actually 11kg (i.e. 41- 30) genetically heavier at 600 days compared with the current genetic level of the breed.

2. Compare with the Percentile Bands Table

Now compare the animal's EBVs to the Percentile Bands Table to assess exactly where the animal ranks within the breed for each trait.

Example Percentile Bands Table

	Calving Ease DIR (%)	Calving Ease DTRS (%)	Gestation Length (days)	Birth Weight (kg)	Milk (kg)	200D Weight (kg)	400D Weight (kg)	600D Weight (kg)	Mature Weight (kg)
Top 5%	+3.6	+0.6	-2.0	-0.2	+7	+24	+37	+54	+57
Top 10%	+2.8	+0.3	-1.5	+0.5	+6	+21	+33	+48	+50
Top 20%	+1.8	-0.1	-0.9	+1.1	+5	+18	+28	+41	+43
Top 30%	+1.1	-0.3	-0.5	+1.5	+4	+16	+25	+37	+38
Top 40%	+0.5	-0.6	-0.2	+1.9	+4	+14	+22	+33	+34
Top 50%	+0.0	-0.8	+0.0	+2.2	+3	+13	+20	+30	+30
Top 60%	-0.6	-1.2	+0.3	+2.6	+3	+11	+17	+26	+26
Top 70%	-1.3	-1.6	+0.5	+3.0	+2	+9	+15	+23	+23
Top 80%	-2.2	-2.2	+0.8	+3.4	+1	+7	+12	+19	+18
Top 90%	-3.4	-3.0	+1.2	+4.1	+0	+5	+9	+14	+13

The table gives you a better perspective and 'range' for a given trait that expands on just the breed average. E.g. when looking at Calving Ease Direct, the breed average is 0 and the top 5% of the breed have values of 3.6% and above; whereas the bottom 10% of the breed has values of -3.4% and below. If we consider our example bull, he is ranked in the top 20% of the breed for growth to 600 days.

As with the breed average EBVs, a Percentile Bands Table should be enclosed in all BREEDPLAN reports and sale catalogues.

3. Compare EBVs to estimate the difference in output from two sires

EBVs can also be used to predict the difference in output if two different sires are used in a herd.

To demonstrate this, let's compare our example bull to another bull. The first bull has a 600-day weight EBV of +41, while the second bull has a 600-day weight EBV of +21. Comparing these animals shows a difference in 600-day weight EBV of 20kg. With – on average – half of this difference being passed on to the progeny of each sire, it can be estimated that calves from the first bull would be 10kg heavier than those from the second bull at 600 days. Extending this to a single year's drop of 50 calves, this difference equates to a potential production difference of 500kg in liveweight by the time the calves reach 600 days of age.

NB: We are assuming both bulls are used over cows of similar genetic value/breed and their progeny are run under similar conditions.

4. The EBV graph

A useful visual way to see rankings of bulls at a bull sale is the EBV graph. It allows you to visually identify the extremeness of the bull's genetic package.

On the x axis is the percentile rankings from the top 100% to the top 1%. On the two y axes is the range of EBVs for the given bull.

Where the coloured bars diverge either left or right is identifiable as the breed average or '50th percentile'.

Bars on the right side – and that reach the far right y axis – are typically more favourable.

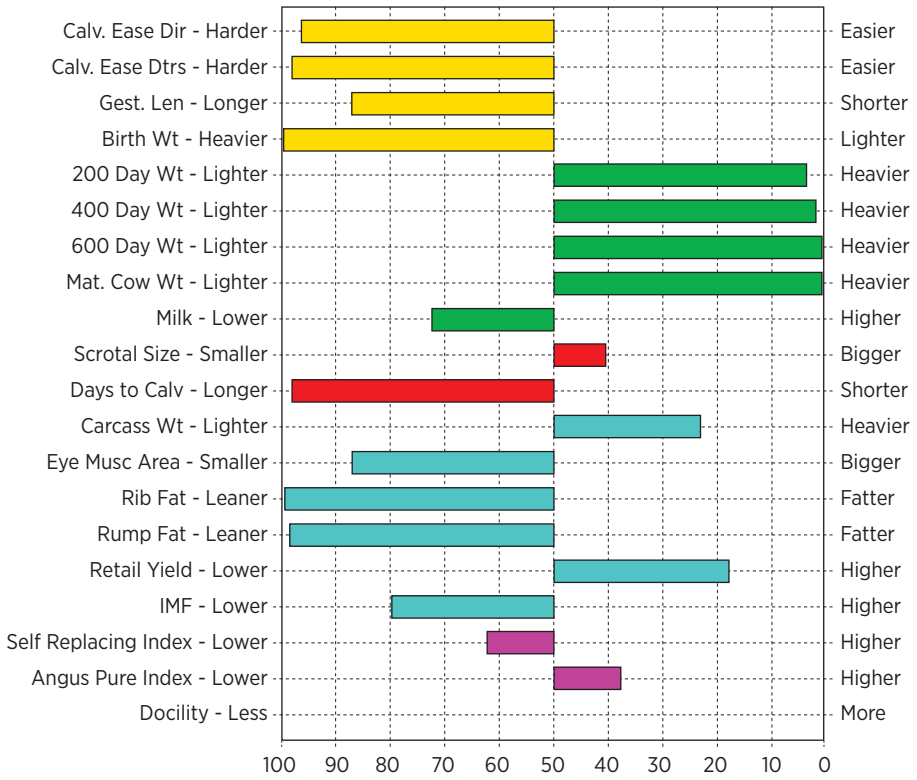
In the example above, this bull is ranked in the top 5% for all growth traits (the green bars). However, in nearly all other traits, his bars go towards the left y axis, indicating he is below the genetic average of the breed for most fertility (red) calving (yellow) and carcass (blue) traits.

The EBV graph can be found for any animal through the given breed's online database. Alternatively, your bull breeder can supply them.

5. EBV accuracy

When evaluating any EBV, you may consider the EBV "accuracy". By definition, an EBV is an estimate of an animal's true breeding value. BREEDPLAN provides an accuracy with each EBV. This is a measure of its stability. The higher the accuracy, the less an animals EBV is likely to change.

Information that contributes to an EBV may come from animal's relatives, its own performance or its progeny. Higher accuracy percentages indicate the given EBV is more likely to be the correct estimate of the animal's true genetic merit.



50th Percentile is the Breed Avg. EBVs for 2014 Born Calves

However, when buying a bull commercially this is not of high importance. Most New Zealand sire bulls are sold as yearlings or two year olds, so the information used to calculate their EBVs has come from their relatives and their own performance only. Significant gains in accuracy can only be achieved when these bulls have their own calves. This is not possible at the bulls' sale age, as there hasn't been sufficient time for their calves to be born and measured. These bulls go into commercial herds and no further information is collected. Bulls at this age will typically have between 50-74% accuracy (although for some traits this will be far lower). A sire bull with his own progeny will have accuracies between 74-99%. This tells us that buying young bulls isn't particularly accurate. However, the genetic gain seen in the commercial cow herd over time will surpass the use of old sires (even though the old sires are highly accurate).

Bulls should be compared on EBVs, regardless of accuracy, as the EBV is the best estimate available of an animal's genetic merit.

6. Visual appraisal

In all situations, EBVs should be used in conjunction with visual assessment for other traits of importance. See Section 06.

PART 2: The traits explained

Calving Ease

Calving difficulty has an obvious negative impact on the profitability of a herd, through increased calf and heifer mortality, slower re-breeding performance and considerable additional labour and veterinary expense. EBVs for traits related to calving ease are calculated from three main sources of information: calving difficulty score, birth weight and gestation length data.

BREEDPLAN produces two calving ease EBVs:
- Calving Ease Direct
- Calving Ease Daughters

(i) Calving Ease Direct

Calving Ease (DIR) EBVs are estimates of genetic differences in the ability of a sire's calves to be born unassisted from two-year-old heifers. The EBVs are reported as differences in the percentage of unassisted calving's.

Higher, more positive Calving Ease (DIR) EBVs are more favourable.

For example, if Bull A has an EBV of +5.0% and Bull B has an EBV of -1.0%, Bull A would be expected, on average, to produce 3% fewer difficult calving's from two-year-old heifers (6% difference between the sires, then halved, as the bull only contributes half the genetics).

(ii) Calving Ease Daughters

Calving Ease (DTRS) EBVs are estimates of genetic differences in the ability of a sire's daughters to calve at two years of age without assistance. The EBVs are also reported as differences in the percentage of unassisted calving's.

Higher, more positive Calving Ease Daughters (DTRS) EBVs are more favourable.

For example, if Bull A has an EBV of +4.0% and Bull B has an EBV of -2.0%, Bull A would be expected, on average, to produce daughters that have 3% fewer calving problems when calving at two years of age (6% difference between the sires, then halved).

Gestation Length

Gestation Length EBVs are estimates of genetic differences between animals in the number of days from the date of conception to the calf birth date.

Gestation Length EBVs are expressed in days and are calculated from the joining date and birth date records for calves conceived by either AI or natural mating.

Shorter gestation length is generally associated with lighter birth weight, improved calving ease and improved re-breeding performance among dams. In addition, calves born with a shorter gestation length are often heavier at weaning due to more days of growth.

Lower or more negative Gestation Length EBVs are considered to be more favourable.

For example, a bull with a Gestation Length EBV of -2 days would be expected to produce calves that are born earlier, and more easily, than a bull with a Gestation Length EBV of +2 days.

Birth Weight

Birth Weight EBVs are estimates of genetic differences between animals in calf birth weight. Calf birth weight is the biggest genetic contribution to calving difficulty in heifers.

Birth Weight EBVs are expressed in kilograms (kg) and are calculated based on weights of calves taken at birth.

Small, or moderate, Birth Weight EBVs are more favourable.

For example, a bull with a Birth Weight EBV of +2kg would be expected to produce lighter calves at birth – and consequently a lower risk of a difficult birth – than a bull with a Birth Weight EBV of +6kg.

NB: While low Birth Weight EBVs are favoured for calving ease, they are generally associated with lower overall growth potential. Consequently, birth weight and growth need to be carefully balanced.

Fortunately, animals can be found that have both moderate Birth Weight EBVs and above average EBVs for later growth.

Milk EBV

Milk EBVs are estimates an animal's maternal effect on the 200-day weight of its calf. In the case of sires, this estimates the maternal effect that his daughters will have on the 200-day weight of their progeny.

The Milk EBV is expressed as kilograms (kg) of calf liveweight at 200 days, i.e. the expected difference in the weight of the calf at 200 days, due

to the maternal effect (milk) of the cow. The Milk EBV is calculated by partitioning the difference in the 200-day weight of calves into growth and milk components.

The optimum level of milk production potential among beef cows is dependent upon the production system and environment in which the cows are run. Selection for increased milk production may be warranted when cows are run under good nutritional conditions and calves are sold as weaners. However, some environments may not support high-milking cows.

Larger, more positive Milk EBVs are generally more favourable, depending on the environment.

For example, a bull with a Milk EBV of +15 kg would be expected to sire daughters with higher milk production than a bull with Milk EBV of +5 kg. This higher milk production potential should see higher weaning weights among the daughters' calves.

Growth

All other things being equal, higher growth rates will lead to higher profitability. BREEDPLAN calculates three growth EBVs: 200 Day Weight, 400 Day Weight and 600 Day Weight.

These EBVs are the best prediction of the animal's ability to grow to weaning (200 day), yearling (400 day) and later ages (600 day).

(i) 200 Day Weight

200 Day Weight EBVs are estimates of the genetic differences between animals in liveweight at 200 days of age, due to their genetics for growth. 200 Day Growth EBVs are expressed in kilograms (kg) and are calculated from the weights of calves taken between 80 and 300 days of age.

This EBV is a measure of an animal's early growth to weaning. It is an important trait for breeders turning out animals as weaners.

Larger, more positive 200 Day Weight EBVs are generally more favourable.

For example, a bull with a 200 Day Weight EBV of +30 kg would be expected to produce heavier calves at 200 days of age (or weaning) compared to a bull with a 200 Day Weight EBV of +10 kg.

(ii) 400 Day Weight

400 Day Weight EBVs are estimates of the genetic differences between animals in liveweight at 400 days of age. 400 Day Weight EBVs are expressed in kilograms (kg) and are calculated from the weights of calves taken between 301 and 500 days of age.

This EBV is an important trait for breeders turning out animals as yearlings.

Larger, more positive 400 Day Weight EBVs are generally more favourable.

For example, a bull with a 400 Day Weight EBV of +50kg would be expected to produce heavier calves at 400 days of age (12-14 months), compared to a bull with a 400 Day Weight EBV of +30kg.

(iii) 600 Day Weight

600 Day Weight EBVs are estimates of the genetic differences between animals in live weight at 600 days of age. 600 Day Weight EBVs are expressed in kilograms (kg) and are calculated from the weights of calves taken between 501 and 900 days of age.

This EBV is an important trait for breeders targeting the production of animals suited for heavy carcass weights at ages over two years.

Larger, more positive 600 Day Weight EBVs are generally more favourable.

For example, a bull with a 600 Day Weight EBV of +70kg would be expected to produce heavier calves at 600 days of age (18-20 months), compared to a bull with a 600 Day Weight EBV of +40kg.

Mature Weight

Mature Weight EBVs are estimates of the genetic differences between cows in liveweight at five years of age. Mature Weight EBVs are expressed in kilograms (kg) and are calculated from weights taken on the cow when her calves' 200-day (weaning) weight is being measured.

Mature Weight EBVs are an indicator of:

- Cow feed requirements – in general, lighter cows will eat less and consequently have lower feed requirements and be less expensive to maintain.
- Cull cow values – the major determinant in the value of cull cows in a commercial herd will be liveweight. Consequently, heavier cows may provide higher returns.

A cow with a Mature Weight EBV of +80kg would be expected to have a higher mature weight than a cow with a Mature Weight EBV of +60kg.

Fertility

Fertility traits are the most economically significant of all traits. Live calves on the ground should be the priority of any breeding herd. Scrotal Size and Days to Calving EBVs provide the best available genetic estimates of the relative value of different animals.

Scrotal Size

Scrotal Size EBVs are estimates of the genetic differences between animals in scrotal circumference at 400 days of age. Scrotal Size EBVs are expressed in centimetres (cm) and are calculated from scrotal circumference measurements taken on bulls between 300 and 700 days of age.

Increased scrotal circumference is associated with increased semen production in bulls, and an earlier age at puberty for bull and heifer progeny. Increased scrotal circumference also has a favourable relationship with days to calving – bulls with larger scrotal circumference tend to have daughters with shorter days to calving.

Larger, more positive Scrotal Size EBVs are generally more favourable.

For example, a bull with a Scrotal Size EBV of +4cm would be expected to produce sons with larger testicles at yearling age and daughters that reach puberty earlier than the progeny of a bull with a Scrotal Size EBV of -4cm.

Days to Calving

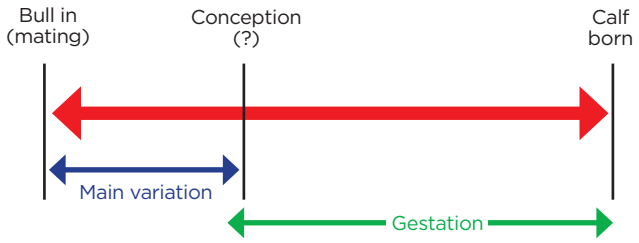
Days to Calving EBVs are estimates of genetic differences between animals in the time from the start of the joining period (i.e. when the female is introduced to a bull) until subsequent calving. Days to Calving EBVs are expressed in days and are calculated from the joining records submitted for females.

The Days to Calving EBV promotes those cows that calve earlier in the season, compared to those that calve later, while penalising those cows that do not calve. Variation in days to calving is mainly due to differences in the time taken for females to conceive after joining starts.

Lower, or more negative Days to Calving EBVs are generally more favourable.

For example, a bull with a Days to Calving EBV of -5 days would be expected to produce daughters that conceive earlier in the joining period, than the daughters of a bull with Days to Calving EBV of +5 days. Females with shorter Days to Calving EBVs also tend to be those that show early puberty as heifers and return to oestrous earlier after calving.

Time between first mating and calf being born



Carcass

BREEDPLAN combines both live animal ultrasound scanning information with abattoir chiller carcass data to calculate EBVs that provide information regarding the genetic differences in carcass composition between animals.

BREEDPLAN currently produces six Carcass EBVs in New Zealand:

- Carcass Weight
- Rib Fat Depth
- Rump Fat Depth
- Eye Muscle Area
- Intramuscular Fat (Marbling)
- Retail Beef Yield

(i) Carcass Weight

Carcass Weight EBVs are estimates of the genetic differences between animals in hot standard carcass weight at 650 days of age. Carcass Weight EBVs are expressed in kilograms (kg).

Larger, more positive Carcass Weight EBVs are generally more favourable.

For example an animal with a Carcass Weight EBV of +40kg would be expected to produce progeny with heavier slaughtered carcass at 650 days of age, than an animal with a Carcass Weight EBV of +30kg.

Carcass Weight should not be confused with yield.

(ii) Eye Muscle Area (EMA)

Eye Muscle Area EBVs are estimates of the genetic differences between animals in eye muscle area at 12/13th rib site in a standard weight steer carcass. EMA EBVs are expressed in square centimetres (cm^2).

Larger, more positive EMA EBVs are generally more favourable.

For example, a bull with an EMA EBV of +4cm^2 would be expected to produce steer progeny with a greater degree of muscle expression, than a bull with an EMA EBV of +1cm^2, relative to carcass weight.

(iii) Rib Fat

Rib Fat EBVs are estimates of the genetic differences between animals in fat depth at the 12/13th rib site in a standard weight steer carcass. Rib Fat EBVs are expressed in millimetres (mm).

More positive or more negative Rib Fat EBVs may be more favourable, depending on your breeding goals relating to the finishing ability of your animals.

A bull with a Rib Fat EBV of -0.4mm would be expected to produce leaner calves, than a bull with a Rib Fat EBV of +0.4mm, relative to carcass weight.

(iv) Rump Fat

Rump Fat EBVs are estimates of the genetic differences between animals in fat depth at the P8 rump site in a standard weight steer carcass. Rump Fat EBVs are expressed in millimetres (mm).

More positive or more negative Rump Fat EBVs may be more favourable, depending on your breeding goals relating to the finishing ability of your animals.

A bull with a Rump Fat EBV of -0.6mm would be expected to produce leaner calves, than a bull with a Rump Fat EBV of +0.6mm, relative to carcass weight.

Stock with positive fat EBVs are likely to produce progeny that are fatter, or more earlier maturing, on average than stock with lower or negative fat EBVs. Increasing fat depth leads to a decrease in retail beef yield. However, most market specifications require a minimum fat depth. Breeders aiming to breed leaner, higher yielding cattle may select for lower fat EBVs. Breeders wishing to finish their animals earlier may tend to select animals with moderate fat EBVs. Caution should be placed on selecting for extremely low fat EBVs for replacement females, as this may indicate females that are more difficult to get in calf.

Differences between Rib Fat EBVs and Rump Fat EBVs can indicate differences in fat distribution among animals.

(v) Retail Beef Yield (RBY)

Retail Beef Yield (RBY) EBVs are estimates of genetic differences between animals in boned-out retail beef yield in a standard weight steer carcass. RBY EBVs are reported as differences in percentage (%) yield.

Larger, more positive RBY EBVs are generally more favourable.

For example, an animal with a RBY EBV of +0.9% would be expected to produce progeny that would yield higher percentages of saleable beef in a standard weight steer carcass, than an animal with a RBY EBV of +0.1%.

(vi) Intramuscular Fat (IMF)

Intramuscular Fat (IMF) EBVs are estimates of genetic differences between animals in intramuscular fat (marbling) at the 12/13 rib site in a standard weight steer carcass. IMF EBVs are reported as differences in percentage (%) IMF.

Larger, more positive IMF EBVs are generally more favourable.

For example an animal with an IMF EBV of +0.8% would be expected to produce progeny that would express more marbling in a standard weight steer carcass, than an animal with an IMF EBV of +0.1%. For markets where marbling is important, higher IMF EBVs can contribute significantly to carcass value.

Docility

Docility EBVs are estimates of genetic differences between animals in temperament. Docility EBVs are expressed as differences in the percentage of progeny that will be scored with acceptable temperament (i.e. either "docile" or "restless") and are calculated from temperament scores recorded on animals using either a crush or yard test when the animals are between 60 and 400 days of age (preferably at weaning).

Docility in cattle is the way cattle behave when being handled by humans or put in an unusual environment, such as being separated from the mob in a small yard. What we define as poor docility is a survival trait in the wild – fear of anything unusual and the desire to escape. In domesticated cattle, it is exhibited as flightiness. Importantly, docility is a highly heritable trait and so can be improved genetically.

Higher, more positive Docility EBVs are more favourable.

PART 3: EBVs in Practice: Bull Selection Exercises

Please note, in these exercises:
- All bulls were assumed to be structurally sound and fertile.
- All EBVs are for bulls of the same breed.

Answers are provided following the exercises.

Hint: Only target the traits in the given breeding objective.

Exercise I

From the following catalogue, select the bull that best fits the different buyers breeding objective. Use the breed average.

BULL	BIRTH WEIGHT	MILK	200 DAY WEIGHT	400 DAY WEIGHT	MATURE WEIGHT
A	-1	5	13	33	52
B	2	10	18	28	46
C	1	0	10	28	46
BREED AVE	2	3	12	28	46

Buyer 1: Sells her cattle as weaners. Increasing milk production in her replacement heifers will lift her profitability.

Buyer 2: Is experiencing calving difficulty. Increasing growth rates are a focus.

Buyer 3: Is breeding in hard hill country. Large mature cows that produce large quantities of milk are slower to rebreed and are not favoured.

Exercise II

From the following catalogue, select the bull that best fits the different buyers breeding objective. Compare to the breed average.

BULL	400 DAY WEIGHT	600 DAY WEIGHT	SCROTAL SIZE	DAYS TO CALVING
A	46	52	1.2	-9
B	40	60	-1	10
C	47	53	2.5	-3
BREED AVE	36	46	0.4	0

Buyer 1: Is breeding finishing steers to kill at 18 months of age. Seeks to improve female fertility.

Buyer 2: Intends to use the bull as a terminal cross over his cows. Sells both the heifers and steers as finished two year olds.

Buyer 3: Stud herd selling yearling bulls. Concerned about trend of selling bulls that are marginal for scrotal size. Clients of the stud predominantly sell their cattle on as yearlings.

Exercise III

Using both the bulls EBVs (below) and the percentile bands table (below), answer the questions on breed percentile bands.

BULL	400 DAY WEIGHT	CARCASS WEIGHT	RETAIL BEEF YEILD	RUMP FAT	EYE MUSCLE AREA	IMF
A	82	62	0.9	-0.1	5.8	0.8
B	77	58	0.4	-1.3	7.9	1
C	76	56	0.3	0.2	7.1	2.2
D	69	48	0.2	1.8	3	1.8
BREED AVE	76	56	0.3	-0.1	4.4	1.5

Question 1: What percentile band does Bull A fit into for the IMF EBV?

Question 2: What percentile band does the Carcass Weight EBV breed average fit into?

Question 3: Bull B has the leanest Rump Fat EBV in the group, Bull D has the fattest rump fat EBV in the group. What is the percentile range does this show?

		Top Value	**Top 1%**	**Top 5%**	**Top 10%**	**Top 15%**	**Top 20%**	**Top 25%**	**Top 30%**	**Top 35%**	**Top 40%**	**Top 45%**	**Top 50%**	**Top 55%**	**Top 60%**	**Top 65%**	**Top 70%**	**Top 75%**	**Top 80%**	**Top 85%**	**Top 90%**	**Top 95%**	**Top 99%**	**Low Value**
Angus Pure Index	($)	$220	$179	$161	$152	$145	$140	$136	$131	$127	$123	$119	115	$111	$107	$103	$100	$95	$91	$86	$81	$72	$53	$14
Self-Replacing Index	($)	$186	$156	$141	$133	$126	$121	$117	$113	$109	$105	$102	98	$94	$91	$87	$83	$80	$75	$71	$66	$59	$43	$7
IMF	(%)	5.4	3.7	3.1	2.8	2.6	2.4	2.2	2.1	1.9	1.8	1.6	1.5	1.4	1.3	1.1	1	0.8	0.7	0.5	0.3	0.1	-0.3	-1.3
Retail Beef Yield	(%)	4.1	2.1	1.5	1.2	1	0.9	0.8	0.6	0.5	0.4	0.3	0.3	0.2	0.1	0	-0	-0	-0	-1	-1	-1	-2	-4
Rump Fat	(mm)	7.2	3.1	2	1.5	1.2	0.9	0.7	0.5	0.4	0.2	0.1	-0.1	-0.2	-0.4	-0.5	-0.7	-0.9	-1.1	-1.3	-1.6	-2	-2.9	-6.6
Eye Muscle Area	(sq cm)	18	9.7	7.9	7.1	6.5	6.1	5.8	5.5	5.2	4.9	4.6	4.4	4.1	3.8	3.6	3.3	3	2.6	2.1	1.6	0.7	-0.7	-5.1
Carcass Wt.	(kg)	96	78	72	68	66	64	62	61	59	58	57	56	54	53	51	50	48	45	43	39	32	22	3
400 Day Wt.	(kg)	116	99	92	88	86	84	82	81	80	78	77	76	75	73	72	70	69	67	64	61	57	46	17

Exercise IV

Select the bull that best fits the different buyers breeding objective. Use the percentile bands table above to appreciate the range of a given EBV.

BULL	400 DAY WEIGHT	CARCASS WEIGHT	RETAIL BEEF YEILD	RUMP FAT	EYE MUSCLE AREA	IMF
A	82	62	0.9	-0.1	5.8	0.8
B	77	58	0.4	-1.3	7.9	1
C	76	56	0.3	0.2	7.1	2.2
D	69	48	0.2	1.8	3	1.8
BREED AVE	76	56	0.3	-0.1	4.4	1.5

Buyer 1: Is targeting premium-branded beef programmes that reward for eating quality. Optimum fatness, large eye muscle areas and good marbling are the key traits rewarded.

Buyer 2: Breeds cross bred steers. She earns more money when her cattle yield well and kill heavy. She has traditionally finished steers as two year olds and now wishes to finish them earlier.

PART 4: Selection Indexes

What are Selection Indexes?

Selection Indexes are a 'surmise' of all available BREEDPLAN EBVs. A Selection Index puts economic weightings on each of the EBVs, according to their relative value to your chosen production system and market. This is expressed as a dollar value or "additional profit per cow mated".

Selection Indexes enable cattle producers to make "balanced" selection decisions; taking into account the relevant growth, carcass and fertility attributes of each animal to identify the animal that is most profitable for a specific system and market. Selection Indexes reflect both the short-term profit generated by a sire through the sale of his progeny, and the longer-term profit generated by his daughters in a self-replacing cow herd.

Standard Selection Indexes are available from most breed societies. Standard breed-specific Selection Indexes have been designed to cater for the different New Zealand markets and production systems that are most relevant to the given breed. These Selection Indexes are intended for use by both stud and commercial breeders.

PART 5: Interpreting Selection Indexes

The Selection Index value for an animal is effectively an EBV of the animal's profitability in that particular production system and market. Ranking bulls on their Selection Index value sorts them, based on their progeny's expected profitability for the targeted production system. In this way, a Selection Index should be used like an EBV, comparing it to the breed average or Percentile Bands Table to rank animals.

Selection Indexes are expressed as "net profit per cow mated". For example, if we compare a bull with an Index of +$60 with a bull that has an Index of +$30, we can estimate that the difference in net profit from the progeny of the bulls would be:

= ½ x difference in Index
= ½ x (60-30)
= $15 per cow mated

(NB. We multiply by ½, because only half the progeny's genes come from the sire.)

If the two bulls were joined to 200 cows during their breeding life, this would equate to a difference of (200 x $15) = $3000.

It is important to note that this difference includes profit across the entire production chain – from joining to slaughter – and also considers the long-term profit generated by a sire's daughters (if a self-replacing Selection Index).

Using Selection Indexes

A risk of using Selection Indexes is that two bulls that have equal dollar values for a given Index may have very different EBV combinations. This can result in some undesirable aspects within a cow herd (i.e. a top-ranking bull has high growth that is rewarded in the Index, but has a larger birth weight that is not suitable for mating heifers). In this way, individual EBVs must be acknowledged but Selection Indexes will simplify and fast track genetic gain.

Useful online tools are the EBV Search and Catalogue Sorter resources within the Internet Solutions databases. This is offered by all breeds using BREEDPLAN and will allow buyers to rank bulls online, before a given sale.

As a guide to using Selection Indexes, it is recommended that breeders complete the following steps alongside physical assessment:

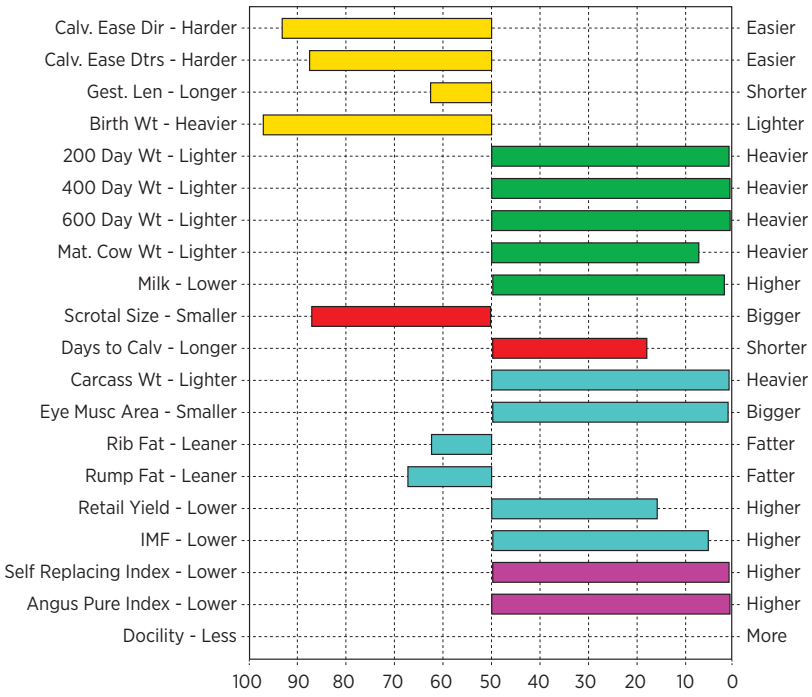
(i) Identify the Selection Index of most relevance
(ii) Rank bulls on the Selection Index
(iii) Consider the individual EBVs of importance

Exercise V

Using the EBV bar graphs and breed indexes, answer the following questions on the example bulls.

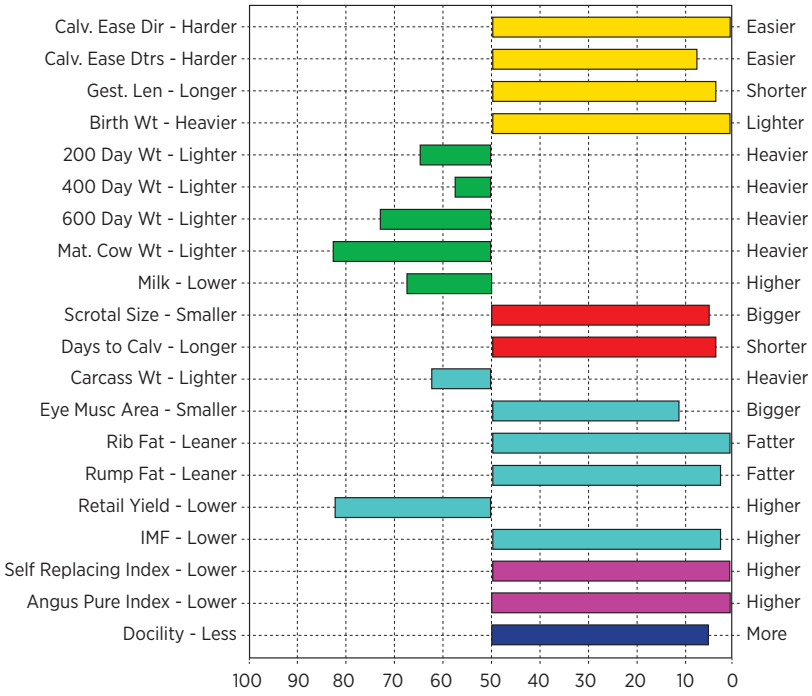
Question 1: Both bulls will generate equal profit in their progeny, however which is appropriate for heifer mating?
Question 2: Which bulls progeny will be of a higher value to the finisher?
Question 3: What are the key differences that will in fact make the two bulls progeny of equal value?

Intensity
($207 Angus Pure Index)



50th Percentile is the Breed Avg. EBVs for 2015 Born Calves

Lady's Man
($207 Angus Pure Index)



50th Percentile is the Breed Avg. EBVs for 2015 Born Calves

Please see Section 5 (Page 29) for answers to the exercises above

SECTION
04

DO EBVS WORK AND WHY BOTHER?

Expectation (Growth example)

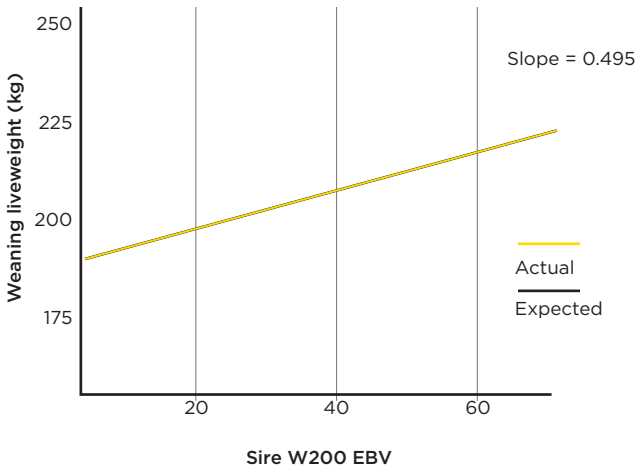
1kg in Bull EBV = 0.5kg in actual calf weaning weight

- In the calf—roughly half the calf genes come from the dam and half from the sire. So, we expect that half of the bulls EBV will be passed on to his calves in actual calf weight. Or, if we compare two bulls; Bull #1 EBV= 80kg, Bull #2 EBV= 40kg you would expect to see a difference of 20kg in actual average calf weight between 1 & 2.
- We expect the sires EBVs to (on average) perform well in predicting the performance of their calves. In doing this, they should show a positive upward slope where groups of bulls have better EBVs and a result—their calves are better. **In a perfect world the slope of the graph would be slope = 0.5 where the EBV perfectly predicts calf performance.** However, it is most useful to see whether there is a positive trend line, as EBVs are estimated. This shows us whether selection on an EBV will deliver actual improvement on a commercial farm. How strong that trend-line is compared to the theoretical expected value of 0.5, is the relationship to look at when proving an EBV to work (or not).

Reality (Growth example)

1kg in Bull EBV = 0.49kg in calf weaning weight

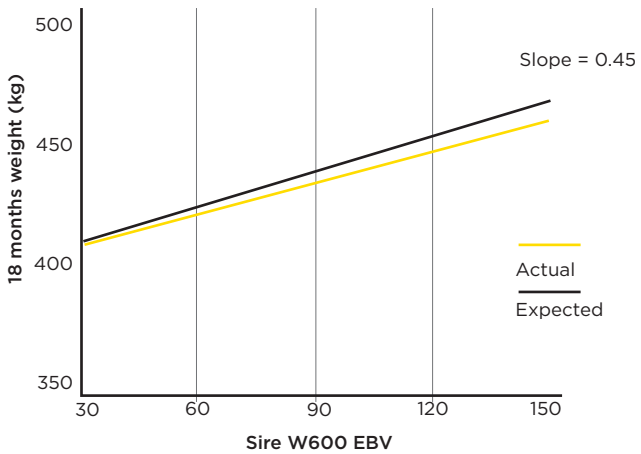
- This is a strong result. That means 99% of the sires EBV has been turned into extra calf weight at weaning.
- Most sires EBVs (across the traits) lined up well and predicted the performance of their calves. On average they did a good job of improving actual performance. I**n fact, 73% of the sires EBVs (that we looked at) turned into actual calf performance.**
- **If you use improved EBVs you will get improved calves.**

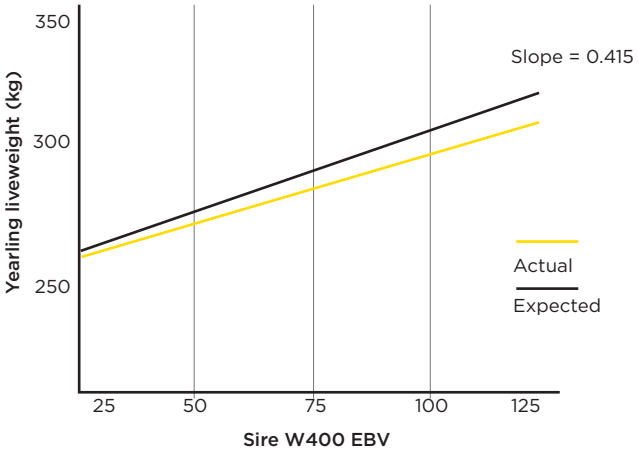


Proving Growth

	Expectation	Reality	Result	% of EBV turned into calf performance	So why bother?
200 Day Weight EBV	1kg in Bull EBV = 0.5kg in calf weight	1kg in Bull EBV = 0.49kg in calf weight	Strong	99%	The heaviest sire's calves had an extra 19kg at weaning. At $4/kg* that's worth an extra $76 per calf
400 Day Weight EBV	1kg in Bull EBV = 0.5kg in calf weight	1kg in Bull EBV = 0.41kg in calf weight	Strong	82%	The heaviest sire's calves had an extra 43kg as yearlings. At $3/kg* that's worth an extra $129 per calf
600 Day Weight EBV	1kg in Bull EBV = 0.5kg in calf weight	1kg in Bull EBV = 0.45kg in calf weight	Strong	90%	The heaviest sire's calves had an extra 66kg at 18 months. At $3/kg* that's worth an extra $198 per calf

* Beef + Lamb NZ Economic Service 2018





Proving Growth: Matching EBVs to actual calf weight (expected slope = 0.5)

SECTION
05

HOW MUCH SHOULD YOU PAY FOR A BULL?

What difference would a bull with a +30 kg EBV for 400 Day Weight make as a terminal sire in a commercial herd?

The sire and dam each contribute 50% of the genes to their offspring. The sire has an EBV advantage of +30kg and we will assume the dam has no influence (i.e. 0kg EBV).

Progeny: 30 kg + 0kg = 30kg
30 kg x ½ =15kg

Let us assume that a bull sires 40 calves a year for four years and yearlings sell at $1.80 per kilo liveweight. So 40 calves in each of four years, each 15kg heavier (because only half the genes come from the bull) will result in an extra 160 calves x 15kg or 2400kg of yearling weight. Multiply the kilos by $1.80 per kg liveweight and you have returned an extra $4320 over the bull's lifetime.

RETURNS

Sire advantage: 400 Day Weight

	per year	lifetime
+30kg EBV	$1080	$4320

Using Selection Indexes to compare the lifetime profitability of bulls

- Using Selection Indexes is more accurate and balanced than EBVs to determine the relative lifetime profitability of a bull, as it represents his overall profitability.
- Establishing the relative lifetime profitability of bulls will enable you to determine their purchase price.

As an example, you run a straight Angus herd generating female replacements and finishing surplus females and all steers to 200kg at 16-20 months. The Angus Self-Replacing Index best represents your production system, so you would use this Index to compare your bulls.

Bull A has an Index per cow mated of $40 and Bull B one of $30. It is assumed that each bull mates 200 cows during its lifetime. Bull A is predicted to generate $2000 more profit during its lifetime than Bull B. Based on this, you can afford to pay $2000 more for Bull A than Bull B and still be just as well off financially.

Answers Section 3 exercises

Exercise I

Buyer 1: Bull B. Superior bull for the targeted 200 Day Weight and Milk traits.

Buyer 2: Bull A. Superior bull for the targeted Birth Weight, 200 Day Weight and 400 Day Weight traits – against the breed average.

Buyer 3: Bull C. Superior bull for the targeted moderation in Mature Cow Weight and Milk traits – against the breed average.

Exercise II

Buyer 1: Bull A. Superior bull for the combination of targeted 400, 600 Day Weight and Days to Calving traits.

Buyer 2: Bull B. Superior bull for the targeted 600 Day Weight trait – note fertility traits aren't of concern in a terminal cross.

Buyer 3: Bull C. Superior bull for the targeted 400 Day Weight and Scrotal Size traits.

Exercise III

Question 1: Top 75%.

Question 2: Top 50% (breed average is the 50th percentile).

Question 3: Top 90-10% (Bull B and Bull D show a large part of the range in their breed for Rump Fat).

Exercise IV

Buyer 1: Bull C. Superior bull for the targeted Rump Fat (close to breed average), Eye Muscle Area and Marbling (IMF) traits.

Buyer 2: Bull A. Superior bull for the targeted Retail Beef Yield, Carcase Weight and 400 Day Weight traits.

Exercise V

Question 1: Lady's Man. His Calving Ease Direct, Calving Ease Daughters, Gestation Length and Birth Weight EBVs are all in the top 10% (or better) of his breed.

Question 2: Intensity. His 200 Day Weight, 400 Day weight, 600 Day Weight, Carcase Weight EBVs are all in the top 10% (or better) of his breed.

Question 3: Lady's Man has moderate growth but excellent calving ease. Intensity has excellent growth but poor calving ease.

SECTION
06

SELECTING A BULL – PHYSICAL ATTRIBUTES

Breeding soundness

Herd fertility has a major impact on returns in a commercial beef herd. In economic terms, a 1% increase in herd fertility is equivalent to approximately a 10% rise in growth rate.

Fertility within a herd is influenced by four major factors:

- Reproductive soundness of bulls
- Structural soundness
- Management
- Genetics

Examining bulls for breeding soundness is a key aspect of herd fertility. This should be completed before each breeding season and will detect most bulls with potential fertility problems. This examination should be performed by a veterinarian each year.

FERTILITY PHYSICAL EXAMINATION

This will cull bulls with undesirable physical characteristics or abnormalities that will inhibit its key job of mating cows. This basic examination can be done by eye at a bull sale. Further tests that make up a BBSE (Bull Breeding Soundness Evaluation) is completed by a veterinarian. This includes a service capacity test, libido assessment, scrotal size/ palpation and semen quality test. Some breeders will provide a BBSE on all bulls before sale.

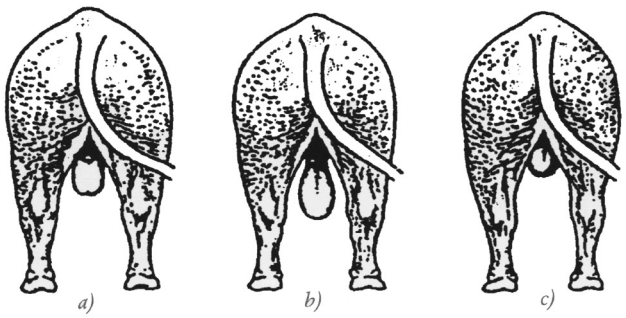
Scrotum and testes

Bulls with straight-sided scrotums often have only moderate testicle sizes. The straight-sided neck of the scrotum is generally due to fat deposits that can impair proper thermoregulation, particularly in the summer. This is often a result of feeding. Such fat deposits may disappear as a bull grows.

Bulls with normally shaped scrotums (which have a distinct neck) are preferred. Testes are located in the scrotum because sperm can only be produced within a narrow temperature range, several degrees cooler than internal body temperature. To maintain semen quality, effective thermoregulation must occur and can only be achieved from 'normal' testes.

Wedge-shaped scrotums are pointed towards the bottom and tend to hold the testes close to the body wall. Bulls with this scrotal configuration have undersized testes that seldom produce semen of adequate quality and should be avoided.

Scrotal shapes encountered in beef bulls



a) *Straight-sided scrotum*. This shape is usually due to a fat-pad at the base of the scrotum, which can interfere with testicular thermoregulation. Testicles in a straight-sided scrotum are frequently only moderately sized.
b) *Normal scrotum.* Note the definite neck. Large sized testicles are more frequently found in a normal-shaped scrotum.
c) *Wedge shaped scrotum*. Testicles in a pointy scrotum are held too close to the body and are most often undersized.

It is useful to palpate (handle and examine) the scrotum and testicles, noting position and consistency; but this is not usually possible, at a bull sale. Palpation should be carried out by an experienced person.

Scrotal size

Scrotal size is important for the following reasons:

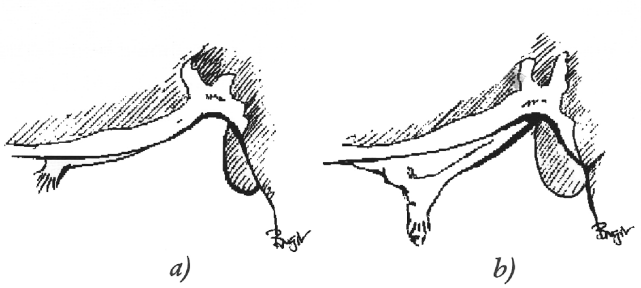
- In conjunction with a bull's serving capacity, it influences the number of cows he can successfully mate during a breeding season (mating potential)
- A key indicator of when a bull reaches puberty
- Positively related to the age at which female relatives reach puberty
- Positively linked to later female fertility
- Influences semen quality

Scrotal size measurements taken in a large experimental herd in Queensland, Australia, showed a positive link between scrotal size and female fertility applied at any age between 12-20 months. Bulls with larger scrotal size at puberty had daughters that conceived earlier in their lives and returned to calf earlier resulting in a more productive lifetime. Cattle that mature reproductively early are always preferred.

Penis and sheath

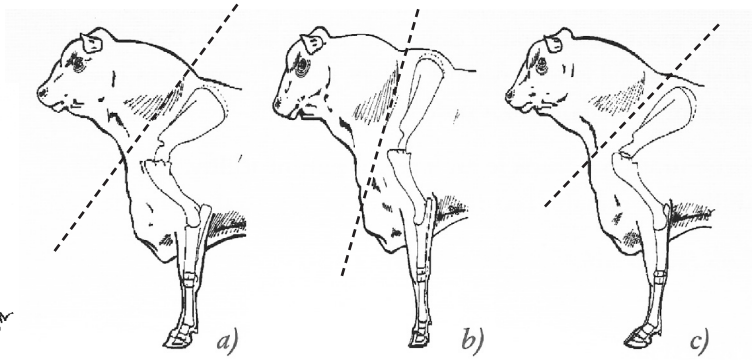
The sheath should be firm, but not tight to the belly, of moderate length and angled forwards when both flaccid and erect. Injuries – like prolapse or legions – that have become inflamed should be identified. This will predispose the bull to further injury or an inability to serve cows at mating.

Bulls with other obvious abnormalities should be culled. Corkscrew penises are a major cause of poor in-calf rates in cow herds and seriously limit a bull's ability to serve.



Sheath
a) Desirable sheath b) Loose, undesirable

Shoulders: The shoulders are naturally sloping. A slope of 45-60 degrees is considered acceptable. A beast whose shoulder blade is tipped forward (straight shouldered) has less angle at the shoulder joint and elbow joint. This reduces the shock-absorbing ability of these front joints.



Front leg and shoulder structure of the bull
a) Correct b) Too straight c) Too much angle

STRUCTURAL PHYSICAL EXAMINATION

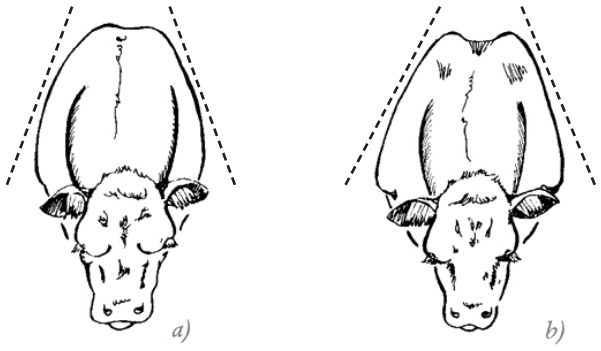
While a bull's fertility is the most important of his traits, he must be sound in his structure so that he lasts many years, serving many cows in a short period of time, without suffering injury. Structural soundness is therefore an integral part of this fertility.

Jaw: The jaw should be wide, enabling the animal to harvest its daily food requirements in as short a time as possible. The teeth on the lower jaw should meet squarely with the upper pad. Bulls with overshot jaws (lower jaw protruding) and undershot jaws may have difficulty grazing, especially when pasture is short.

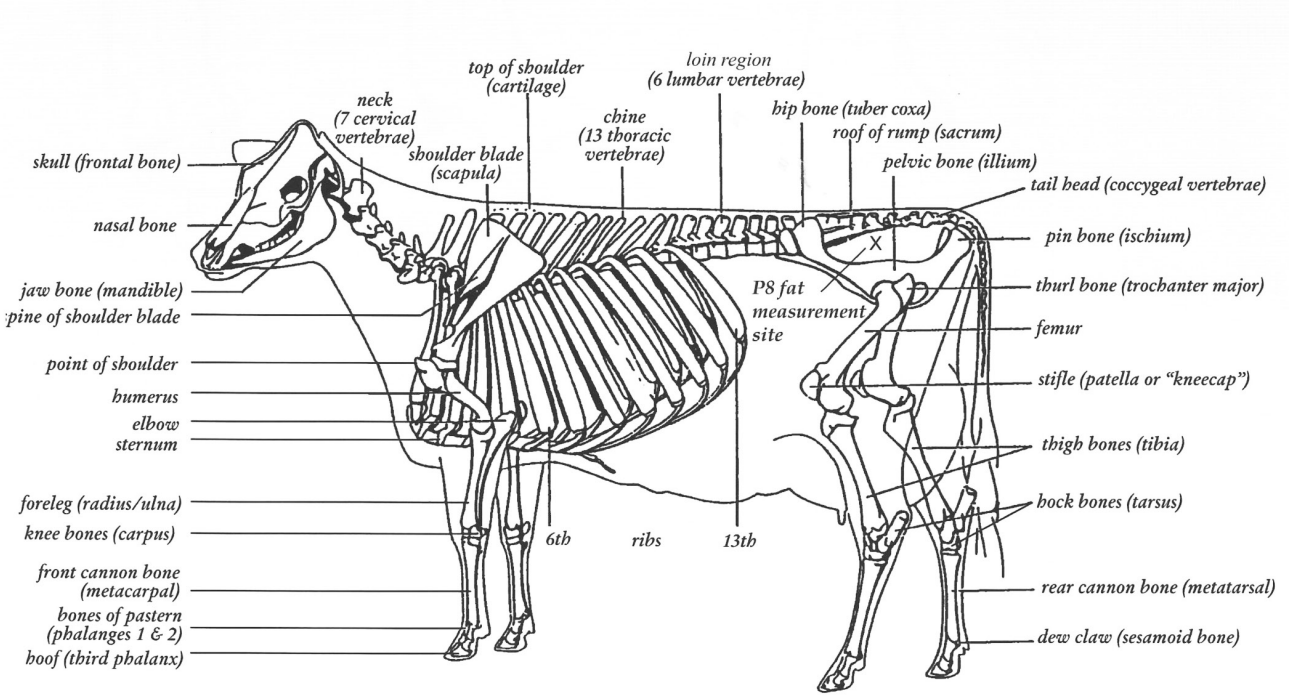
Eyes: Some breeds are very susceptible to eye cancer. Eye cancer is a serious condition leading to wastage in cattle and possible downgrading of the carcass. It can be minimised by ensuring that animals are well pigmented around the eyes, have eyes which are well set into the head, and have a well "hooded" forehead. Susceptibility to eye cancer is a heritable trait.

Neck: The neck should appear to be of a reasonable length and held high. Often, the neck appears to be short because there is too much angle to the shoulder and the point of the shoulder pushes forward into the neck region (refer to Bull C on shoulder structure illustration). If the head and neck are held low, this can indicate the shoulder is too straight (see Bull B).

The shoulder should lie smoothly against the rib cage. Bulls whose shoulders are wide at the point of the shoulder (the base of the neck) or wide between the shoulder blades (when observed from above) may throw heavily-shouldered calves. This increases the chance of calving problems.



Prominent shoulder blades may increase calving difficulties
a) Smooth shoulders b) Prominent shoulders



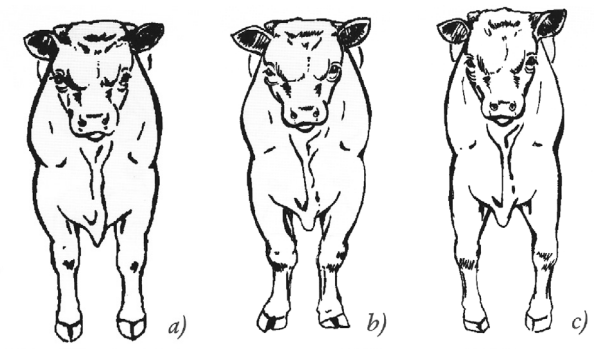
Front legs and feet: The front legs of the bull should be straight when viewed from in front. On a structurally sound animal, you can draw a vertical line from the point of the shoulder to the middle of the claw. This line should intersect the knee. As the knee joints carry more than half the bull's body weight, deviations from this line will cause excessive wear in these joints.

A 'knock-kneed' bull may have turned out front feet (up to 10 degrees is considered normal). A bull is considered knock-kneed when the knee joints lie inside this line, which may eventually lead to overgrown outside claws.

A bull that is wide at the knees (bow-legged) presents a more serious problem. These animals are often narrow in their stance and may roll their feet as they walk. They can also be wide in their shoulders.

From the side, the foreleg and cannon bones should be in a straight line. The knee joint forward of this line (buck-kneed) can be associated with steep shoulders and pasterns and may be a serious fault.

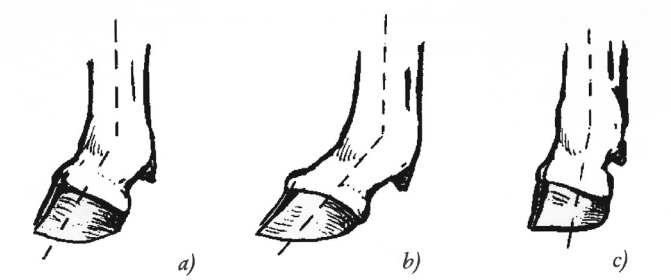
The way the claws of the feet grow often indicates structural problems higher up the legs.



Front leg structure
a) Normal b) Knock-kneed c) Bow-legged

Long or excessively short, even claws may indicate too much or not enough pastern angle, causing both claws of the hoof to grow or wear excessively. Overgrown claws affect the mobility and performance of the animal.

The figure below indicates the correct angle of the pastern joint. Uneven wearing of the two claws, where one grows longer than the other, is often due to a problem in the leg structure. It is caused by an uneven distribution of weight through the foot.

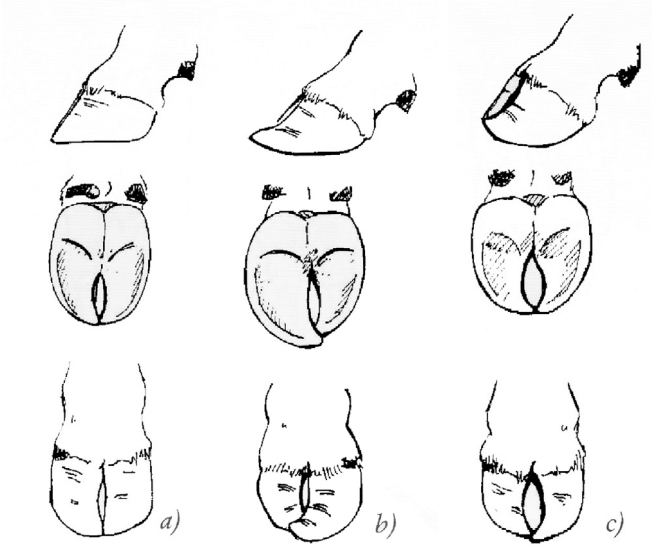


Pastern angle of front and hind legs
a) Correct b) Too much angle c) Too straight

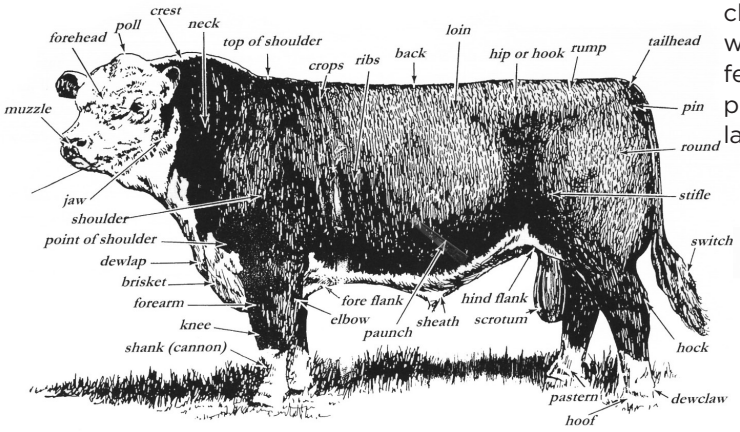
If the claws curl across each other without growing long, this may indicate a serious genetic fault known as 'scissor claw'. These cattle wear the back of the hoof, causing lameness and reduced mobility.

Where excessive claw growth is caused by things other than structure (soft soil, heavy grain feeding, lack of exercise), extra pressure is placed on the leg joints – eventually causing lameness.

Feet: Avoid overgrown, scissor or curved claws. Mild curling is normal. It is exaggerated by heavy feeding and soft soils. Overgrown, uneven claws usually indicate poor limb structure or early signs of hip arthritis. Avoid extremely short feet, which are often associated with over-straight legs.



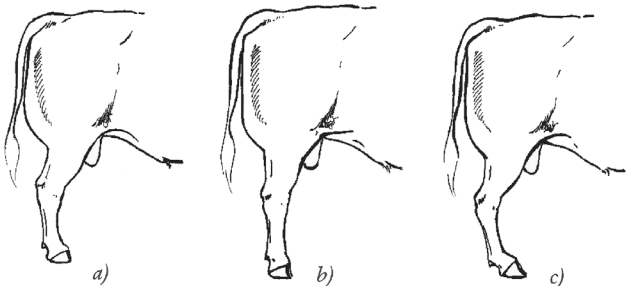
Feet
a) Normal b) Large outside claw and long curled toe
c) Scissor claw



Hind legs and feet: When a bull mounts a cow, he straightens up the joints in his hind legs. When he thrusts, he further straightens the legs. This places enormous stress on all joints, but particularly the hock. If these joints don't have enough angulation, they become swollen and painful, leading to their eventual breakdown.

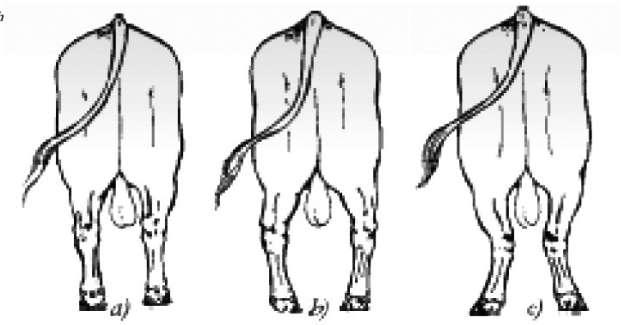
Straightness in the hind leg can be seen in the hock and pastern joints, and this indicates straightness in the stifle and hip. These cattle will wear the front of the claws, resulting in short and upright hooves. Straight-legged bulls are also much less athletic than a sound bull and appear to suffer a higher incidence of broken or damaged penises during serving.

If the degree of the angle in the leg joints is greater than ideal, a 'sickle hocked' condition may exist. This is less of a problem than straight legs, but in extreme cases may cause strained ligaments (pastern and hocks) and long claw growth, increasing the chance of injury and affecting serving ability.



Hind leg structure, from the side
a) Correct b) Too straight c) Sickle-hocked

Viewed from behind, the tibia and metatarsus (hock joint) should be in a straight line. A bull is 'cow hocked' when the hocks are rotated inwards and the hooves rotated outwards. This may cause problems, but usually only in extreme cases, where uneven pressure on the claws causes the outside claw to grow long. A more serious problem occurs where the legs are wide at the hocks, but the feet are turned in (bow-legged). Extra strain is placed on the ligaments of the hock joints causing lameness and even permanent damage.

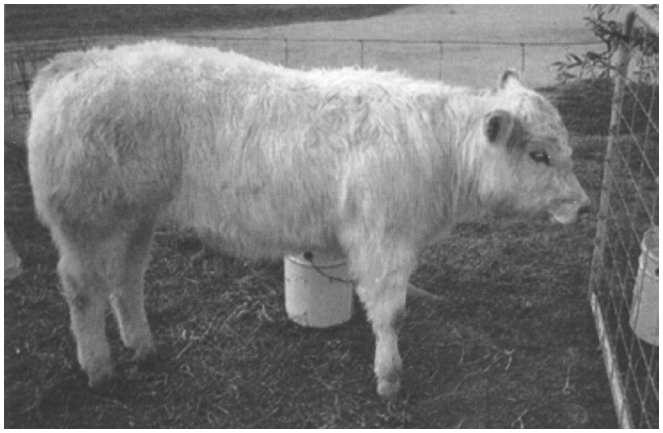


Hind leg structure, from the back
a) Correct b) Too straight c) Sickle-hocked

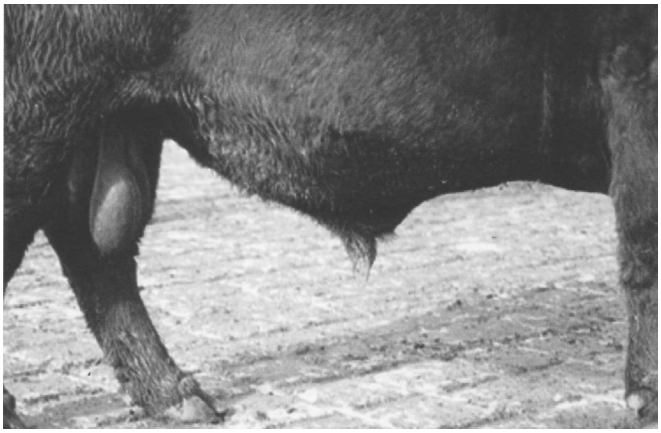
Mobility: Where an animal places its feet when walking naturally tells you a lot about its structure:

- A structurally correct animal will place its hind foot in the imprint left by the front foot.
- An animal with sickle hocks will tend to overstep the imprint of the front foot.
- A straight-legged (post-legged) animal tends to place its hind foot short of the imprint of the front foot.

Temperament: Flighty or aggressive temperament is a health risk and production cost. Buying bulls that are quiet and settled is important. Temperament is fairly heritable.



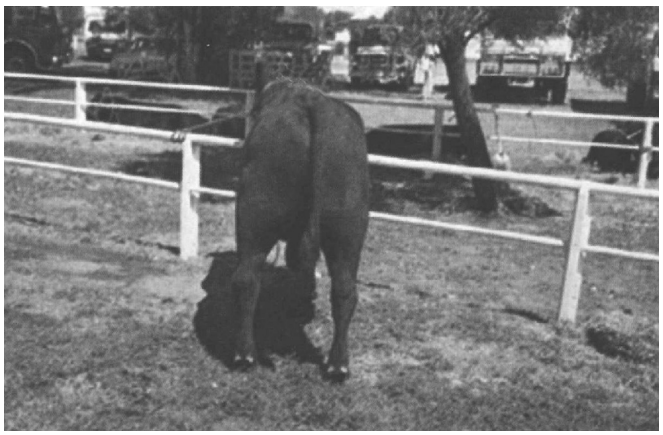
Straight shoulders: Note the straightness throughout the front leg. Poor structure is often obvious as early as six months, like this bull.



A well placed sheath, lying close up to the body.

Heavy shoulders: A bull such as this may increase the chance of calving difficulties.

An excessively long and badly angled sheath, exposing the prepuce and prone to injury.

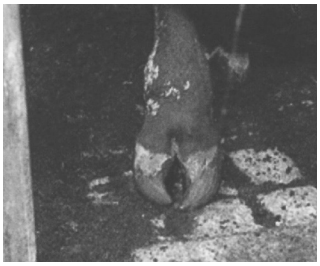


Bow legged: The legs are out at the hocks, placing stress on these joints, and leading to an uneven hoof growth and early breakdown.

Spiral Deviation 'corkscrew' Penis: A serious fault preventing full service.

Low pasterns: Often associated with sickle hocks, the result will be long hooves and eventual lameness.

A sound commercial bull ready to work.



Scissor claw: A very serious genetic fault that causes lameness.

Uneven claw growth: Often caused by incorrect structure in the legs.

Post legged: The straightness in the stifle and hip. The bull is very prone to breakdown, particularly in the hip joint.

Poppy, unprotected eyes make the bull very prone to eye cancer.

Well set hooded eyes.

Sickle hocked: Too much angle in the leg joints seen here in the hock and pastern.

Beef Class Structural Assessment system

The Beef Class Structural Assessment (BCSA) system is internationally recognised. It is a useful and effective way to classify an animal for structural soundness and basic type measures. Beef class scores stand for an animal at the time of classification only, as structural soundness can change with time and maturity of a given animal. BCSA takes into account all of the structural soundness physical aspects discussed and provides a subjective score that is used in many bull sale catalogues in New Zealand and around the world.

HOW TO USE

For docility:

1 is Ideal (docile); 3 is less ideal (restless); and 5 is aggressive.

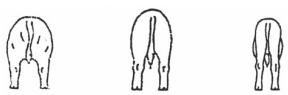
Scores of 1 and 2 are preferred.

For traits scored 1-9:

- 5 score is ideal
- 4 and 6 show slight variation from ideal, but acceptable in any breeding programme
- 3 and 7 shows greater variation, but would be acceptable in most commercial breeding programmes dependent on the emphasis for that structural aspect
- 2 and 8 are low scoring animals and should be looked at closely before purchasing
- 1 and 9 should not be catalogued and are considered culls

For traits scored in 1-5 units:

Higher values are preferred. However, higher values can have other physical consequences (i.e. heavily muscled cattle may have restricted mobility).

Trait	Key	Scoring Range	
Docility	D	(1) 2 3 4 (5)	1. Docile 3. Restless 5. Aggressive
Front Feet Claw Set Rear Feet Claw Set	FC RC	 1 2 3 4 5 6 7 8 9	1. Open/Divergent 5. Good 9. Scissor Claw
Front Feet Angle Rear Feet Angle	FA RA	 1 2 3 4 5 6 7 8 9	1. Stubbed Toe 5. Good 9. Shallow Heel
Rear Legs Side View	RS	 1 2 3 4 5 6 7 8 9	1. Straight 5. Good 9. Sickle Hocked
Rear Legs Hind View	RH	 1 2 3 4 5 6 7 8 9	1. Bow Legged 5. Good 9. Cow Hocked
Front Legs Front View	FF	 1 2 3 4 5 6 7 8 9	1. Bow Legged 5. Good 9. Knocked Knee
Udder Evenness	UE	1 2 3 4 5 6 7 8 9	1. Dropped Fore Qtr. 5. Good Balance 9. Dropped Rear Qtr.
Teat Size and Shape	TZ	 1 2 3 4 5 6 7 8 9	1. Very Small/Thin 5. Good 9. Very Large/Bulbous
Sheath & Navel Score	SN	 (1) 2 3 4 (5)	1. Pendulous 3. Good 5. Clean/Tight
Capacity	CP	 (1) 2 3 4 (5)	1. Lacking Capacity 3. Medium 5. Large Volume
Muscle Score	LM	 A B C D E	A. Very Heavy C. Medium E. Light

SECTION
07

BRINGING YOUR NEW BULL HOME

Summary

- Bulls are a large investment, so spend a little time making sure they adjust to their new environment, are fit, free from disease and actively working.
- Consult with your veterinarian and draw up a policy for treating bulls and schedule an annual BBSE pre mating.

Health and handling considerations

It is wise to set up an annual BBSE (Bull Breeding Soundness Evaluation) and health treatment programme with your veterinarian for all your breeding bulls. The more information you have on a bull's reproductive and structural soundness, the greater the guarantee of him leaving you offspring. This applies equally to young bulls as when you're buying mixed-age sires.

A standard BBSE can include:

- Serving capability
- Serving capacity
- Semen evaluation, including a full morphology
- Palpation of the testicles and reproductive tract
- Measuring scrotal size

At purchase, check the animal health status of the bull breeder's herd before you buy. This is especially relevant when purchasing from areas where TB is prevalent.

Bovine Viral Diarrhoea (BVD) has become an endemic disease in New Zealand and can cause serious financial losses in breeding herds. It is wise to only purchase bulls that have been tested BVD-antigen negative and are vaccinated against the disease. An annual vaccination is required following the two initial sensitising vaccinations.

Temperament is a major factor to check when you buy bulls. Inspect them in the yards or paddock before sale and note any unusual behaviour or activity. Note bulls that are continually pushing to the centre of a mob, running around, unreasonably nervous, aggressive or excited. This behaviour should be written down in the sale catalogue and referred to during the auction. At the sale, note any changes of temperament by individual bulls. Some bulls which are quiet in the yard or paddock may not like the pressure and noise of the auction and become excited. Others that were excited before get much worse in the sale ring and can really perform. Using the yard or paddock behaviour as a guide, rather than the temperament shown in the ring, you can often buy such bulls cheaper, provided they were satisfactory in other respects.

When you buy a new bull for your herd, you can reduce problems by getting him settled in properly in his new environment. Bulls of all breeds can become upset and excited in the sale and delivery process. They are subjected to strange yards, different noises, loss of their mates, different people, different handling methods, trucking, unloading, new paddocks and different water and feed. This combination can be enough to upset even quiet animals. New bull buyers are often concerned about the apparent bad temperament of a bull that seemed quiet enough when purchased. Understanding why bulls become upset and reducing these causes of stress allows them to settle down quickly.

Delivery

At auction sales, possession is yours after the fall of the hammer, so careful treatment of animals from then on is important. Sometimes, the vendors provide insurance against loss in transit, accidental loss of use or infertility. However, insurance is usually the responsibility of the buyer.

When you buy a bull, ask what health treatments he has received. Knowing what has been done can reduce any future health treatments.

When you use a professional carrier:

- Make sure they know which bulls can be mixed together.
- Discuss resting procedures for long trips, expected delivery time, truck condition and quiet handling by the carrier.
- Ensure you give explicit instructions on the delivery docket. Important details include ear tag details and/or brand numbers, your address and your contact telephone numbers.
- When buying bulls from distant locations you may have to fit in with other delivery arrangements to reduce cost. You should make it clear how you want your bulls handled.

Arrival

When the bulls arrive home, unload them at the yards into a group of quiet stock – for example, steers or herd cows. Never jump them from the back of a truck into a paddock. Bulls from different origins should be put into separate areas with other cattle for company.

Provide feed and water, then leave them alone until the next morning. The bulls should then receive routine health treatments. Bulls should be drenched and held in the yards for 24 hours to prevent introducing worms and, if necessary, treated for lice. Horned bulls should be well tipped to allow easier working through yards and races.

A bull's behavior will decide how quickly he can be separated and moved out to paddocks.

New bulls should be paddocked separately from older bulls to avoid fighting and the risk of injury.

The new bull may be paddocked with the older bulls after their first mating.

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