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GENETICS

$Indexes for beef cattle

What are $Indexes?

Selection indexes take the hard work out of knowing how much emphasis to place on estimated breeding values (EBVs) when you are selecting breeding animals. The MLA Tips & Tools *Buying better bulls* and *The accuracy and success of EBVs* provide more information about EBVs, how they work and how they can be applied to sire selection.

An index gives you a single EBV that reflects the value of an animal to your breeding objective in dollar terms. This dollar index ($Index) ranks animals for a single selection goal – profit.

Indexes help make a balanced selection. They balance the amount of emphasis put on growth, maternal, carcase and fertility traits to give you the most profitable herd over the long-term. High indexing animals may not have the highest EBV for any single trait.

The process of balanced (index) selection combines economics with genetics. Economic values for performance measures are calculated for an individual herd production and market situation. Using sound genetic theory, these economic values are then used to calculate appropriate weightings for all the EBVs currently available. These weightings apply pressure to those EBVs that will achieve the greatest long-term profit. This process is managed by a piece of software called BreedObject. The following example demonstrates how BreedObject can be used to determine a dollar index.

How are $Indexes calculated?

Typical production statistics (prices and costs) underlie each index. When developing an index the market and production system is defined. This includes variables such as age and weight at slaughter, weaning percentage, time of calving, level of calving difficulty, and the cost of feed. The economic value of a small improvement in each trait is calculated for each set of parameters. This is the basis for deciding how much emphasis to put on each trait.

Key benefits

- An index gives you a single EBV that reflects the value of an animal in dollar terms
- $Indexes balance the amount of emphasis put on growth, maternal, carcase and fertility traits to give you the most profitable herd over the long-term

Benefits and costs are evaluated for both the long-term sustainability of the cow herd and the sale animal from birth to slaughter. Compromises between traits are taken into account when calculating indexes, such as increased growth versus increased birth weight versus increased cow maintenance weight.

The index also includes the effect genetics will have now and in the future. Improvements in some traits such as female fertility will not be apparent in the short-term, only producing a result when the daughters of a new bull start to produce calves themselves.

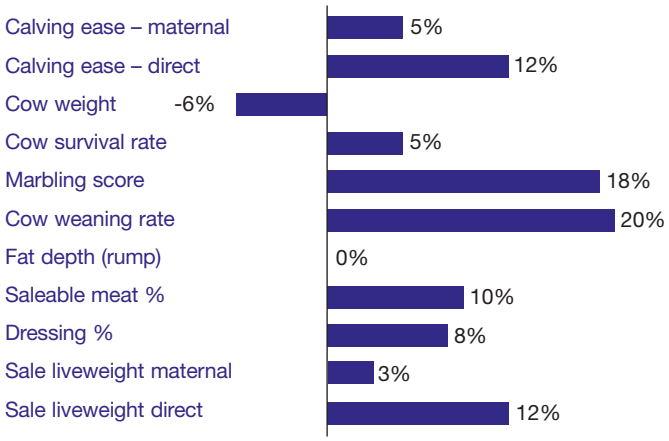
For traits that affect the pasture phase of production, it is assumed that feed is a limiting factor for part of the year, so any increase in the feed requirements of the herd is a cost.

Putting indexes into practice

Figure 1 shows the trait emphasis of the Shorthorn index used for herds producing steers for the feedlot and subsequently Japan. As might be expected, marbling is as important as growth rate, but fertility (weaning rate) and calving ease are also important as they influence the future breeding herd profitability. The system then works out which EBVs to put pressure on and ranks the animals accordingly.

The assumed calving rate and level of calving difficulty each reflect typical rates for Shorthorns in temperate Australia and new sire selection has been carried out to ensure these rates are not negatively affected.

Figure 1: Trait emphasis for the Shorthorn B3 index



What do index values mean?

Indexes are EBVs that indicate a predicted difference in the progeny of the animals being compared. Index values are expressed in dollar terms. Figure 2 shows that differences between animals indicate a difference in their ability to make profit within a commercial herd.

Figure 2: The effect of two bulls on herd profit – Bull A with an index value of +40 and Bull B with an index value of +20

	Bull A	Bull B
Index values	+40	+20
Extra profit per cow mated (half diff in EBVs)	$10	
Profit per cow mated – if mated to random sample of cows – ie each bull has equal value cows – assume base profit per cow $200	$210	$200
If mated to 100 cows in working life – extra profit	$1,000	

The calculations indicate that progeny of Bull A will make more money for the herd owner (and other people in the production chain) than the calves from Bull B. As for all EBVs the mathematics is simple.

Assuming the bulls are given an equal split of available cows, the difference in expected profit from the two bulls will be the difference in the values divided by two [(40 – 20)/2]. This is divided by two because only half the genes come from the bull; the other half comes from the cow (which in this case was assumed to be of equal value).

Note: The actual dollar values shown in this example would only equate if the herd in which the bulls were being used had exactly the same market prices, weight gains and all other inputs as the herd used to set up the index. However, if you choose an index that has been developed for a market and environment that is close to your system, the ranking of the bulls will be consistent, even though the observed dollar differences may be different. Also, not all the profit is made by the breeder, some of the advantages are realised by feedlots and processors.

Published indexes

Most indexes you see in sale catalogues or on the web are standardised breed-specific indexes. These indexes have been designed by the individual breed societies to represent some of the more common market and production scenarios in which their breed predominates. For example, the Angus society has an index for the long-fed Japanese market, the Hereford society produces an index for Hereford Prime and the Brahman society publishes a grassfed Jap Ox index.

Standardised indexes allow bull buyers to find a scenario that is reasonably close to their own production system and market. They can use this index as their primary selection tool.

However, as the indexes are standardised there may be a need to modify the selections to meet individual requirements. This can easily be done by examining the individual EBVs of the top ranking sires.

While the indexes have a general market focus, each index will be based on standard production parameters, as well as the specified market criteria. These parameters have been assigned by breed society representatives as typical of the production system that will meet the nominated market. For example, a herd producing steers to be long-fed for the Japanese market is assumed to have relatively high fertility rates (eg 85% weaning). A herd producing for this market with lower weaning rates would need to place more emphasis on fertility traits than the standard index. This can be done by a customised index.

Breed	Index available
Angus	B3 Supermarket CAAB Northern terminal
Hereford/Poll Hereford	Supermarket Hereford Prime Grassfed Export
Brahman	Jap Ox
Charolais	Domestic Supermarket Export
Limousin	Domestic Terminal Steer Self-replacing Steer Terminal
Murray Grey	Long-fed Export Supermarket
Shorthorn	Domestic Supermarket Domestic Restaurant Export B3 Export B3M (M= mature cows)
Simmental	Self-replacing Supermarket Japan Terminal

Do published indexes work?

Indexes do work and the best way to see this is to examine the key profit drivers that indexes are trying to change, then look at the outcome of progeny from high and low indexing bulls. For the Shorthorn B3 index, the key profit drivers are cow weaning rate and marble score. This translates to emphasis on the calving ease, scrotal size and intramuscular fat (IMF) EBVs.

The Durham Research Project is a MLA donor company project carried out in conjunction with the Shorthorn Society. This project has been testing the progeny of sires with different index values for four years. Three groups of progeny have been processed after 200 days on feed – one at domestic weights and one at export weights. Results have been adjusted to a 300kg carcase weight – the standard for BREEDPLAN EBVs. This makes the data collected on the domestic weight carcases comparable with data from the heavier carcases.

Shorthorn steers that are progeny of test sires in a feedlot prior to slaughter

In the first two years of the project, 23 sires were tested and their index values for the B3 index varied from 2 to 41. As shown in Figure 3, results for birth weight (reflecting the emphasis on calving ease) and IMF show that progeny from the top five indexing sires had higher average IMF values and lower birth weight than progeny from the five lowest ranking bulls.

This shows that selection on index values will change these traits in the direction you would expect (the direction that is economically favourable).

Carcases from test sires were measured and results compared to the EBV and index values of the sires

How BreedObject deals with conflicting traits

Conflicts can occur between many of the traits we might want to improve.

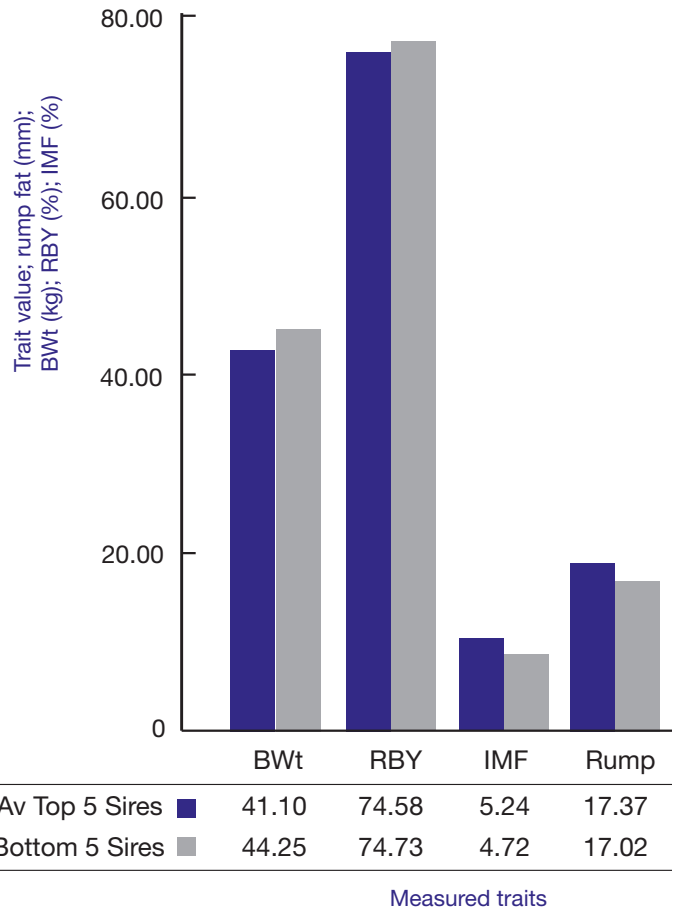
Using the Shorthorn example, the calculations suggest there is economic benefit if saleable meat yield increases. For this to happen we would expect the progeny of the top indexing sires to be leaner than their counterparts from the lower indexing sires.

But remember, BreedObject compensates for antagonisms between traits. The actual emphasis on the rump EBV is positive, reflecting the fact that fatness is positively correlated to weaning rate (fatter cows tend to have higher fertility).

Because weaning rate has a higher economic value than saleable meat yield in this scenario, the progeny from the top indexing sires are slightly fatter than the progeny from the low indexing sires and saleable meat yield appears marginally worse, but in effect is held constant.

Here BreedObject does a balancing act and chooses the best combination of animals with a balance of traits. Rarely can it achieve improvement in every trait desired because animals that have the perfect blend of genetic merit across all traits are hard to find!

Figure 3: Progeny results for high and low indexing sires



Where do you find $Index values?

The standard index values for individual animals are easily found on breed society websites. The list of animals can be restricted by a number of criteria, such as sex and age, or whether they are sires. The list can then be ranked on the index values (see Figure 4).

Figure 4: Listing of Brahman bulls from the Brahman breeders website ranked by Jap Ox Index

Brahman Animal Listing

Entries: 1 - 15 of 250 are shown (The first 250 rows retrieved) **Sorted by:** Jap Ox Index ($) - descending
Hide EBVs Show EBV Acc Hide $Index Values Show All Entries First Previous Next Last
Selection Criteria: Animal is a PUBLISHED SIRE, Jap Ox Index ($) >= 0,
Home Animal Enquiry Member Enquiry Sale Catalogues Semen Catalogues Download Files

Name/ID	Birth Wt. (kg)	200 Day Wt. (kg)	400 Day Wt. (kg)	600 Day Wt. (kg)	Mat. Cow Wt. (kg)	Milk (kg)	Scrotal Size (cm)	Days to Calv.	Carcase Wt. (kg)	Eye Muscle Area (sq cm)	Rib Fat (mm)	Rump Fat (mm)	Retail Beef Yield (%)	IMF %	Jap Ox Index ($)
CBV 97-7429 AVANSO VIVA	+2.6	+17	+28	+43	+49	-1	+2.7	-24.2	+18	-	-	-	-	-	+$60
JDH KARU MANSO 600 (IMP US)	+5.6	+45	+65	+77	+67	+3	+1.6	-	+38	+3.7	+0.2	0.0	+0.7	+0.6	+$57
JJ WISE DUDOR 873 (IMP US)	+6.9	+42	+69	+87	-	+1	+1.1	-	+38	+1.5	-1.6	-2.1	+0.8	+0.3	+$57
LANCEFIELD KALAHARI MANSO 9125 (AI) (ET)	+6.5	+45	+61	+78	+73	0	-	-	+36	-	-	-	-	-	+$56
FEC D MANDRAKE MANSO (ET)	+5.6	+41	+56	+75	+71	0	+0.6	-	+34	+3.7	-0.5	-0.7	+1.4	-0.2	+$53
CBV 99-7671 TOM CONDUCTOR	+3.3	+23	+28	+43	+45	-1	+2.1	-16.0	+17	-	-	-	-	-	+$51
VALUCK 656	+3.7	+23	+47	+62	-	-	-	-	+29	-	-	-	-	-	+$51
LANCEFIELD D DYNOMITE 333/D (AI)	+4.8	+33	+50	+63	-	-3	-	-	+29	-	-	-	-	-	+$50
LANCEFIELD SIGNIFICANT 9139 (AI) (ET)	+5.6	+36	+52	+64	-	-5	+1.4	-	+30	-	-	-	-	-	+$50
CBV 96-6812 IMPACT	+2.6	+18	+28	+45	+51	-2	+1.6	-11.0	+19	-	-	-	-	-	+$48
MK INTERNATIONAL 20/1 (ET)	+3.7	+23	+41	+52	+52	-6	+2.6	-	+25	+2.8	-0.6	-0.9	+1.0	0.0	+$47
LANCEFIELD KINSMAN MANSO 8930 (AI) (ET)	+5.2	+38	+53	+66	+59	0	-	-	+32	-	-	-	-	-	+$47
CBV 97-7261 TOM COUNTER	+1.7	+12	+25	+42	+50	0	+0.9	-12.8	+18	-	-	-	-	-	+$46
TTT MR SUVA CRATA 450	+5.7	+31	+46	+65	+67	0	+0.9	-	+27	-	-0.9	-1.2	-	-	+$46
JDH KARU AMANO MANSO (IMP US)	+4.8	+38	+58	+66	-	+2	-	-	+33	-	-	-	-	-	+$46
Breed Avg. EBVs for 2001 Born Calves	+1.6	+12	+17	+21	+21	-1	+0.4	0.0	+12	+1.6	+0.1	+0.1	+0.2	+0.1	+$17

(14 Trait Leading EBVs shown in this table)

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