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Progeny testing of elite sires for profitability traits

Breeding, backgrounding and heifer evaluation

NSW DEPARTMENT OF PRIMARY INDUSTRIES

Abstract

Breeders in Australia have generally been reluctant to invest in the conduct of properly structured progeny test programs. Semen from Australian bred sires are unlikely to be successfully traded on the international market unless these sires are adequately progeny tested to improve the accuracy of their estimated breeding values (EBVs) for a comprehensive suite of economic traits. The aim of the project was to progeny-test potentially elite young Australian Angus sires for traits influencing profitability of beef production. The project generated data that provided EBVs for a comprehensive suite of economic traits for 38 highly selected young Australian bred sires. Mean accuracies ranged from 55% to 93% and they represent some of the highest accuracies for young Australian sires. It is recommended that well-planned progeny test programs should be encouraged. The provision of seed funds from industry and other funding bodies may be necessary.

Executive Summary

Breeders in Australia have generally been reluctant to invest in the conduct of properly structured progeny test programs. Semen from Australian bred sires are unlikely to be successfully traded on the international market unless these sires are adequately progeny tested to improve the accuracy of their estimated breeding values (EBVs) for a comprehensive suite of economic traits. It is anticipated that if short-term funding assistance is provided to demonstrate the benefits of structured progeny testing to the Australian beef industry then breeders will be willing in the longer-term to invest in the full cost of implementing these programs. Such programs will assist Australian breeders in positioning themselves in the global genetics market by providing quality progeny test information on potentially elite young sires. In addition, the program will provide valuable information to enhance the genetic tools available to all cattle breeders in Australia.

The objective of the project was to progeny-test potentially elite young Angus sires for traits influencing profitability of beef production. Data generated from the project was to be used to:

1. derive more accurate estimated breeding values (EBVs) on young Australian-bred sires:
2. provide information on genetic relationships between traits currently included in Breedplan, with particular emphasis on relationships with feed intake traits;
3. potentially provide a population with utility for validation and application of genetic markers; and
4. provide a population structure suitable for imposing other research into genetic issues of interest to Angus breeders.

The data collected from this project have been used to derive more accurate EBVs on a comprehensive range of economic traits for 38 highly selected young Australian bred sires. The mean accuracies achieved for the different traits ranged from 55% to 93%, and represents some of the highest accuracies for EBVs for young sires in Australia. The data generated from the project, together with existing BREEDPLAN data, have been used by the Animal Breeding and Genetics Unit at the University of New England (AGBU) in their routine analysis of genetic relationship among economically important traits, especially as they relate to net feed intake. Blood and DNA samples from the progeny and the associated phenotypic data are currently being used for validation of insulin-like growth factor-I (IGF-I) and potential gene markers for net feed intake by the Cooperative Research Centre for Beef Genetic Technologies (Beef CRC). The project provided opportunity for research into maternal productivity of cows selected for net feed intake, animal behaviour and welfare, and gene expression studies for net feed intake.

The immediate impact of this project is that for the first time a number of industry Angus sires with moderate to high accuracies of EBVs for net feed intake and the other traits of economic importance are available to the beef industry. Gene markers are the next major technological tools for genetic improvement in beef cattle. In the next five years the DNA samples and the associated phenotypic data from this project will play a vital role in the discovery and validation of gene markers for net feed intake and other traits in beef cattle. This project demonstrated that a well planned progeny test program is a reliable and effective means for generating accurate EBVs on traits of economic importance on young beef sires. Such well planned progeny test programs have the additional utility for the superimposing other valuable research with minimal extra resources. The data and biological

samples generated is an invaluable resource leading into the era of genomic research and its application.

It is recommended that well-planned progeny test programs should be encouraged, especially if it incorporates testing cattle for NFI. This might involve the provision of seed funds from industry and other funding bodies.

Contents

1 Background

For the past two decades, Angus seedstock breeders in Australia have made extensive use of imported semen, predominantly from North America, to enhance rates of genetic improvement. During this time Australia has also developed a world-leading genetic evaluation system in GROUP BREEDPLAN. The leading seedstock herds in Australia are now at a point where their genetics is on par with the best in the world. With the best genetics and genetic tools available to them, Australian seedstock producers have the potential to identify elite bulls and to market semen from these bulls internationally. By pursuing this opportunity Australia has potential to become a major source of elite genetics to the international semen market, and to reposition itself to be a net exporter of beef cattle genetics.

Figure 1 shows that the proportion of calves registered in the Angus Herd Book that were sired by "foreign" bulls has increased considerably from 9% in 1980 to 38% in 1999. The impact of "foreign" genetics on the Angus breed in Australia is even more dramatically demonstrated by the fact that 76% of calves born in 1999 had "foreign" paternal grandsires, and 47% of calves had "foreign" maternal grandsires. The vast majority of these sires were from USA. Clearly, there is a need to rectify this situation if Australian breeders are to have a greater influence on the direction of genetic change in the Angus breed.

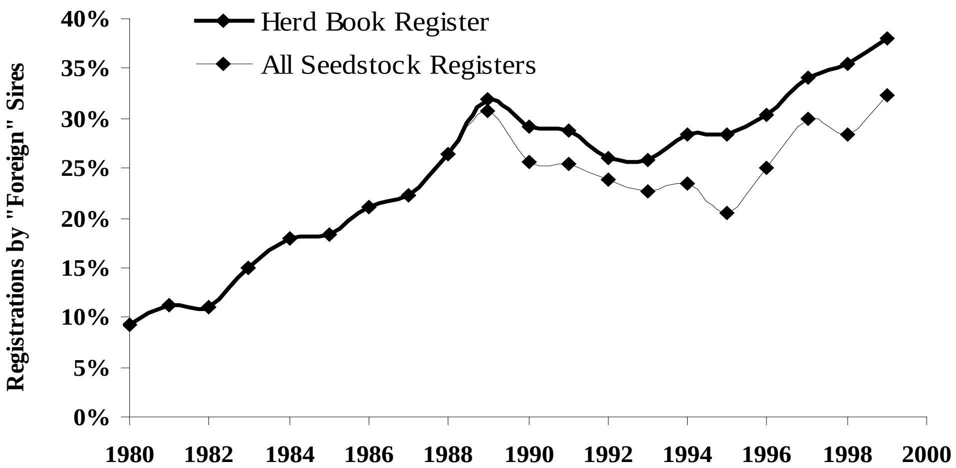


Figure 1. Proportion of calves registered in the Angus herd book

To identify and effectively market semen from elite bulls, accurate information on the full suite of traits of economic importance is required. While a large amount of information on some traits can be obtained through individual animal performance recording, structured progeny testing is required to obtain accurate information on the full suite of traits. Unfortunately, breeders in Australia have generally been reluctant to invest in the conduct of properly structured progeny test programs. This is in contrast to USA where many breeders have embraced progeny testing as an essential part of identifying elite genetics. The accuracy of estimated breeding values (EBVs) for American sires used in Australia tends to be significantly higher than the accuracies of EBVs for locally bred sires. For example, in the June, 2001 Angus Group Breedplan Directory the average accuracy for the percent intramuscular fat (IMF%) EBV for AI sires from USA was 76%, compared to an average accuracy of only 62% for Australian bred sires.

It is unlikely that semen from Australian bred sires can be successfully traded on the Australian and international semen market unless these sires are adequately progeny tested. It is anticipated that if short-term funding assistance is provided to demonstrate the benefits of structured progeny testing to the Australian beef industry then breeders will be willing in the longer-term to invest in the full cost of implementing these programs.

The proposed project aims to assist Australian breeders in positioning themselves in the global genetics market by providing quality progeny test information on potentially elite young sires. In addition, the project will provide valuable information to enhance the genetic tools available to all cattle breeders in Australia.

2 Project Objectives

By 31 December 2006, the Research Organisation will have progeny-tested potentially elite young Angus sires for traits influencing profitability of beef production. Data generated from the project will be used to:

1. derive more accurate EBV on young Australian-bred sires:
2. provide information on genetic relationships between traits currently included in BREEDPLAN, with particular emphasis on relationships with feed intake traits;
3. potentially provide a population with utility for validation and application of genetic markers; and
4. provide a population structure suitable for imposing other research into genetic issues of interest to Angus breeders.

3 Methodology

The project utilised a research herd of 430 Angus cows owned by NSW Department of Primary Industries (NSW DPI) and located at the Agricultural Research Centre, Trangie, in the central-west of NSW. This herd was previously used in the MLA funded DAN.75 research program to investigate the genetic basis of genetic variation in feed intake and efficiency in beef cattle. The use the Trangie research herd added considerable value to the project over and above using a commercial herd for progeny testing. The herd is fully recorded with a comprehensive historical database of pedigree and performance measurements, including the most extensive records on feed intake of any herd world-wide. Use of this herd enabled adjustment for the contribution of the dam in the analysis of progeny test data. In addition, the bank of performance records previously collected on the herd helped to increase the accuracy of the progeny test and enhanced the power of the research information obtained from the program.

The project started in September 2001 for three years of matings, with 13 sires tested per year, except for one year when one of the backup sires was from the research centre. Hence a total to 38 industry sires were used over this period. Semen from selected young Angus bulls were used in an AI program to breed approximately 30 progeny (heifers and steers) from each bull. Each year, for three years, 10 AI sires and 3 natural service “back-up” Angus sires were tested in each “cohort”.

The breeding herd was managed as one unit and the females were on pasture all year round. Perennial pastures included windmill grass (*Chloris truncata*), spear grass (*Stipa spp.*), and wallaby grass (*Danthonia sp.*). Annuals were primarily barley grass (*Hordeum leporinum*), rats-tail fescue (*Vulpia myuros*), burr-medic

(*Medicargo spp.*) and crowsfoot (*Erodium sp.*). Much of the summer feed consisted of dry residue from winter annuals. Pasture quality and quantity was influenced by rainfall. The average annual rainfall at the research centre is 480 mm and is distributed evenly across the year with no distinct peak periods. In general, rainfall during the period of the project was lower than the long term average, with the period between March 2002 and February 2003 recording only 49% of the expected long term average. The conditions at the Trangie area met the official drought declarations criteria from June 2002 to August 2003, and again from February 2004 to March 2004. Supplementary feeding of hay and grains were provided when necessary to minimise the effect of drought.

Each year, a small number of randomly selected females were joined to three natural service bulls (10 cows per bull) right from the beginning of the mating season in October. The remainder of the females (400) were mated by two rounds of artificial insemination (AI), after which they were randomly allocated to the three natural service bulls. The AI was conducted by a commercial artificial breeding company, using standard protocols. The total number of cows programmed for insemination was split among 3 (approximately equal sized) groups, commencing the synchrony protocol on 3 consecutive days. The cows were synchronised for AI using a protocol which combines the use of progesterone via a slow release intravaginal device (EAZI-BREED™ CIDR®, Pfizer Aust. Pty Ltd), and (CIDR®), administered for 8 days, with an initial injection of oestradiol benzoate (ODB - 2 mL Cidirol®) at the time of CIDR insertion, an injection of prostaglandin (2mL Juramate®) given at the time of CIDR removal, and a second injection of ODB (1 mL Cidirol) given 24 hours after CIDR removal. Heat detection devices (KMAR® Heatmount detectors, Kamar Inc., USA) were applied to the cows 24 hours after CIDR removal. A day later, cows were inspected to determine those in estrus, and these were inseminated first, after which the rest were also inseminated. Following insemination, the groups were prepared for re-synchrony of those returning to service. CIDR devices (washed and re-cycled from the first administration) were re-inserted into these cows 15 days after initial device removal, and they were given ODB injections (1 mL Cidirol) at the same time. The devices were then removed 8 days later and heat detectors applied. Cows returning to service were detected on heat and presented for insemination as above. After that a cover bull was allocated to each of the groups of cows from early November to mid December.

Females were tested for pregnancy by ultrasound in late January or early February each year. The calving season spanned July to September, with most calves born in August. At calving, assistance was given only after prolonged labour. Calves were tagged and body weight and size (height, length and girth) recorded at birth. The parentage of calves was confirmed through DNA fingerprinting. Calves nursed their dams until they were weaned at approximately 225 days of age. All males were castrated at approximately 3 months of age. Appendix 1 contains a schedule of activities associated with the project.

Data were collected on growth performance, structural soundness and ultrasound measurements of fat depth, eye muscle area and marbling of all progeny. A proportion of the steer progeny were finished on grain, and slaughtered, with additional measurements taken on feed intake, growth performance and carcass traits. A proportion of the heifer progeny (approximately 8 per sire) were retained into the Trangie herd and mated for collection of data on reproduction. The last measurements on the third cohort of progeny were concluded in September 2006. All the data collected were entered into the National Beef Recording Scheme database, for the computation of EBVs for the sires. The design of the project and a list of the traits evaluated is presented in Figure 2 and Table 1, respectively.

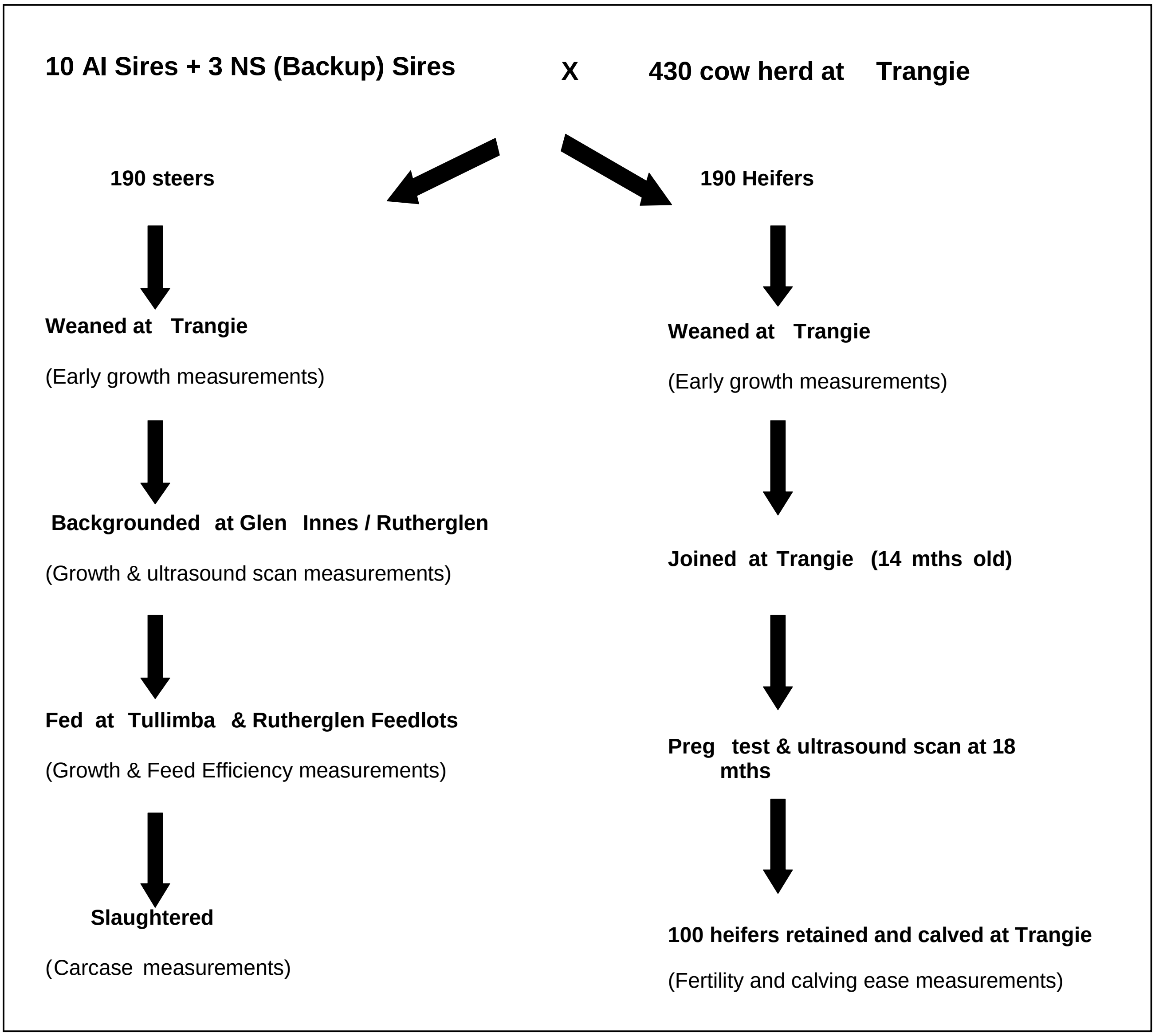


Figure 2. Project design

Table 1. Traits measured

Trait Name	When Measured	Comment
Birth Weight	Birth	
200 Day Weight	Pregnancy-testing and weaning	Average age of calf is between 80 and 300 days
400Day Weight	Post-joining and pre-joining	Average age of calf is between 300 and 500 days
600 Day Weight	Weaning	Average age of calf is between 500 and 700 days
Mature Cow Weight	Weaning	Measured when a calf is weaned, weaning of the 1st to 4th calf
Scrotal Size	Approximately 400 days of age	Average age range is between 300 to 700 days
Days to Calving	Default from joining records - bull in/bull	
Gestation Length	Default from joining records - bull in/bull	
Calving Ease	Birth	
Carcase Weight	Abattoir	Adjusted to 650 days of age
Scan Eye Muscle Area	400-500 days of age	Average age range is between 300 to 800 days
Scan Rib Fat	400-500 days of age	Average age range is between 300 to 800 days
Scan Rump Fat	400-500 days of age	Average age range is between 300 to 800 days
Scan Intra-Muscular Fat	400-500 days of age	Average age range is between 300 to 800 days
Net Feed Intake	Feedlot	Data submitted included start weight, end weight and daily feed intake

4 Results and Discussion

The list of sires and the number of progeny tested at each stage of the project are presented in Tables 2a, 2b and 2c. Progeny from a total of 39 sires were tested. One of the sires tested was from the research centre while the remaining 38 were from the industry Angus herds.

BREEDPLAN EBVs generated for a comprehensive range of economic traits after the progeny test data were submitted, are presented in Appendices 2, 3 and 4. They represent the genetic merit of a group of highly selected young Australian bred sires. Corresponding accuracies for the EBVs are presented in Appendices 5, 6 and 7. Breedplan has a minimum level of accuracy that is required for the EBV of a particular trait to be published. Breedplan EBVs for all the growth traits (except mature cow weight) were available for all the sires prior to the start of the progeny test. For the other traits, however, not all the sires had Breedplan EBVs at the start of the progeny test. For Calving ease, for example, less that a third of the sires had published EBVs, and no sire had EBVs for Net Feed Intake (Appendix 8). This is in contrast with the end of progeny test, where 92% of the sires had publishable EBVs for Calving Ease DTRS, and all sires had EBVs for all the other traits. In addition, mean accuracies for the different traits at the start of the progeny test, ranged from zero to 76%, while the corresponding mean accuracies at the end of the progeny test were from 55% to 93%.

The data generated from the project, together with existing BREEDPLAN data, have been used by AGBU in their routine analysis of genetic relationship among economically important traits, especially as they relate to net feed intake. This has helped to enhance the genetic evaluation system to offer improved genetic services not only to Angus breeders, but also to other breeds registered in BREEDPLAN.

Blood and DNA samples were collected from all sires, cows and their progeny. Together with their associated phenotypic data this has become a valuable resource for validation of potential gene markers. This resource is currently being used by the Beef CRC for the validation of potential gene markers for net feed intake.

The design and population structure of the project provided opportunity for research into additional beef production issues. A study on the maternal productivity of cows selected for high and low net feed intake was undertaken by NSW DPI researchers. The results of this study have been published by Arthur et al. (2005) and the abstract has been attached as appendix 8. Other research conducted on the herd included studies on animal behaviour and welfare by NSW DPI researchers, insulin-like growth factor-I (IGF-I) for prediction of EBV by NSW DPI and AGBU researchers, and gene expression studies for net feed intake by NSW DPI and University of Adelaide researchers.

The progeny test herd was also used by the Angus Society of Australia and NSW DPI as a focal resource for education programs in cattle breeding and selection. Several field days were conducted the research centre at Trangie and at the Beef CRC research feedlot at Tullimba.

Table 2a. First cohort of sires and their number of progeny tested at different stages of the project.

Cohort 1	Progeny Weaned		Backgrounded	Pregnant	Retained	Heifer calves	
AI Sires	Male	Female	Steers	Heifers	Heifers	Male	Female
CAMPBELL FARMS EMULATION V536	12	12	12	10	8	5	3
EASTERN PLAINS NEW DESIGN U5	9	17	8	13	8	4	1
EDI ANGUS A. RITO S8 (AI) (ET)	15	11	12	11	7	4	3
GLENAVON UNITED U39 (AI)	12	13	12	10	8	6	2
KENNY'S CREEK TONKIN T25 (AI)	15	15	12	12	8	4	3
MITTA VALLEY TITAN T63 (APR)	11	19	10	12	8	0	8
MOOGENILLA V22 (AI)	13	14	12	9	6	4	2
RAFF ULTIMATE U27 (AI) (ET)	18	14	12	12	8	5	2
RENNYLEA U214 (APR) (AI)	13	15	11	14	8	5	3
ST PAULS TRAV-ALBERT T67 (AI)	10	10	10	9	8	4	4
Natural Service Sires							
ARDROSSAN NEW DESIGN V053 (AI)	21	13	12	9	7	3	3
COMFORT HILL STOCKMAN U26 (AI)	13	17	9	14	7	4	3
WATTLETOP VIBE V86 (AI) (ET)	18	25	12	22	8	3	4

Table 2b. Second cohort of sires and their number of progeny tested at different stages of the project.

Cohort 2	Progeny Weaned		Backgrounded	Pregnant	Retained	Heifer calves	
AI Sires	Male	Female	Steers	Heifers	Heifers	Male	Female
Comfort Hill Yellowstone W86	10	13	10	9	7	3	2
Five Star Whiskey W6	9	18	9	16	10	2	2
Kansas Pied Piper W19	16	7	16	5	5	2	2
Kenny's Creek Headliner V87	10	13	10	11*	10	4	2
Koojan Hills SOMETHIN SPECIAL	20	14	20	8	7	2	4
Rosevale V9	16	16	16	13	12	3	2
St Pauls Vampire V51	14	13	14	9	8	2	1
Twynam Uppercut U85	17	11	17	8	7	2	2
Wallaroy Vanguard 2000 V189	14	11	14	7	6	1	4
Wattletop Wooly W120	14	10	13	7	7	2	4
Natural Service Sires							
Alumy Creek KM Future Direction W03	9	11	9	9	8	4	2
Bald Blair New Design V86	9	17	9	13	10	2	7
Eastern Plains Max W7	16	15	15	14	5	2	3

**One heifer had an inconclusive scan, assigned as pregnant*

Table 2c. Third cohort of sires and their number of progeny tested at different stages of the project.

Cohort 3	Progeny Weaned		Backgrounded	Pregnant	Retained	Heifer calves	
AI Sires	Male	Female	Steers	Heifers	Heifers	Male	Female
Alloura Warrior W06	12	14	12	12	9	1	5
Booroomooka Westall W391	18	13	15	9	8	4	4
Brumar Vanquish V9	13	13	13	11	10	4	4
Hazeldean Perfect Storm V113	16	13	16	10	9	1	5
Hidden Valley Existence X18	17	12	17	11	10	3	2
Hidden Valley Expectation X11	17	8	17	8	7	2	2
Lawsons GAR Precision W363	10*	17	9	14	10	7	2
Strathtay Universe X19	16	7	15	4	3	2	0
Witherswood Waterloo W93	16	13	16	10	9	4	3
Ythanbrae New Design 036 V429	15	10	15	9	9	6	2
Natural Service Sires							

Bald Blair RockN D X63	14	19	13	16	10	5	2
Wattletop Future Direction X27	7	10	7	9	8	2	4
Eastern Plains New Design W102**	10	15					

**One calf was not registered as DNA parentage verification could not identify dam*

***This sire is owned by NSW DPI and was included in the matings to make up the required number of natural service sires as per the design of the project.*

5 Success in Achieving Objectives

All the objectives of the project have been successfully achieved.

The data collected from this project have been used to derive more accurate EBVs on a comprehensive range of economic traits for highly selected young Australian bred sires. The mean accuracies achieved for the different traits ranged from 55% to 93%, and represents some of the highest accuracies for EBVs for young sires.

The data generated from the project, together with existing BREEDPLAN data, have been used by AGBU in their routine analysis of genetic relationships among economically important traits, especially as they relate to net feed intake.

DNA samples from the progeny and the associated phenotypic data are currently being used for validation of potential gene markers for net feed intake by the Beef CRC

The project provided opportunity for research into maternal productivity of cows selected for net feed intake (NSW DPI researchers), animal behaviour and welfare (NSW DPI researchers), IGF-I for prediction of EBV (NSW DPI and AGBU researchers), and gene expression studies for net feed intake (NSW DPI and University of Adelaide researchers).

6 Impact on Meat and Livestock Industry – now & in five years time

The immediate impact of this project on the beef industry is that that for the first time a number of Australian Angus sires with moderate to high accuracies for NFI EBVs are available to industry. It has also provided a database of industry cattle assessed for NFI. This is in addition to the relatively higher accuracies of the EBVs of the other traits of economic importance.

Gene markers are the next major technological tools for genetic improvement in beef cattle. In the next five years the DNA samples and the associated phenotypic data from this project will play a vital role in the discovery and validation of gene markers for net feed intake in beef cattle.

7 Conclusions and Recommendations

It can be concluded from the success of this project that a well planned progeny test program is a reliable and effectively means for generating accurate EBVs on traits of economic importance on young beef sires. Such well planned progeny test programs has the additional utility for the superimposing other valuable research with minimal extra resources. The data and biological samples generated is an invaluable resource leading into the era of genomic research and its application.

There has always been the need to test more cattle for NFI to build up the numbers to generate more robust genetic parameters on the relationships between NFI and the other traits. This need has been made even more important by recent developments that indicate that the contribution of IGF-I information to NFI EBVs is low, and by the need for validation herds for NFI and other genetic markers.

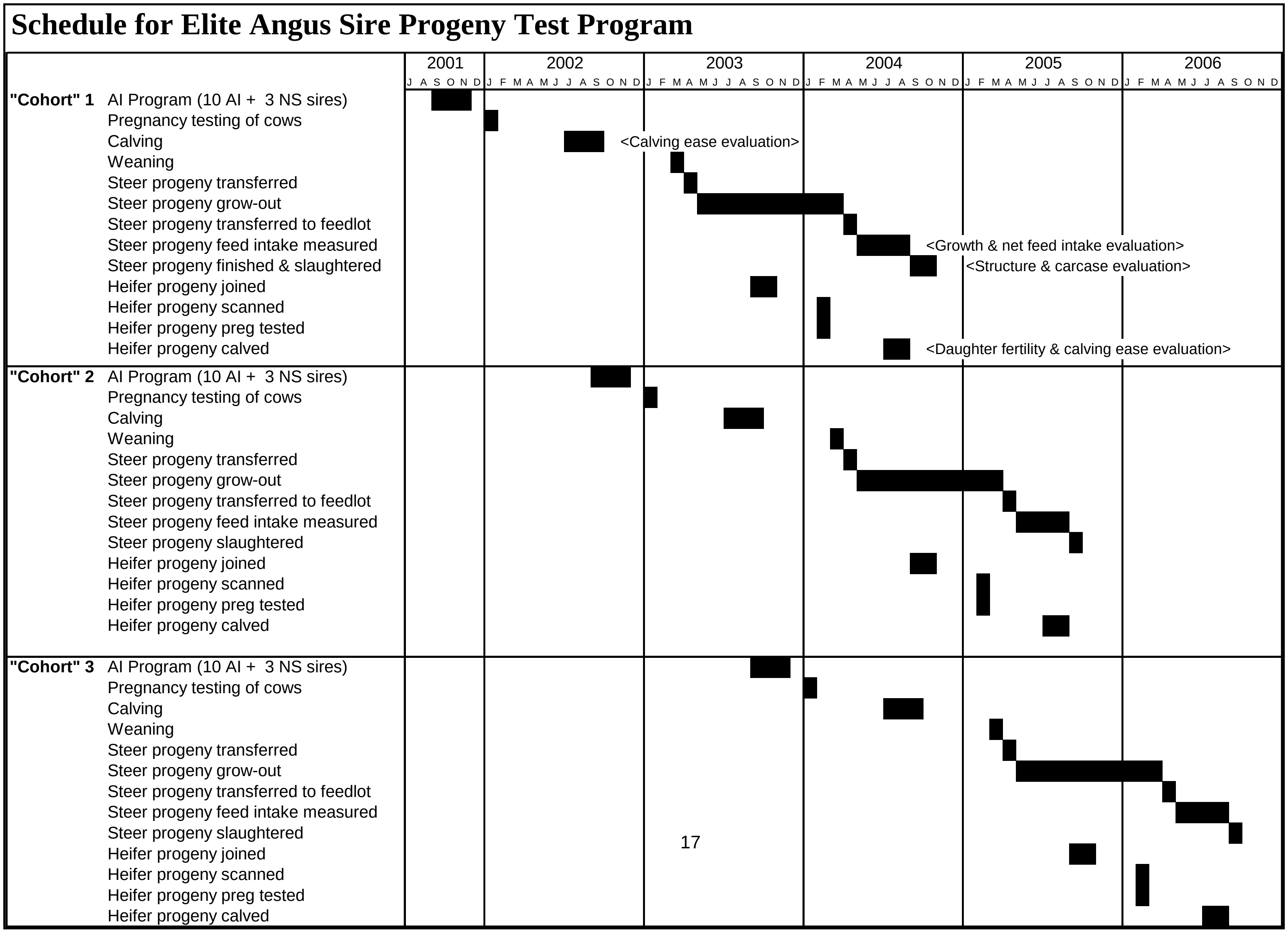
It is recommended that well-planned progeny test programs should be encouraged, especially if it incorporates testing cattle for NFI. This might involve the provision of seed funds from industry and other funding bodies.

8 Bibliography

Arthur, P.F., R.M. Herd, J.F. Wilkins and J.A. Archer. 2005. Maternal productivity of Angus cows divergently selected for postweaning residual feed intake. *Australian Journal of Experimental Agriculture.* 45: 985-993.

9 Appendices

9.1 Appendix 1



9.2 **Appendix 2.** Estimated breeding values of progeny test sires for growth traits and net feed intake*

Sire Name	Society_Id	Birth Wt (kg)	200 Milk (kg)	200-Day Wt (kg)	400-Day Wt (kg)	600-Day Wt (kg)	Mature Cow Wt (kg)	Trial Net Feed Intake
ALLOURA WARRIOR W06	DGJW06	2.4	15	25	43	62	47	-0.09
BOOROOMOOKA WESTALL W391	NGMW391	5.3	15	31	62	78	48	-0.04
BRUMAR VANQUISH V9	WMCV9	5.1	12	30	40	62	56	-0.13
CAMPBELL FARMS EMULATION V536	VVXV536	5.2	10	33	66	76	61	-0.83
COMFORT HILL YELLOWSTONE W86	BBAW86	5.9	14	43	79	102	106	-0.48
EASTERN PLAINS NEW DESIGN U5	NEPU5	0.5	12	21	45	58	56	0.06
EDI ANGUS A. RITO S8	CMFS8	2.5	16	34	63	86	85	-0.25
FIVE STAR WHISKEY W6	BGXW006	4.8	12	40	82	104	95	-0.13
GLENAVON UNITED U39	NFWU39	2.5	10	28	58	71	74	-0.35
HAZELDEAN PERFECT STORM V113	NHZV113	5.8	1	42	66	85	78	-0.16
HIDDEN VALLEY EXISTENCE X18	SEWX18	4	11	34	59	81	79	-0.32
HIDDEN VALLEY EXPECTATION X11	SEWX11	2.3	18	37	69	83	65	0.21
KANSAS PIED PIPER W19	NKLW19	4.4	17	34	63	87	68	-0.19
KENNY'S CREEK HEADLINER V87	NDIV87	8	14	50	76	101	81	0.33
KENNY'S CREEK TONKIN T25	NDIT25	4.2	14	35	65	80	70	0.38
KOOJAN HILLS SOMTHIN SPECIAL	WKHW26	4.5	6	35	63	77	57	-0.25
LAWSONS GAR PRECISION W363	VLYW363	3.1	14	30	59	74	57	-0.7
MITTA VALLEY TITAN T63	CDJT63	4.6	2	38	67	75	63	-0.27
MOOGENILLA MOOGENILLA V22	BWFV22	3.6	4	28	44	51	45	-0.1
RAFF ULTIMATE U27	QRFU27	7.3	13	49	90	124	144	-0.05
RENNYLEA RENNYLEA U214	NORU214	1.5	14	32	54	72	29	0.28
ROSEVALE V9	NQMV9	4.3	5	33	63	75	76	-0.03
ST PAULS TRAV-ALBERT T67	NSTT67	3	13	29	55	70	69	0.5
ST PAULS VAMPIRE V51	NSTV51	4.5	8	33	65	81	74	-0.13
STRATHTAY UNIVERSE X19	WJYX19	4.4	11	31	59	76	69	-0.82
TWYNAM UPPERCUT U85	NXTU85	2.6	14	30	56	73	69	-0.2

Sire Name	Society_Id	Birth Wt (kg)	200 Milk (kg)	200-Day Wt (kg)	400-Day Wt (kg)	600-Day Wt (kg)	Mature Cow Wt (kg)	Trial Net Feed Intake
WALLAROY VANGUARD 2000 V189	NEDV189	4.1	10	45	80	103	103	0.16
WATTLETOP WOOLY W120	NWPW120	2.2	6	32	66	79	95	-0.14
WITHERSWOOD WATERLOO W93	CWJW93	5	13	34	73	96	95	-0.3
YTHANBRAE NEW DESIGN 036 V429	VLYV429	3.6	13	40	80	103	99	-0.19
ALUMY CREEK KM FUTURE DIRECTION W03	NKEW03	1.9	12	31	51	61	37	0.01
ARDROSSAN NEW DESIGN V53	NAQV53	3.2	20	31	70	85	79	0.31
BALD BLAIR NEW DESIGN V86	NBBV86	2.6	17	24	51	63	55	-0.63
BALD BLAIR ROCKN D X63	NBBX63	8	9	46	73	87	84	-0.18
COMFORT HILL STOCKMAN U26	BBAU26	2.8	9	27	52	62	61	-0.05
EASTERN PLAINS MAX W7	NEPW7	2.4	4	29	53	64	57	-0.28
WATTLETOP FUTURE DIRECTION X27	NWPX27	5.3	14	38	67	83	66	-0.31
WATTLETOP VIBE V86	NWPV86	2.7	14	36	67	85	88	-0.21

Source: Extracted from BREEDPLAN in February 2007

9.3 **Appendix 3. Estimated breeding values of progeny test sires for reproduction traits**

Sire Name	Society_Id	Gestation Length (days)	Scrotal Size (cm)	Days to Calving	Calving Ease Dir (%)	Calving Ease DTRS (%)
ALLOURA WARRIOR W06	DGJW06	-1	1.3	-0.8	1.3	1.3
BOOROOMOOKA WESTALL W391	NGMW391	-2.7	1.4	-1.1	0.1	-1.4
BRUMAR VANQUISH V9	WMCV9	-0.5	1.1	-0.9	-1	
CAMPBELL FARMS EMULATION V536	VVXV536	-2.4	0.1	-0.6	-1.4	0.8
COMFORT HILL YELLOWSTONE W86	BBAW86	-5	1.3	-3.2	-1	-0.3
EASTERN PLAINS NEW DESIGN U5	NEPU5	-2.9	1.3	-0.9	3.1	1.8
EDI ANGUS A. RITO S8	CMFS8	-4.1	0.2	-2.9	2	0.7
FIVE STAR WHISKEY W6	BGXW006	-1.7	0.5	-2.7	-0.2	2.5
GLENAVON UNITED U39	NFWU39	-4.8	1.9	-5.6	1.3	1.6
HAZELDEAN PERFECT STORM V113	NHZV113	-4	1.3	-3.2	-2.4	-1.8
HIDDEN VALLEY EXISTENCE X18	SEWX18	-2.3	0.8	1.5	-1.3	-3.7
HIDDEN VALLEY EXPECTATION X11	SEWX11	-3.2	0.3	0.5	2.2	0.6
KANSAS PIED PIPER W19	NKLW19	-2.4	-0.8	-0.1	-3	
KENNY'S CREEK HEADLINER V87	NDIV87	-1.8	1	-2.2	-3.6	0.4
KENNY'S CREEK TONKIN T25	NDIT25	-4.6	0.3	-1.8	-2.8	-2.7
KOOJAN HILLS SOMTHIN SPECIAL	WKHW26	-1.8	0.1	-1.7	-1.2	-0.2
LAWSONS GAR PRECISION W363	VLYW363	-3	-0.9	-0.5	1.5	0.8
MITTA VALLEY TITAN T63	CDJT63	-0.2	4.5	-1.7	-4.3	0.4
MOOGENILLA MOOGENILLA V22	BWFV22	-2.4	1.1	-3.9	-0.5	-1.2
RAFF ULTIMATE U27	QRFU27	-0.8	2.9	1.5	-3.9	-1.8
RENNYLEA RENNYLEA U214	NORU214	-4.9	1.4	-5.5	3.9	3.1
ROSEVALE V9	NQMV9	-1.8	-0.8	-3.2	-0.1	1.8
ST PAULS TRAV-ALBERT T67	NSTT67	-3.7	0.8	-4.5	2.1	-1.6
ST PAULS VAMPIRE V51	NSTV51	-2.4	1.7	-0.2	-1.5	-0.5
STRATHTAY UNIVERSE X19	WJYX19	-0.9	2	-0.4	1.2	

Sire Name	Society_Id	Gestation Length (days)	Scrotal Size (cm)	Days to Calving	Calving Ease Dir (%)	Calving Ease DTRS (%)
TWYNAM UPPERCUT U85	NXTU85	-3.5	1.6	0	2	1.1
WALLAROY VANGUARD 2000 V189	NEDV189	-2.8	0.4	-1.7	-1	-0.3
WATTLETOP WOOLY W120	NWPW120	-6.1	0.6	-2.5	3.1	2.7
WITHERSWOOD WATERLOO W93	CWJW93	-1.5	1.1	-1.6	-0.4	-2.6
YTHANBRAE NEW DESIGN 036 V429	VLYV429	-5.5	0.8	-2.1	1	1
ALUMY CREEK KM FUTURE DIRECTION W03	NKEW03	-2.9	0.7	-0.3	1.9	2.2
ARDROSSAN NEW DESIGN V53	NAQV53	-2	1.9	-0.8	-0.1	-2.1
BALD BLAIR NEW DESIGN V86	NBBV86	-0.7	1.4	-1.3	2.3	0.2
BALD BLAIR ROCKN D X63	NBBX63	-1.4	1.5	-3.2	-2.6	2.5
COMFORT HILL STOCKMAN U26	BBAU26	-0.9	0.8	-1.2	1.1	1.9
EASTERN PLAINS MAX W7	NEPW7	-5.6	0.2	-1.6	0.3	-0.4
WATTLETOP FUTURE DIRECTION X27	NWPX27	-3.2	-0.5	1	-2.2	-2.5
WATTLETOP VIBE V86	NWPV86	-5.4	-0.7	0.2	2.2	-3.8

Source: Extracted from BREEDPLAN in February 2007

9.4 Appendix 4. Estimated breeding values of progeny test sires for carcass traits

Sire Name	Society_Id	Carcase Wt (kg)	Rib Fat (mm)	Rump Fat (mm)	Eye Muscle Area (cm^2)	Retail Beef Yield (%)	Intra-Muscular Fat (%)
ALLOURA WARRIOR W06	DGJW06	36	0.8	0.7	4	0.1	1.6
BOOROOMOOKA WESTALL W391	NGMW391	44	-0.5	-0.9	5.2	1.6	1.4
BRUMAR VANQUISH V9	WMCV9	22	-0.3	-0.5	0.7	0	0.1
CAMPBELL FARMS EMULATION V536	VVXV536	32	1.9	0.8	1.6	-1.9	1.9
COMFORT HILL YELLOWSTONE W86	BBAW86	49	0.9	0	2.8	-0.3	0.9
EASTERN PLAINS NEW DESIGN U5	NEPU5	32	-0.8	-1.6	1.2	1.5	0.5
EDI ANGUS A. RITO S8	CMFS8	57	-0.9	-1.7	2.2	1.1	1
FIVE STAR WHISKEY W6	BGXW006	58	0.2	0.1	-0.4	-0.5	1.2
GLENAVON UNITED U39	NFWU39	29	0.3	-1	2.1	0.1	1
HAZELDEAN PERFECT STORM V113	NHZV113	42	0.9	1.1	3.1	-0.3	1.4
HIDDEN VALLEY EXISTENCE X18	SEWX18	41	-0.6	-0.9	2.7	1.2	0.1
HIDDEN VALLEY EXPECTATION X11	SEWX11	55	-0.8	-1.3	2.4	1.5	0.5
KANSAS PIED PIPER W19	NKLW19	54	-2.2	-2.6	1	1.7	0.9
KENNY'S CREEK HEADLINER V87	NDIV87	48	0.8	1.5	1.1	-0.5	0.8
KENNY'S CREEK TONKIN T25	NDIT25	39	0.7	1.2	1.1	-1.3	1.2
KOOJAN HILLS SOMTHIN SPECIAL	WKHW26	49	0	1.2	3.1	0.5	0.9
LAWSONS GAR PRECISION W363	VLYW363	48	-1	-1.7	4.2	1.7	0.7
MITTA VALLEY TITAN T63	CDJT63	51	1	2.1	2.9	0	0.8
MOOGENILLA MOOGENILLA V22	BWFV22	14	1.7	1.9	-2.2	-3.1	1.5
RAFF ULTIMATE U27	QRFU27	69	-1.2	-1.4	2.3	1	0
RENNYLEA RENNYLEA U214	NORU214	45	0.2	0.3	1.4	0	1.7
ROSEVALE V9	NQMV9	44	-0.5	-0.9	2.8	0.9	0.7
ST PAULS TRAV-ALBERT T67	NSTT67	36	1.3	2.6	-0.1	-1.2	1.2
ST PAULS VAMPIRE V51	NSTV51	37	1.9	0.5	0.8	-1.8	1.3
STRATHTAY UNIVERSE X19	WJYX19	44	-1.6	-2.1	1.8	1.7	-0.3
TWYNAM UPPERCUT U85	NXTU85	39	-0.8	-2.8	4	1.9	0.7

Sire Name	Society_Id	Carcase Wt (kg)	Rib Fat (mm)	Rump Fat (mm)	Eye Muscle Area (cm^2)	Retail Beef Yield (%)	Intra-Muscular Fat (%)
WALLAROY VANGUARD 2000 V189	NEDV189	65	-1.1	-1.9	1.2	1.2	0.5
WATTLETOP WOOLY W120	NWPW120	41	-1.4	-1.7	-0.4	0.7	1.4
WITHERSWOOD WATERLOO W93	CWJW93	53	0.9	1.1	4.1	0.2	1.1
YTHANBRAE NEW DESIGN 036 V429	VLYV429	62	-1	-1.6	3.7	2	0.6
ALUMY CREEK KM FUTURE DIRECTION W03	NKEW03	40	1.1	1.6	5.1	0.3	1.5
ARDROSSAN NEW DESIGN V53	NAQV53	58	-1.8	-2.8	3.9	2.5	0
BALD BLAIR NEW DESIGN V86	NBBV86	27	0.8	1	3	-0.3	1.9
BALD BLAIR ROCKN D X63	NBBX63	45	-1.4	-2	1.9	1.7	0.1
COMFORT HILL STOCKMAN U26	BBAU26	36	-1.2	-1.9	3	1.8	0.2
EASTERN PLAINS MAX W7	NEPW7	30	0.5	0.7	1.5	-0.4	0.5
WATTLETOP FUTURE DIRECTION X27	NWPX27	46	0.5	0.3	4.4	0.4	1.5
WATTLETOP VIBE V86	NWPV86	48	-0.6	-0.6	2.8	1	1

Source: Extracted from BREEDPLAN in February 2007

9.5 Appendix 5. Accuracies (%) of estimated breeding values of progeny test sires for growth traits and net feed intake

Sire Name	Society_Id	Birth Wt (kg)	200 Milk (kg)	200-Day Wt (kg)	400-Day Wt (kg)	600-Day Wt (kg)	Mature Cow Wt (kg)	Trial Net Feed Intake
ALLOURA WARRIOR W06	DGJW06	94	64	90	89	90	79	69
BOOROOMOOKA WESTALL W391	NGMW391	98	62	96	96	96	83	74
BRUMAR VANQUISH V9	WMCV9	89	54	84	84	85	71	66
CAMPBELL FARMS EMULATION V536	VVXV536	96	77	95	94	94	88	72
COMFORT HILL YELLOWSTONE W86	BBAW86	91	64	87	87	87	76	64
EASTERN PLAINS NEW DESIGN U5	NEPU5	94	72	91	91	91	82	70
EDI ANGUS A. RITO S8	CMFS8	94	74	91	92	92	80	66
FIVE STAR WHISKEY W6	BGXW006	92	63	88	89	90	79	63
GLENAVON UNITED U39	NFWU39	95	75	93	92	93	82	69
HAZELDEAN PERFECT STORM V113	NHZV113	97	66	94	94	93	81	75
HIDDEN VALLEY EXISTENCE X18	SEWX18	94	60	90	90	90	78	69
HIDDEN VALLEY EXPECTATION X11	SEWX11	90	56	86	86	87	75	68
KANSAS PIED PIPER W19	NKLW19	88	63	86	86	86	74	68
KENNY'S CREEK HEADLINER V87	NDIV87	92	67	88	89	88	78	65
KENNY'S CREEK TONKIN T25	NDIT25	98	90	97	97	97	91	72
KOOJAN HILLS SOMTHIN SPECIAL	WKHW26	96	73	93	93	93	81	72
LAWSONS GAR PRECISION W363	VLYW363	91	62	86	87	88	78	69
MITTA VALLEY TITAN T63	CDJT63	95	78	92	93	93	80	66
MOOGENILLA MOOGENILLA V22	BWFV22	94	77	91	90	90	80	70
RAFF ULTIMATE U27	QRFU27	96	83	94	94	93	86	67
RENNYLEA RENNYLEA U214	NORU214	96	86	94	94	94	90	69
ROSEVALE V9	NQMV9	92	68	92	92	93	83	73
ST PAULS TRAV-ALBERT T67	NSTT67	95	78	91	91	90	78	66
ST PAULS VAMPIRE V51	NSTV51	95	73	92	92	92	81	69
STRATHTAY UNIVERSE X19	WJYX19	89	52	85	85	85	73	66

Sire Name	Society_Id	Birth Wt (kg)	200 Milk (kg)	200-Day Wt (kg)	400-Day Wt (kg)	600-Day Wt (kg)	Mature Cow Wt (kg)	Trial Net Feed Intake
TWYNAM UPPERCUT U85	NXTU85	97	85	94	95	95	90	75
WALLAROY VANGUARD 2000 V189	NEDV189	96	65	92	93	92	81	67
WATTLETOP WOOLY W120	NWPW120	92	67	91	92	91	79	71
WITHERSWOOD WATERLOO W93	CWJW93	95	62	91	92	91	78	67
YTHANBRAE NEW DESIGN 036 V429	VLYV429	93	62	89	89	89	78	78
ALUMY CREEK KM FUTURE DIRECTION W03	NKEW03	91	64	85	86	87	75	66
ARDROSSAN NEW DESIGN V53	NAQV53	91	71	87	87	87	76	69
BALD BLAIR NEW DESIGN V86	NBBV86	91	68	87	87	88	77	75
BALD BLAIR ROCKN D X63	NBBX63	92	58	88	88	88	77	72
COMFORT HILL STOCKMAN U26	BBAU26	94	74	89	89	89	79	65
EASTERN PLAINS MAX W7	NEPW7	90	64	86	87	86	76	58
WATTLETOP FUTURE DIRECTION X27	NWPX27	90	64	86	86	86	76	67
WATTLETOP VIBE V86	NWPV86	93	75	90	90	90	81	73
Mean		**93**	**69**	**90**	**90**	**90**	**80**	**69**

Source: Extracted from BREEDPLAN in February 2007

9.6 Appendix 6. Accuracies (%) of estimated breeding values of progeny test sires for reproduction traits

Sire Name	Society_Id	Gestation Length (days)	Scrotal Size (cm)	Days to Calving	Calving Ease Dir (%)	Calving Ease DTRS (%)
ALLOURA WARRIOR W06	DGJW06	86	80	56	64	56
BOOROOMOOKA WESTALL W391	NGMW391	94	93	63	75	66
BRUMAR VANQUISH V9	WMCV9	81	50	37	49	
CAMPBELL FARMS EMULATION V536	VVXV536	93	86	61	57	44
COMFORT HILL YELLOWSTONE W86	BBAW86	84	65	55	61	49
EASTERN PLAINS NEW DESIGN U5	NEPU5	89	86	63	65	58
EDI ANGUS A. RITO S8	CMFS8	85	79	57	54	37
FIVE STAR WHISKEY W6	BGXW006	85	79	56	63	51
GLENAVON UNITED U39	NFWU39	85	90	65	71	62
HAZELDEAN PERFECT STORM V113	NHZV113	87	92	63	68	59
HIDDEN VALLEY EXISTENCE X18	SEWX18	86	79	51	58	46
HIDDEN VALLEY EXPECTATION X11	SEWX11	82	76	49	51	35
KANSAS PIED PIPER W19	NKLW19	82	75	54	43	
KENNY'S CREEK HEADLINER V87	NDIV87	83	80	60	66	57
KENNY'S CREEK TONKIN T25	NDIT25	96	96	76	84	77
KOOJAN HILLS SOMTHIN SPECIAL	WKHW26	86	81	64	68	59
LAWSONS GAR PRECISION W363	VLYW363	83	76	55	54	40
MITTA VALLEY TITAN T63	CDJT63	87	84	63	61	43
MOOGENILLA MOOGENILLA V22	BWFV22	87	76	66	64	55
RAFF ULTIMATE U27	QRFU27	90	92	66	72	66
RENNYLEA RENNYLEA U214	NORU214	94	88	68	73	66
ROSEVALE V9	NQMV9	86	85	66	68	61
ST PAULS TRAV-ALBERT T67	NSTT67	89	83	65	67	60
ST PAULS VAMPIRE V51	NSTV51	90	85	62	53	39
STRATHTAY UNIVERSE X19	WJYX19	80	74	37	43	

TWYNAM UPPERCUT U85	NXTU85	90	91	73	75	68
WALLAROY VANGUARD 2000 V189	NEDV189	86	73	61	71	58
WATTLETOP WOOLY W120	NWPW120	86	76	61	66	57
WITHERSWOOD WATERLOO W93	CWJW93	88	86	57	65	55
YTHANBRAE NEW DESIGN 036 V429	VLYV429	83	78	58	61	53
ALUMY CREEK KM FUTURE DIRECTION W03	NKEW03	73	75	60	64	56
ARDROSSAN NEW DESIGN V53	NAQV53	70	61	62	64	58
BALD BLAIR NEW DESIGN V86	NBBV86	75	67	61	64	58
BALD BLAIR ROCKN D X63	NBBX63	77	70	56	63	54
COMFORT HILL STOCKMAN U26	BBAU26	82	68	64	70	61
EASTERN PLAINS MAX W7	NEPW7	73	76	57	63	54
WATTLETOP FUTURE DIRECTION X27	NWPX27	76	78	59	65	59
WATTLETOP VIBE V86	NWPV86	80	82	66	69	64
Mean		**84**	**79**	**60**	**63**	**55**
Sire Name	**Society_Id**	**Gestation Length (days)**	**Scrotal Size (cm)**	**Days to Calving**	**Calving Ease Dir (%)**	**Calving Ease DTRS (%)**

Source: Extracted from BREEDPLAN in February 2007

9.7 Appendix 7. Accuracies (%) of estimated breeding values of progeny test sires for carcass traits

Sire Name	Society_Id	Carcase Wt (kg)	Rib Fat (mm)	Rump Fat (mm)	Eye Muscle Area (cm^2)	Retail Beef Yield (%)	Intra-Muscular Fat (%)
ALLOURA WARRIOR W06	DGJW06	79	80	80	68	77	75
BOOROOMOOKA WESTALL W391	NGMW391	85	87	87	77	85	83
BRUMAR VANQUISH V9	WMCV9	72	76	76	57	72	70
CAMPBELL FARMS EMULATION V536	VVXV536	88	87	87	79	83	84
COMFORT HILL YELLOWSTONE W86	BBAW86	82	79	79	71	71	78
EASTERN PLAINS NEW DESIGN U5	NEPU5	86	83	84	76	79	81
EDI ANGUS A. RITO S8	CMFS8	87	84	85	77	79	83
FIVE STAR WHISKEY W6	BGXW006	84	82	82	75	76	80
GLENAVON UNITED U39	NFWU39	88	84	86	79	80	84
HAZELDEAN PERFECT STORM V113	NHZV113	84	84	84	74	82	80
HIDDEN VALLEY EXISTENCE X18	SEWX18	80	81	81	68	78	76
HIDDEN VALLEY EXPECTATION X11	SEWX11	77	79	79	66	76	74
KANSAS PIED PIPER W19	NKLW19	84	80	82	75	72	80
KENNY'S CREEK HEADLINER V87	NDIV87	84	82	82	75	76	80
KENNY'S CREEK TONKIN T25	NDIT25	92	92	91	86	89	89
KOOJAN HILLS SOMTHIN SPECIAL	WKHW26	88	85	85	79	80	83
LAWSONS GAR PRECISION W363	VLYW363	79	81	81	69	78	76
MITTA VALLEY TITAN T63	CDJT63	86	85	86	77	80	83
MOOGENILLA MOOGENILLA V22	BWFV22	86	85	86	78	80	84
RAFF ULTIMATE U27	QRFU27	88	86	87	80	83	85
RENNYLEA RENNYLEA U214	NORU214	89	88	89	82	85	86
ROSEVALE V9	NQMV9	88	86	86	80	81	84
ST PAULS TRAV-ALBERT T67	NSTT67	86	83	85	77	79	82
ST PAULS VAMPIRE V51	NSTV51	88	86	86	80	80	85
STRATHTAY UNIVERSE X19	WJYX19	74	77	77	61	73	70
TWYNAM UPPERCUT U85	NXTU85	90	89	89	83	85	87

Sire Name	Society_Id	Carcase Wt (kg)	Rib Fat (mm)	Rump Fat (mm)	Eye Muscle Area (cm^2)	Retail Beef Yield (%)	Intra-Muscular Fat (%)
WALLAROY VANGUARD 2000 V189	NEDV189	87	84	84	77	77	82
WATTLETOP WOOLY W120	NWPW120	86	82	83	76	77	81
WITHERSWOOD WATERLOO W93	CWJW93	81	83	83	71	80	78
YTHANBRAE NEW DESIGN 036 V429	VLYV429	80	82	82	72	79	77
ALUMY CREEK KM FUTURE DIRECTION W03	NKEW03	82	79	80	73	73	79
ARDROSSAN NEW DESIGN V53	NAQV53	84	82	84	76	76	82
BALD BLAIR NEW DESIGN V86	NBBV86	82	81	81	74	75	79
BALD BLAIR ROCKN D X63	NBBX63	78	80	80	69	77	75
COMFORT HILL STOCKMAN U26	BBAU26	84	82	83	75	77	81
EASTERN PLAINS MAX W7	NEPW7	79	76	76	67	72	73
WATTLETOP FUTURE DIRECTION X27	NWPX27	78	79	79	70	77	75
WATTLETOP VIBE V86	NWPV86	86	84	86	78	79	84
Mean		**84**	**83**	**83**	**74**	**78**	**80**

Source: Extracted from BREEDPLAN in February 2007

9.8 Appendix 8. Percentage of sires with published accuracies for trait EBVs at the start and end of the progeny test.

	Percentage of sires with published accuracies		Mean accuracy	
	Start*	End	Start*	End
Birth Wt	100	100	76	93
200 Milk	100	100	53	69
200-Day Wt	100	100	72	90
400-Day Wt	100	100	70	90
600-Day Wt	100	100	69	90
Mature Cow Wt	95	100	60**	80
Trial Net Feed Intake	0	100	-	69
Gestation Length	68	100	64**	84
Scrotal Size	92	100	62**	79
Days to Calving	82	100	43**	60
Calving Ease Dir	32	100	42**	63
Calving Ease DTRS	21	92	37**	55*
Carcase Wt	95	100	57**	84
Rib Fat	92	100	56**	83
Rump Fat	92	100	55**	83
Eye Muscle Area	92	100	52**	74
Retail Beef Yield	92	100	50**	78
Intra-Muscular Fat	92	100	51**	80

* For each cohort of sires, published Breedplan data for the year the cohort's progeny were born was used, hence they do not include any progeny test data.

**These values are based on only the sires with Breedplan published accuracies, hence the true mean is expected to be lower than what is reported here.

9.9 Appendix 9. Abstract of publication on maternal productivity (Arthur et al. 2005)

CSIRO PUBLISHING

www.publish.csiro.au/journals/ajea *Australian Journal of Experimental Agriculture*, 2005, **45**, 985–993

Maternal productivity of Angus cows divergently selected for post-weaning residual feed intake

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Abstract. Data on 185 Angus cows were used to study the effect of divergent selection for residual feed intake on maternal productivity across 3 mating seasons, starting from 2000. The cows were the result of 1 to 2.5 generations of selection (mean of 1.5), and differed in estimated breeding value for residual feed intake by 0.8 kg/day. In general, cows lost subcutaneous fat (measured 2 times a year) during the period when they were nursing calves, and gained fat thereafter. No significant selection line differences in fatness were observed except for those measured at the start of the 2000 (10.8 ± 0.4 *v.* 9.3 ± 0.4 mm), 2001 (11.3 ± 0.4 *v.* 9.8 ± 0.4 mm) and 2002 (7.0 ± 0.5 *v.* 5.7 ± 0.5 mm) mating seasons, where high residual feed intake cows had significantly ($P<0.05$) higher rib fat depths. No significant selection line differences in weight (measured 4 times a year) were observed. However, the cows either maintained or lost weight during the calf nursing period, and gained weight thereafter, with mean weights ranging from 450 to 658 kg. There were no significant selection line differences in pregnancy (mean 90.4%), calving (mean 88.7%) and weaning (mean of 80.8%) rates, milk yield (mean 7.7 kg/day) and weight of calf weaned per cow exposed to bull (mean 195 kg). The study indicates that after 1.5 generations of divergent selection for residual feed intake there are no significant selection line differences for maternal productivity traits.