Selection for Economically Important Traits

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Ian Locke is the managing partner of a family grazing business called Wirruna Poll Hereford Stud (WPHS) located at Holbrook, NSW, in the south eastern part of Australia. Having completed a Degree in Agricultural Economics (University of New England, Armidale) and an early career as an agricultural business consultant in Sydney and Orange in NSW, Ian began his farming career in 1994 following his passion in growing grass and beef cattle. Ian has grown a significant bull breeding business in Wirruna Poll Hereford Stud and runs a prime lamb breeding flock. As well as hands-on agriculture, Ian chairs the International Beef Recording Scheme (BREEDPLAN®) and is a Board member of the Agricultural Business Research Institute (ABRI) in Armidale.

Introduction

The primary objective of a seedstock producer should be to make genetic improvement. Genetic improvement occurs when the average genetic value of the offspring (e.g. the current calves) is higher than the average genetic value of the previous generation from which the parents were selected. In other words, the calves are genetically superior to their parents. Genetic improvement can be made to either an individual trait or across a range of traits.

We know that we can change animals over time with genetic selection. In 40 years, the Champion Hereford Bull of 1960 has been dramatically changed to those of the 2000's.

Champion Bull 1960

Champion Bull 2001

Too often, the efforts of some in the seedstock sector are to change the genotype of cattle to chase the latest fad or fashion in cattle. This is often further encouraged in the

judging rings where in the 1960's smaller cattle were promoted for their smaller beef cuts suiting the 'modern' housewife. The big framed and leaner cattle of the 1990's were pushed with claims of maximum feedlot performance and efficiencies on kill floors with greater carcase weight and less fat trim. For me, in our cattle production environment, the optimum is somewhere in between these extremes. In breeding there are many trade-offs where breeding for one trait can have adverse consequences on the other. Leading seedstock producers will be concentrating on making genetic improvement for a large range of traits simultaneously, with the relative importance given to each trait determined by the influence that the trait has on the profitability of the beef enterprise.

The important message is to develop a deep understanding of the factors that drive profit in your beef enterprise (and that of the majority of your clients) and to use the tools available that can, on balance, improve the genetic traits that influence these economic factors.

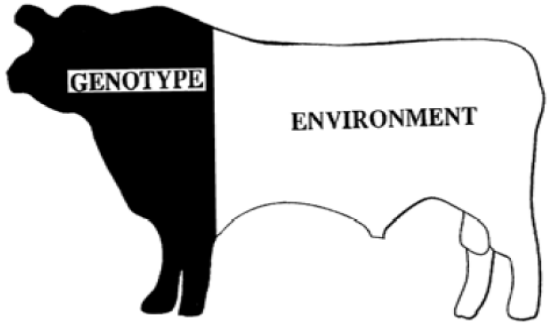
This paper discusses the experience of Wirruna Poll Herefords in using BREEDPLAN® as a selection tool and the associated add-on technologies that help to balance the traits and benchmark genetic progress over time.

Selecting Animals for Use in a Breeding Program

There are several key factors influencing the rate of genetic improvement in the seedstock herd:

1. Selection differential-the greater the genetic superiority of the parents, the greater the genetic gain
2. Generation Length-the younger the age of the parents, the quicker the generation turnover and the greater the genetic gain
3. Accuracy-the better the quality and quantity of data recorded, the higher the accuracy of our estimation of an animal's 'true breeding value' becomes. Therefore, the response achieved from a breeding program will be increased.

Given the relationship between genetic superiority of the selected animals and the rate of genetic improvement that is achieved, the important link is that we must also know how to identify these animals that are, in fact, genetically superior. If we are looking to choose one of a group of bulls, it is a challenge to "see" many of the traits that influence the profitability of a beef enterprise. For example; it is hard to tell what level of marbling a bull's progeny may have or how fertile his daughters will be compared to another bull by assessing them visually.



We do have objective measurement such as physical weights and carcase scanning, however, this can be complicated by a raft of non-genetic factors such as nutrition, disease status and age. The implication of this is "What you see is not necessarily what you get".

Even the most astute cattlemen find it

difficult making selection decisions that are not clouded by differences between animals, that are due to non-genetic factors. To make genetic improvement, it is imperative that selection decisions are based on genetic differences between animals. The BREEDPLAN® system was developed for this purpose.

Breedplan

BREEDPLAN® is an advanced genetic evaluation system adopted by some 45 breeds of beef cattle across 15 countries including South Africa. Namibia, Zimbabwe and Botswana. The analytical software was developed and maintained by the world renowned Animal Genetics and Breeding Unit (AGBU) at The University of New England (Australia) and is licensed exclusively to the Agricultural Business Research Institute (ABRI) for implementation internationally.

BREEDPLAN® considers all the pedigree and performance information that is available on an animal, and its relatives, to produce an estimate of an animal's breeding value. This is called an Estimated Breeding Value (EBV). EBVs are produced for a range of economically important traits. These traits currently include:

BREEDPLAN® Traits

GROWTH	FERTILITY	CARCASE	OTHER
Birth Weight (BWT)	Scrotal size (SS)	Carcase weight (CWT)	Docility
Growth -200 Day Weaning (200D)	Days to calving (DtC)	Fat depth – Rump (P8F)	Net feed intake
Growth -400 Day Yearling (400D)	Gestation length (GL)	Fat depth – Rib (Rib)	Flight time
Growth -600 Day Final (600D)	Calving ease-direct (CE-dir)	Retail beef yield (RBY%)	Shear force
Maternal (Milk)	Calving ease-daughters (CE-Mat)	Intramuscular fat (IMF%)	Conformation
Mature Cow Weight (MCW)			

Table 1

The main benefit offered by BREEDPLAN® is its use as a selection tool to assist in the identification of the most genetically superior animals for use within a breeding program from those that are available. Our herd receives a Breedplan Report every quarter, showing the BREEDPLAN® EBVs of all our active sires, cows and bulls, steer and heifer progeny. This report also shows Breed information such as breed average values for traits and a 'Percentile Table' allowing comparisons of where your animals may genetically fit when compared to the breed, as a herd or individually.

This report allows effective identification of the animals with the best genetic package, including the ability to identify and select against normal trait antagonisms. For example, increase growth and calving ease simultaneously, or increase muscle while maintaining fat cover.

Over time, BREEDPLAN® has added a suite of genetic tools to further assist with animal selection and lifting the rate of genetic progress. This paper will further expand on these add-on BREEDPLAN® tools, including:

- Completeness of Performance
- BreedObject Selection Indexes
- TakeStock®
- Mate selection
- Internet Solutions

Completeness of Performance

While most of the trait recording is optional, BREEDPLAN® encourages complete recording to underpin the accuracy of EBVs. BREEDPLAN® members receive a "Completeness of Performance" report that assesses how "complete" their information is. Importantly the report identifies data gaps and areas where additional performance information could potentially be recorded.

Completeness of Performance Star Ratings

A 'STAR' herd rating is also produced and is calculated on a 0-5 scale based on the proportion of calves within the herd born in a fixed 5-year period that have performance recorded for each trait. Herds with a "5" STAR rating are considered to be gold standard recording "complete" performance information for all the traits for which EBVs are available.

This technology has been an important add-on to BREEDPLAN® as it provides a simple system to assess the integrity of the herd data that goes into the calculation of their BREEDPLAN® EBVs. The promotion of more data and the associated increased accuracy of the EBVs can lead to improved levels of genetic progress.

Selection Indexes

While cattle producers can have BREEDPLAN® EBVs for a range of economically important traits comprehensively describing the genetic merit of an animal, there remains the dilemma of how to select animals for different production systems or target markets. BreedObject is a tool that combines EBVs for an animal with economic weightings (based on cost of production and returns on outputs), to produce a single Selection Index ($Index). Many Breed Societies have developed either one Selection Index or multiple Selection $Indexes to cover a range of production/market scenarios.

As an example, there are three standard selection indexes calculated for South African Simbra animals. These are:

- Self Replacing Feedlot Index
- Namibian Self Replacing Grass Fed Index
- Self Replacing Weaner Index

Such $Indexes enable cattle producers to make 'balanced' selection decisions, taking into account the relevant growth, carcase and fertility attributes of each animal. This assists them to identify animals that will be the greatest value to their particular enterprise. Being self replacing indexes, these reflect both the short term profit generated from sale

of progeny and the longer term contribution to profit generated by the daughters retained in the herd.

The $Index value for an animal is effectively an EBV of the animal's profitability in that particular commercial production scenario and market. Animals can be ranked on their $Index value, sorted on their progeny's expected profitability.

It is very important to identify the $Index of most relevance to the production system that the animals will be used in. In order to identify the most relevant $Index, it is recommended that producers:

- Consider the description of the Selection Index
- Take into account the main profit drivers within the production system that the Selection Index is describing
- Evaluate the weightings that are being put on each EBV within the Selection Index

Once the appropriate $Index is selected, using it to rank bulls and compare them with breed average $Index values, or better still a 'Percentile Table', gives a useful indication of how the target bull compares with the current genetic level of the breed for your particular production scenario.

While BREEDPLAN® herd recording is implemented by the seedstock sector to fine tune their breeding programs, the important beneficiaries of genetic gain are their clients, i.e. the commercial beef producer who is motivated to access genetics that maximize the profitability of their beef production enterprise. The $Index tool is fast being recognized as a valuable selection tool by commercial beef producers.

Case Study – Grain Fed $Index (Herefords Australia)

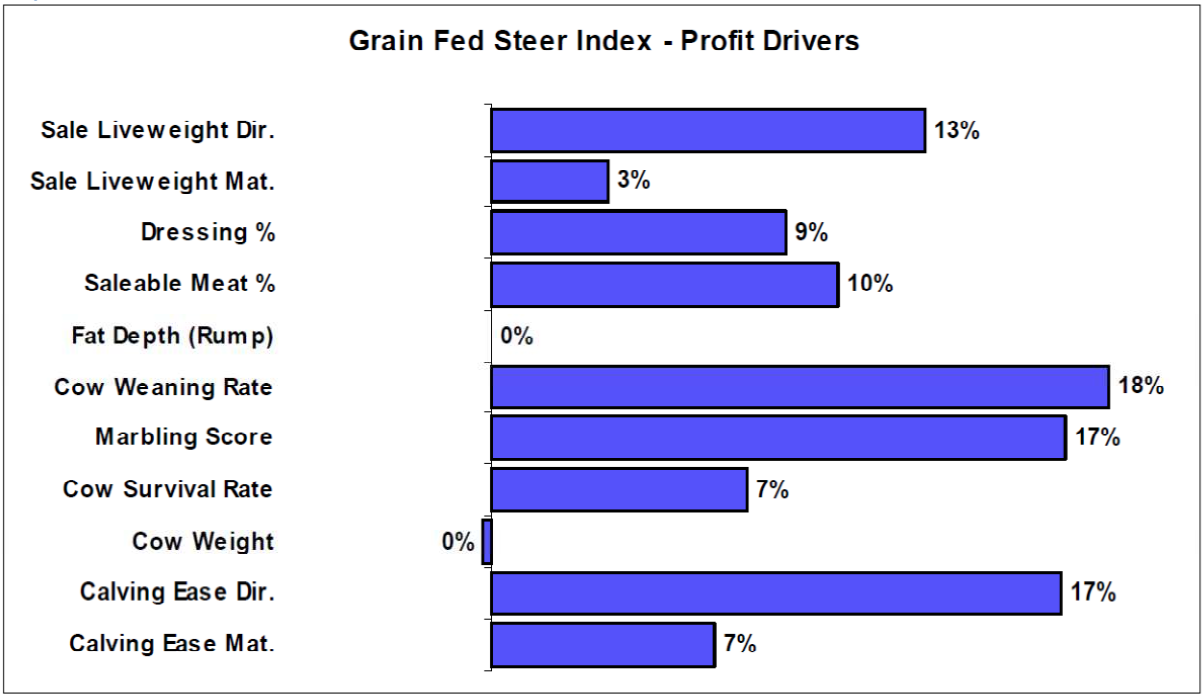
To illustrate the usefulness of the BreedObject Selection Index technology, I have chosen the Herefords Australia Grain-fed $Index as the one that most represents the needs of Wirruna Bull buying clients.

This index was developed in consultation with our Hereford breed association and the ABRI technical services team. The underlying economic model takes into consideration the costs and returns of producing commercial cattle for this specific market.

The Hereford Grain Fed Steer Index estimates the genetic differences between animals in net profitability per cow joined for an example commercial herd targeting pasture grown steers with a 125 day feedlot finishing period for the grain fed markets. Steers are assumed marketed at 600 kg live weight (330kg HSCW and 20 mm P8 fat depth) at 20 months of age. Daughters are retained for breeding. There is a significant premium if steers reach marble score of 2 or greater.

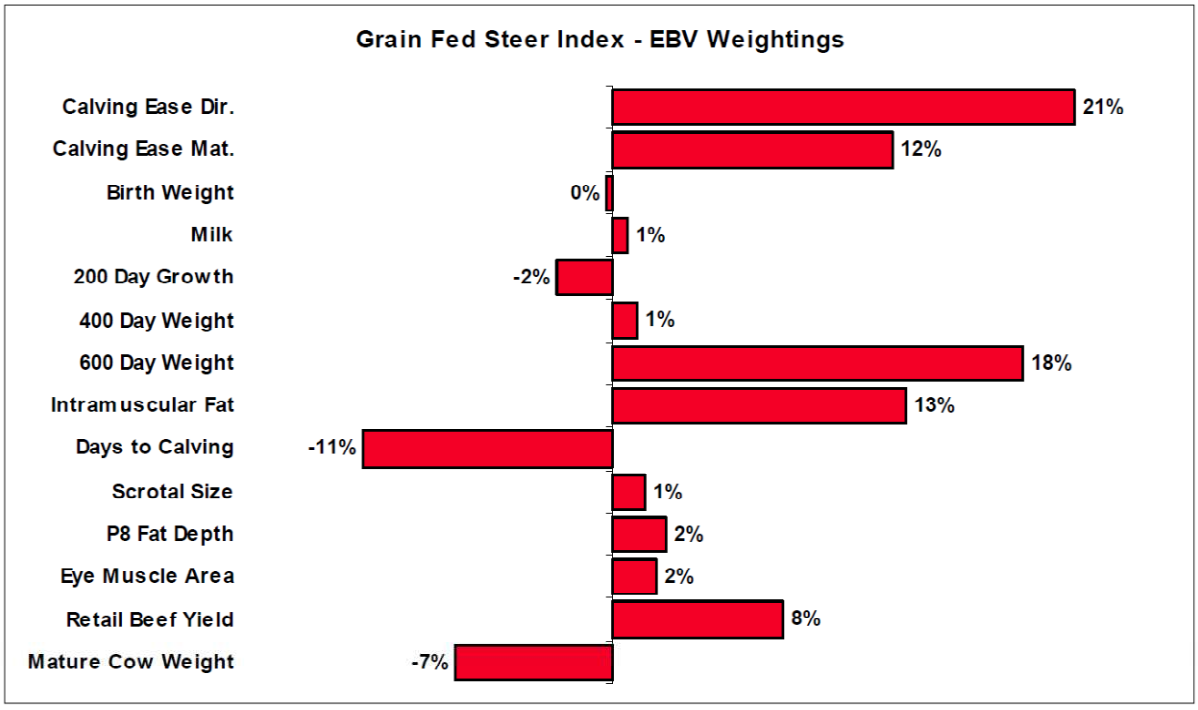
The 'Blue' bar graph *(Graph 1)* shows the key economic traits that are important in this selection index. The different trait emphasis reflect the underlying profit drivers in a commercial operation targeting the production of grain finished steers.

Graph 1



Considering the genetic relationship between the key profit drivers and the EBVs that are available, this transposes to the EBV emphases shown in *Graph 2*. The sign indicated the direction of the emphasis. For example, greater 600 Day weight EBVs and shorter Days to Calving EBVs are favoured.

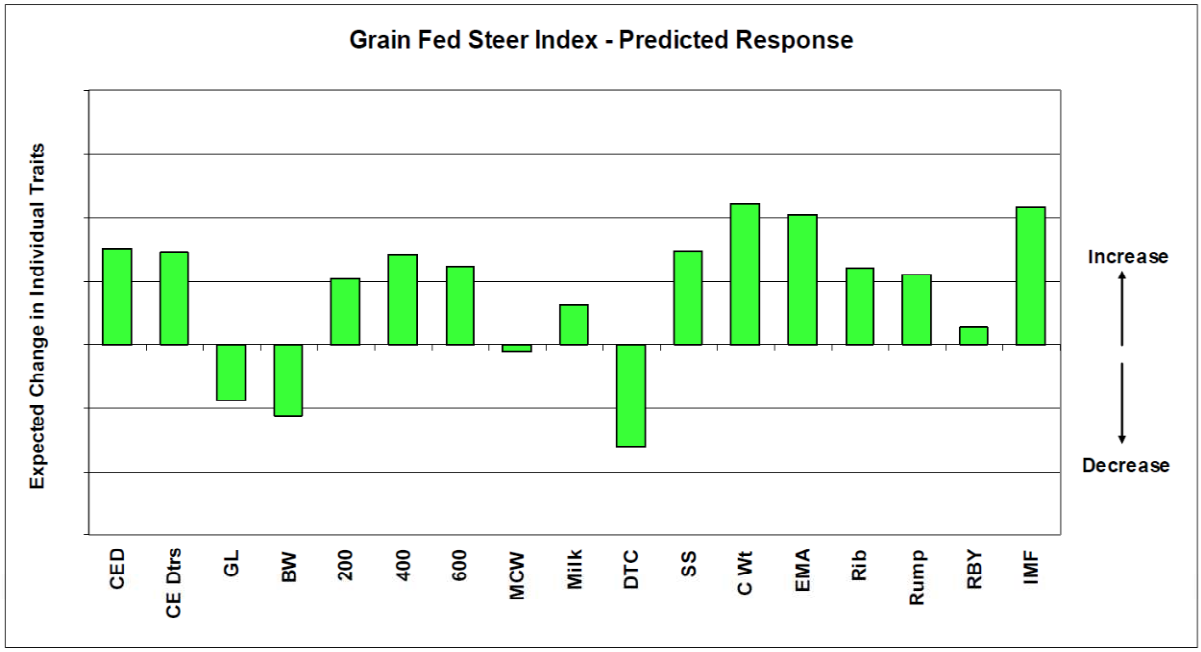
Graph 2



BreedObject can further illustrate the likely change that will occur to each individual trait, given the genetic relationships between traits, if we select animals using this $Index.

Graph 3 assumes that the top 10% of published Hereford sires, ranked on Grain Fed $Index, are used within a breeding program. The response to this selection is exhibited for each individual traits represented by the green bars.

Graph 3



Although EBVs and $Indexes take into account all the available performance information on an animal, they do not provide information for all the traits that must be considered during the selection of functional cattle. In all situations, EBVs and the associated genetic tools should be used in conjunction with visual assessment for other traits of importance (e.g. structural soundness, temperament).

TakeStock

The selection indexes are further utilised to benchmark a herd's genetic progress using a new tool called TakeStock®. The Software was developed by AGBU and offered by ABRI. TakeStock®:

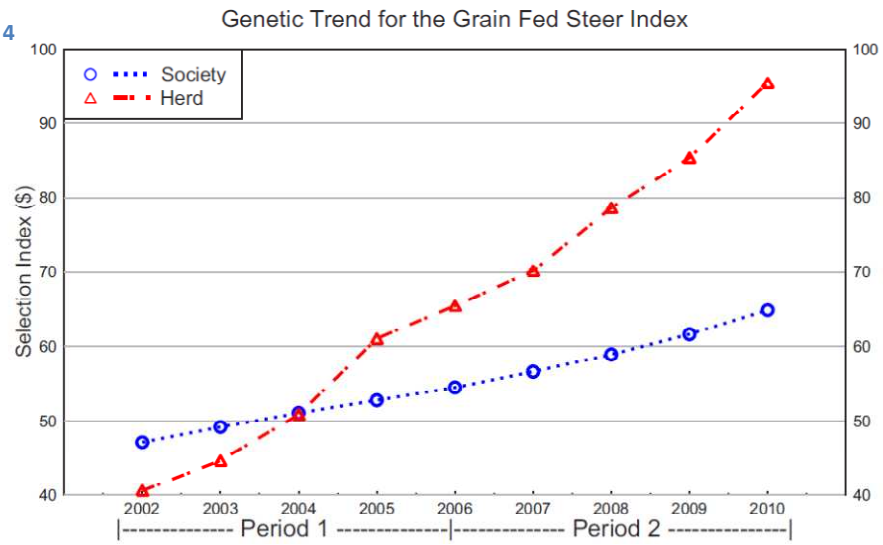
1. Evaluates a herd's genetic progress against a $Index
2. Benchmarks the herd's progress against the breed
3. Identifies Key Performance Indicators (KPIs) that explain significant differences in the rate of genetic progress between herds.

The Wirruna herd receives two TakeStock® reports per year. I have taken excerpts from our winter 2012 TakeStock® report for the Grain Fed $Index to demonstrate the TakeStock® analysis. The summary report *(Table 2)* contains the information about the rate of genetic progress being made by the herd and this is also shown in *Graph 4* showing the genetic trend for the Wirruna herd and the Hereford breed.

Table 2: Summary TakeStock® Report
Period 1 – 2002 to 2006 Period 2 – 2006 to 2010

		Herd	Breed Average
Average Index value in Period 2	Males (bulls & steers)	$79.82	$59.85
	Females	$78.65	$59.66
	Steers	$95.63	$49.69
Average Index value of parents in Period 2	Sires	$93.14	$66.28
	Dams	$63.63	$52.31
Average Index value in Period 2		$79.27	$59.75
Average Index value in Period 1		$53.79	$51.49
Average genetic progress in Period 2 (pa)		$7.52	$2.38
Average genetic progress in Period 1 (pa)		$6.67	$1.89
Average number of progeny per year in Period 2		456	92

Graph 4



The Hereford breed has improved the Grain Fed $Index by around $2.14/cow mated/yr over the last 10 years. The Wirruna rate of genetic gain over the same period has averaged over $7/cow mated/yr.

Wirruna started the evaluation period in 2002 at below breed average for the Grain Fed $Index. Since 2002, the Wirruna herd average $Index has risen to $95 for 2010 born calves, well above the breed average of $65 and currently ranking in the top 5% of the breed.

Space in this paper does not permit reproduction of all the TakeStock® reports; however *Table 3* gives a summary of Key Variables report which shows the KPIs that are significantly influencing the rate of genetic progress being made across herds. The Key Variables show that Wirruna's genetic progress has been achieved through the good genetic principles of applying a high (relative to breed average) selection differential in sires and dams and turning over generations quickly. The high (in the top 5% band) sire: dam mating correlation means that Wirruna has mated better sires to better dams (i.e. positive assortative or 'best to best' mating).

Table 3: Key Variables

	Herd	Breed Average	Percentile Band
Period 1 – 2002 to 2006	Period 2 – 2006 to 2010		
Average genetic progress in Period 1	$6.67	$1.89	5
Average genetic progress in Period 2	$7.52	$2.38	5
Average Index value in Period 2	$79.27	$59.75	5
Key Performance Indicators			
Selection differential of sires	$34.29	$13.16	5
Selection differential of dams	$5.08	-$0.83	5
Sire: dam mating correlation	0.30	0.03	5
VARIABLES AFFECTING GENERATION LENGTH			
Average age of dams at first calving	2.0	2.6	
Average age of all sires used	4.3	4.6	
Average age of all dams used	3.9	5.1	

Clearly, TakeStock® technology has provided the tools to benchmark and encourage seedstock herds to improve their rate of genetic gain based on a particular $Index. If more herds progress at double the rate of gain achieved by the average seedstock herds, this represents a huge boost in profitability for the commercial beef industry.

Calculating the economic benefits

The following *Table 4* is a crude attempt to quantify the benefits of using higher value genetics to the Australian Beef Industry. This analysis was based on some simple economics and calculated $276,300 (R2,332,000 *at 1ZAR = 0.1185 AUD*) extra benefit could be derived/year from using Wirruna genetics over the breed average available.

The total contribution of Wirruna to profitability of the commercial beef industry in Australia could well be higher than this. Domestic semen sales of around 400 straws are sold annually into Australia and internationally, semen companies have the marketing rights in a bull like Wirruna Daffy D1 who had orders for 9,000 semen straws in his first year of collection. Because Wirruna is now at the top level of the pyramid of Hereford Seedstock herds in Australia, some of its sires are being used by other Hereford seedstock herds which further multiply Wirruna's genetics. This creates an economic benefit that is additional to the $276,300 calculated in *Table 4*.

This analysis shows that seedstock herds that select for commercially important traits have the capacity to make very substantial increases to the profitability of their commercial clients.

Table 4: Benefits of Wirruna Genetics to the Beef Industry

Assumptions:

- Based on Grain fed $Index
- Sells 150 bulls per year
- On average each bull produces 120 progeny
  - say 40 progeny each year for 3 years
- 18,000 calves produced each year from Natural service
- 420 calves/year in Australia from Wirruna semen
- Average $Index for Wirruna Bull born 2010 is +$95, Breed ave. is +$65
- Estimate of average female Hereford exposed female has $Index of +$42*

Economic contribution of Wirruna to Australian Beef herd:

18,420 x (95-42)/2 = $488,130 pa**

Equivalent economic contribution if breed average Herford bulls used:

18,420 x (65-42)/2 = $211,830 pa**

Extra annual benefit derived by Wirruna Genetics

$488,130 - $211,830 = $276,300 pa (ZAR = R2,332,000)

(*) We know that the average $Index for performance recorded Hereford animals born in 2006 is about +$55 and allowing for a 7 year (one generation) lag @ $1.90/cow/year for non recorded animals gives us a best guess estimate of +$42 for the average value of exposed cows.

(**) The $Index of the progeny is half the difference of the Sire and the Dam

Mate Selection Tools

The next piece in the puzzle is how to optimize the rate of progress for a selected $Index. This is addressed by using mate selection tools such as Total Genetic Resource Management (TGRM) or MateSel. Once again these are add-on tools to Breedplan and utilize a chosen $Index to help decide which sire to mate with each dam, which parents are best to use in an Embryo Transfer (ET) program, which AI sire to use and how to do this while containing the overall level of inbreeding.

The TGRM package was developed by a team under Professor Brian Kinghorn at the University of New England and has been used routinely in the Australian beef, lamb, pig and dairy industries over the last decade. Wirruna have used this software to assist with breeding decisions and consider it has added extra impetus to our rate of genetic progress in the Wirruna herd over the last 7 years.

MateSel is a new and upgraded mate selection tool being rolled out by ABRI over the coming year. Like TGRM, MateSel integrates complex breeding issues into a single, easy to use, decision making framework. In effect, you input a list of candidate sires and candidate cows, set various constraints and the software generates a mating list

that optimizes the genetic gain while allowing for all of the parameters and constraints. Some of these may include:

- maximum level of inbreeding
- maximum/minimum size of mating groups
- no of AI straws available for use
- maximum/minimum EBV ranges
- genetic defect management
- Horn/Poll gene management

MateSel will be web based adding extra flexibility for breeders to input their parameters and submit their run request via the web and receive their resultant mating lists back electronically within a shorter time frame.

It can be described as…, "like an internet dating site for cows"!

Internet Solutions

Internet Solutions is a web based information system provided by the ABRI that pulls together BREEDPLAN® information and many of the associated tools, and is available as on online facility via Breed Society websites.

It allows enquirers to seek and sort animals by EBVs, $Index, Sire lines, Completeness of Recording herd rating, bulls catalogued for sale and so-on. Use of Internet Solutions has grown rapidly and now receives over 3 million page enquiries per month, from all over the world from many breeds.

I use Internet Solutions daily and believe it to be one of the best technologies to assist breeders since the introduction of BREEDPLAN® itself. It is a most useful tool for researching:

- Pedigrees/Bloodlines
- Animal Performance
- Breeders of interest
- Progeny performance
- Ranking animals on EBVs
- Ranking animals on $Index
- Search/Sort sale catalogues
- Search/Sort semen sires
- Mating predictor tools
- Breeder contact details
- Potential Sires to use
- Calving history information
- Herd Completeness of Recording rating
- Etc.

The following pages provide a brief snapshot of the type of information available on Internet Solutions. *Figure 1* is the Animal enquiry page where the user puts in various parameters including animal sex, maximum or minimum EBVs/Accuracies/$Index values and can sort the target list on traits or a particular $Index. In the *Figure 1* example, note that I have inputted the following underlined parameters to search the Hereford database for all Polled Males that have a maximum Birthweight EBV of 5.0kg and are greater than $90 for Grain Fed $Index. Also, I have asked for this target list to be sorted on Grain Fed $Index. This tool is fundamental for my researching of future genetics to use in the Wirruna herd.

Figure 2 shows how individual animals may be displayed on the web. In this case, the EBVs, $Index and percentile bands for Wirruna Daffy D1 are shown. The percentile information is displayed as a bar graph with the breed average as the common reference point. This gives users an immediate reference point to assess where the EBVs and Indices fit within the breed.

Figure 1- Animal enquiry input page

Hereford Animal Enquiry by EBV

Home | Animal Enquiry | EBV Enquiry | Mating Predictor | Member Enquiry | Sale Catalogues | Semen Catalogues | Download Files | Online Transactions

Enter Selection Criteria Then Click Search

Clear | Search

Name:	Enter the start of an animals name
Animal Identifier(s):	Enter one or more animal identifiers separated by commas Use wildcard if required. (eg. XYZ%)
Calving Year(s):	Enter one or more calving years separated by commas
Listing Type:	• Any ○ Published in Sire Summary ○ Currently Listed for Sale ○ Listed in Semen Catalogue
Select if:	Animal is Male
Select if:	Animal is Polled
Select if:	
Herd Completeness of Performance Rating:	All
Breeder Located:	Anywhere
Sire Name:	
Dam Name:	
Exclude Sire Ident:	
Exclude Grand Sire Ident:	
Exclude Dam Ident:	
Exclude Grand Dam Ident:	

Trait Description	Min	Max	Min. Accuracy (%)	Breed Avg *
Calv. Ease Direct (%)				-0.3
Calv. Ease Dtrs (%)				+0.9
Gest. Len. (days)				-0.1
Birth Wt. (kg)		5.0		+4.3
200 Day Wt. (kg)				+27
400 Day Wt. (kg)				+43
600 Day Wt. (kg)				+62
Mat. Cow Wt. (kg)				+61
Milk (kg)				+12
Scrotal Size (cm)				+1.5
Days to Calv.				-1.7
Carcase Wt. (kg)				+38
Eye Muscle Area (sq.cm)				+2.4
Rib Fat (mm)				0.0
Rump Fat (mm)				+0.2
Retail Beef Yield (%)				+0.7
IMF %				0.0
Supermarket Index ($)				+$65
Grass Fed Steer Index ($)				+$59
Grain Fed Steer Index ($)	90			+$65
EU Index ($)				+$73

Sort By Grain Fed Steer Index ($)	• Default ○ Ascending ○ Descending
On EBV Listing Display	• Name: ○ Animal Identifier(s):

* Breed Avg. EBVs for 2010 Born Calves (Click for Percentiles)

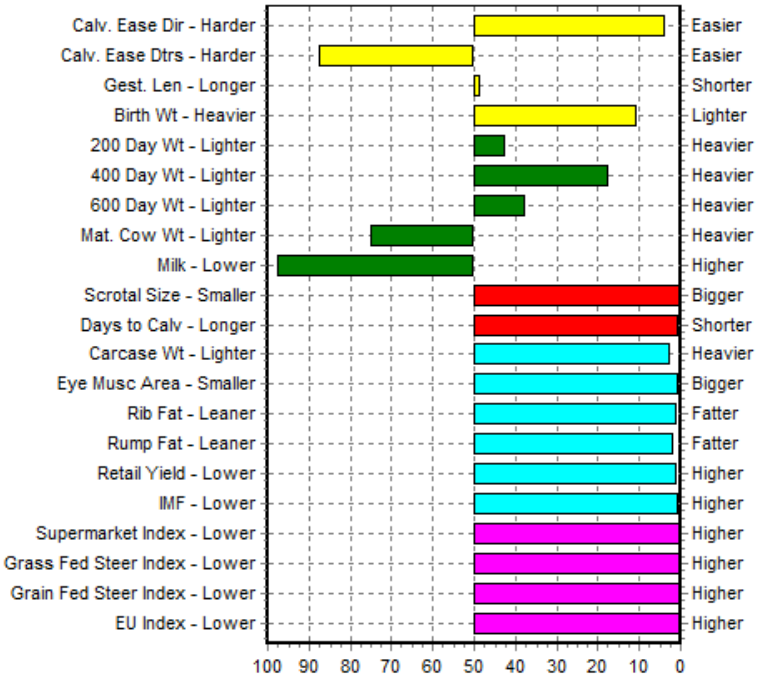
Description of EBVs and $Indexes

Figure 2-Animal Performance information

Hereford EBV Graph for
WIRRUNA DAFFY D1 (P)

Home | Animal Enquiry | EBV Enquiry | Mating Predictor | Member Enquiry | Sale Catalogues | Semen Catalogues | Download Files | Online Transactions

EBV Percentiles for WIRRUNA DAFFY D1 (P)



50th Percentile is the Breed Avg. EBVs for 2010 Born Calves

	Calv. Ease Direct (%)	Calv. Ease Dtrs (%)	Gest. Len. (days)	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 %
EBV	+6.5	-1.2	0.0	+2.1	+28	+51	+67	+51	+5	**+5.0**	-5.2	+57	+7.3	+1.4	+2.1	+2.0	+1.2
Acc	65%	53%	95%	96%	94%	87%	88%	77%	60%	85%	45%	76%	63%	68%	72%	66%	69%
Breed Avg. EBVs for 2010 Born Calves Click for Percentiles																	
EBV	-0.3	+0.9	-0.1	+4.3	+27	+43	+62	+61	+12	+1.5	-1.7	+38	+2.4	0.0	+0.2	+0.7	0.0

Traits Observed: BWT, 200WT, 400WT, 600WT, SS, FAT, EMA, IMF
Statistics: Number of Herds: **16**, Progeny Analysed: **191**, Scan Progeny: **20**,

SELECTION INDEX VALUES		
Market Target	**Index Value**	**Breed Average**
Supermarket Index ($)	+$ 109	+$ 65
Grass Fed Steer Index ($)	+$ 119	+$ 59
Grain Fed Steer Index ($)	+$ 135	+$ 65
EU Index ($)	+$ 127	+$ 73
$Index Descriptions (Click Here)		

Key Messages

Over 50 years ago, a group of innovative performance recording beef producers in Australia recognised the need to make better informed breeding decisions to select genotypes that would improve economic traits in their beef herds. This saw the formation of the National Beef Recording Scheme that eventually became BREEDPLAN®. Today BREEDPLAN® is recognised as a world leading genetic evaluation tool.

This paper has focussed on how we have utilised BREEDPLAN® and its associated technologies in the management and selection decisions of the Wirruna Poll Hereford herd and the resultant genetic progress that has resulted.

The key messages are:

- BREEDPLAN® EBVs measure a range of economically important traits
- The Completeness of Performance technology encourages more "complete" data and pedigree information, which promotes the integrity of the BREEDPLAN® system.
- It is important to adopt a selection $Index that most represents your particular production system and market environment. Making selection decisions based on that $Index helps to both balance the trait weightings according to economic importance and provide what is effectively a profit EBV for your particular production scenario.
- Using the TakeStock® tool helps to benchmark a herd's genetic progress against the breed based on the selected $Index. It also helps seedstock breeders to focus on the Key Performance Indicators that explain the significant drivers of genetic gains made and highlight areas to focus future efforts to make gains.
- Mate Selection tools such as TGRM and MateSel are further add-on technologies that help to optimise a herd's genetic progress while balancing various constraints such as inbreeding. Like a computer matching dating site for cows, the new web-based software called MateSel will offer an easy to use and flexible mating decision support tool.
- Combining much of the BREEDPLAN® technologies together is the Internet Solutions web-based system. This is an immensely valuable Animal & EBV enquiry tool to access a various Breed Societies' databases online and is fundamental to searching, ranking and indentifying genetics that will deliver the next generation of beef cattle offering improved profitability.

Thank you for the opportunity to travel to South Africa to deliver this paper.