

Beef Bulletin

Quarter 1 - 2011



Beef CRC's two decades of achievement



**Poll gene test for Brahman
breeds commercialised**



**Commercialising
EBVs**



BRD vaccine success

Beef CRC Governing Board



Dr Guy Fitzhardinge, Chairman

Dr Fitzhardinge is a commercial cattle producer from NSW, a past member of the Boards of Meat Research Corporation and Meat and Livestock Australia.



Dr Greg Robbins, non-executive Director

Dr Robbins is General Manager of Animal Science for the Queensland Department of Primary Industries and Fisheries (QDPI&F) and former Director of the Queensland Beef Industry Institute.



Dr Keith Steele, Deputy Chairman

Dr Steele is a business advisor with beef R&D management experience, genomics knowledge and corporate governance and finance skills.



Dr Heather Burrow, Chief Executive Officer

Dr Burrow has extensive research management experience and a quantitative genetics research background.



Mr Rob Backus, non-executive Director

Mr Backus brings northern beef sector and feedlot expertise and knowledge of the industry relevance of genomics to the Board.



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Mr Scholes-Robertson holds a Bachelor of Business and is a qualified Chartered Accountant.



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Mrs Robinson is a commercial beef producer in central Queensland and has extensive beef enterprise technology extension experience.



Mr Richard Rains, non-executive Director

Mr Richard Rains is the Chief Executive Officer of Sanger Australia Pty Ltd, an international meat trading business.



Ms Robyn Clubb, non-executive Director

Mrs Clubb has extensive financial, management and accounting experience as well as a strong rural background and operator of a beef cattle enterprise in southern NSW.



Dr Jay Hetzel, non-executive Director

Dr Hetzel has worked for over 30 years in cattle genetics and genomics research and commercialisation.

About the Beef CRC

The Co-operative Research Centre for Beef Genetic Technologies aims to add \$179 million dollars to the value of the Australian and New Zealand Beef industries each year from 2012 through world-class gene discovery and gene expression research to improve profitability, productivity and animal welfare of beef enterprises.

MISSION

To capture the benefits of the human and bovine genome projects and the "Livestock Revolution" by improving the profitability, productivity, animal welfare and responsible resource use of Australian and global beef businesses through worldclass gene discovery and gene expression research and accelerated adoption of beef industry technologies.

From the CEO

This edition of the Beef Bulletin looks at where we are to date in delivering the products and technologies developed through the Beef CRC's third funding term. It also provides a brief update on industry use of selected products from Beef CRC's earlier phases.

Even though the bovine genome was only sequenced for the first time in 2006 and the full assembly was not available until 2009, the Beef CRC and its research and industry partners have made some very significant achievements in developing beef genetic technologies since 2005, as profiled in this edition.

By June 2012, the Beef CRC believes it will have met or exceeded all outputs that were included in its revised Commonwealth Agreement, formally approved by the Participants and the Commonwealth in early 2010.

This, the third iteration of the Beef CRC, with its focus on beef genetic technologies, is due to wind-up in June 2012. Unfortunately, the timing could not be worse!

Applications of genomic technologies in Australia and elsewhere are just now entering the 'growth' phase of the technology development curve.

Unless the research commenced by Beef CRC in 2005 continues beyond June 2012, Australia will not only lose the considerable momentum it has gained over the past six years but also risk losing valuable

international partnerships which have provided collaborators with global leadership of beef genomics.

Further, the Australian beef industry may face the unacceptably high risk of leaving the introduction of new genomic technologies to multi-national companies, or other countries or industries, which will not have the central focus to grow and develop the Australian beef industry which the Beef CRC has.

This would mean incurring a loss of influence over how the technologies are offered, gaining access to the technologies on sub-standard terms and potentially disrupting systems that currently operate in Australia, and which are already delivering value. All this would occur at a time when major drivers of change such as climate change and global food security require the Australian beef industry to exponentially increase its output from the same or a reduced natural resource base when faced with large increases in the cost of production resulting from increased costs of land, water, grain, energy and labour resources.

The beef industry has never needed a genomics research and implementation capability more. For this reason, Beef CRC and its research and industry partners are now working on an application for a 5-year extension of funding, due for submission by 1 July 2012. Our chances of success must be regarded as low, due to the relatively small amount of funding



Dr. Heather Burrow

likely to be available in this selection round and the large number of potential applications. But nevertheless, we will be giving it our very best shot!

And, with or without the CRC extension funding, the Australian beef industry should be justifiably proud of the Beef CRC's achievements to date.

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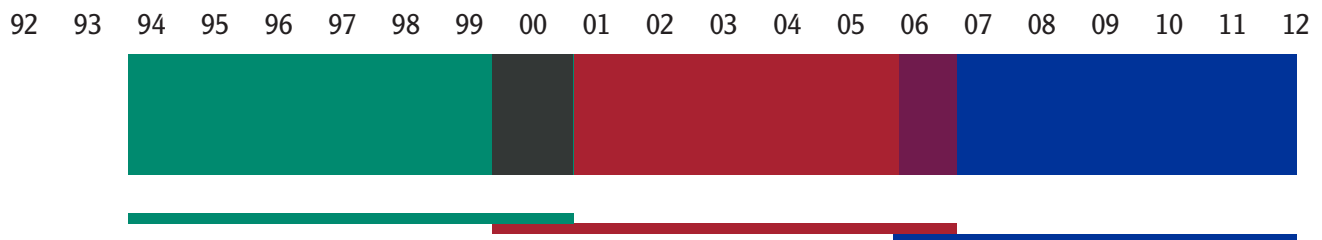
CORE PARTICIPANTS



SUPPORTING PARTICIPANTS



Beef CRC timeline



■ Beef CRC 1

CRC for the Cattle and Beef Industry (Meat Quality)

Major industry issue addressed:

Can we guarantee beef eating quality from Australia's extremely diverse production environments?

■ Beef CRC 2

CRC for the Cattle and Beef Quality

Major industry issues addressed:

- What trade-offs for guaranteed beef eating quality?
- Implement results through new delivery pathways via MSA and BREEDPLAN
- Develop and commence delivery of DNA marker pipeline

■ Beef CRC 3

CRC for the Beef Genetic Technologies

To address four major issues:

- High Quality Beef for Global Consumers
- Feed Efficiency, Maternal Productivity and Responsible Resource Use
- Adaption and Cattle Welfare
- Female Reproductive Performance

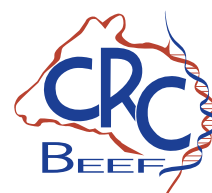
CRC1



CRC2



CRC3



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Boosting BREEDPLAN



Dr Hans Graser

- **Three funding terms of Beef CRC have ensured that new, hard-to-measure but economically very important traits have been added to BREEDPLAN, significantly increasing BREEDPLAN's value to the beef industry.**
- **Prediction equations based on DNA information from the new high density panels will be delivered to BREEDPLAN by April 2012.**

Since the Beef CRC began contributing data to BREEDPLAN in 1993, performance-recorded Australian cattle breeds have shown steadily rising rates of genetic gain.

Now a wave of new genetic information is coming through, made possible by the inclusion of new DNA-based genomic technologies.

BREEDPLAN is built on "phenotypic" data, which comprises measured records of economically important characteristics of an animal. About a decade ago, technologies began appearing that seemed to promise to greatly reduce the enormous labour and cost of phenotypic recording by identifying the genes associated with these economically important traits.

At the time, "genotypic" (DNA-based) data promised a revolution that would leave the old methods in the dust.

However, according to one of BREEDPLAN's founders, Dr Hans Graser, Director of the Animal Genetics and Breeding Unit (AGBU), the process has proved not to be so simple. There is now a clear realisation that gene interactions are far more complicated than was originally thought.

Forecasts of dramatic advances through genomics were made on the assumption that a handful of genes would explain most of the genetic variation for a trait.

However once the Bovine Genome was sequenced in 2006 and the full assembly released in 2009, it became clear that things were not as straightforward as expected.

It turns out, Hans says, that hundreds, even thousands of interacting genes may be at work to control a single trait.

Technology has produced some answers to this complexity, including the single-nucleotide polymorphism (SNP, pronounced "snip") chip. These chips allow tens or hundreds of thousands of genetic sequence differences to be quickly compared against each other, revolutionising the business of gene discovery.

The Beef CRC has used this technology to record genetic differences from thousands of animals, even reaching back into its archival material to genotype long-dead cattle used in Beef CRC's first term. A few CRC animals have also been fully sequenced, a procedure that was prohibitively expensive only a few years ago, to contribute to the global knowledge of beef cattle genomics.

That information now sits in the Beef CRC databases at AGBU.

"The genomics database will contribute to BREEDPLAN when DNA-based prediction equations are accurate enough to provide useful outcomes for industry," Hans says, noting that this is a Beef CRC objective for mid-2012.

"Early on, we thought we could use genomics to explain 50 per cent of the genetic variation which is the equivalent of an EBV with an accuracy of 70 per cent," Hans says. "Now the aim is to explain 15 per cent of variation, which equates to an accuracy of 40 per cent. To get higher accuracies, we need more recorded animals."

"For most traits that are phenotypically recorded, we get accuracies that are higher than we are currently achieving with DNA markers—40-60 per cent for the animals we have on record."

BREEDPLAN will use both sources of information, with genomic data providing an independent cross-reference for the phenotypic information.

Given the current pace of progress, Hans expects that by mid-2012, Beef CRC researchers will have developed improved equations that are strong enough to provide a useful prediction value for traits determined through use of DNA.

However, he warns the value of the data will be compromised unless researchers are able to validate the prediction equations against performance in animals that are completely independent of animals in the discovery populations.

"We are coming back full circle," Hans said. "At the start of the CRC's second term, it was the genotyping that was expensive. Ten years later, genotyping costs have dropped dramatically while phenotyping costs have increased due to higher labor costs and economies of scale have gone down."

The Angus, Hereford, Charolais, Limousin and Brahman societies have established Breeding Information Nucleus (BINs) herds which aim to amass phenotypic data.

DNA samples from every BIN calf are being collected, because, Hans said, the genomics revolution is only just gathering pace: the most promising developments are yet to come.

The Beef CRC is currently undertaking a bid for a five-year extension that will allow it to wrap up any outstanding research and industry delivery threads. If successful, CRC researchers will utilise the BIN herds to underpin the ongoing research activities.

Given the extremely rapid changes in genomic technologies over the past five years, Hans predicts that over the next five years, DNA sequencing may become so cheap and fast that the existing SNP chips may be made redundant because the full sequence will be readily available for all animals.

If the phenotypic information is available to back up the DNA data, then it is likely that at that time, genomics will begin to exponentially accelerate genetic gain, as many had hoped it might have done by now. However, the greatest requirement to achieve the desired levels of genetic gain is accurate measurements on many more animals than are currently available.



Angus feedlot

New traits added to BREEDPLAN through Beef CRC research

The introduction of scanned carcass traits to the breeding program as a result of the BREEDPLAN validation program and Beef CRC phase 1, increased the \$ profit per cow joined relative to industry recording of weights alone.

The subsequent inclusion of reproduction traits and actual carcass and feed efficiency traits based on the first and second phases of Beef CRC increased genetic progress even further. As at 2008, expected profit per cow meeting this market specification was around \$90 and this was increasing at over \$5/year.

The difference between the 2008 profit value and the profit value that would have occurred in 2008 if only growth rates were available (around \$60 by extrapolation) is the incremental value of the new traits added into BREEDPLAN due to CRC research.

GENETIC PROGRESS IN PROFITABILITY

(Certified Australian Angus Beef Index)

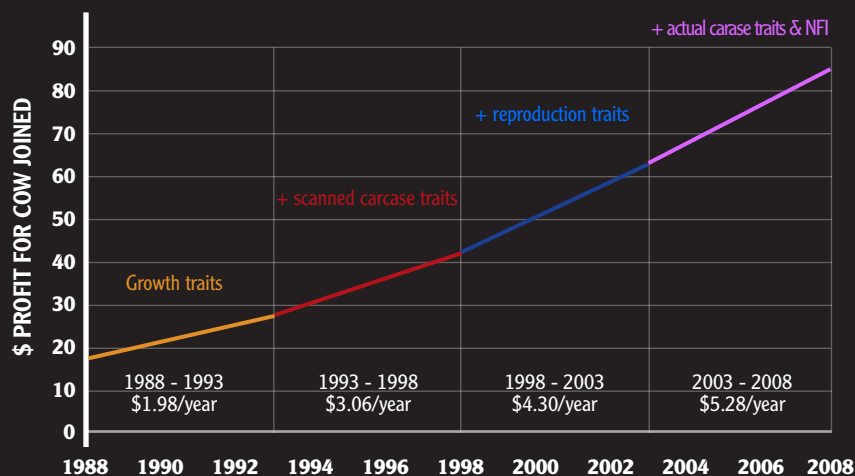


Figure 1: Genetic progress in profitability in the Australian Angus CAAB Index

BeefSpecs Calculator

Complex science underpins a powerful new, easy to use tool



- **'BeefSpecs is a groundbreaking new calculator that can help cattle producers predict weight and fat specifications of animals destined for store and prime beef markets. The product is a result of over a decade of research and development by the Beef CRC and its partners, Meat and Livestock Australia and the NSW Department of Industry and Investment.**
- **The BeefSpecs calculator is available freely online at www.mla.com.au/beefspecs**
- **BeefSpecs currently predicts the performance of groups. But refinements are now being made to the model to allow prediction of the performance of individual animals. The individual animal model is expected to be released for industry use by December 2011.**

The BeefSpecs calculator, freely available to industry on the MLA website, takes up only a few square centimetres of screen space, but it represents over a decade of research by the Beef CRC and its partners.

In fact, the calculator is powered by about fifty years of accumulated science on how cattle grow, and it is

about to get an update that will make it even more valuable to the Australian beef industry.

The BeefSpecs calculator requires users to input initial live weight, P8 fat depth and frame score (an indication of frame size relative to age) to define the growth and maturity parameters of cattle while on-farm.

By the end of the Beef CRC's term in 2012, BeefSpecs will allow for even better predictions to help beef producers meet weight and fat specifications, and it will be complemented by some new tools.

The changes will be particularly valuable to producers who use *Bos indicus* genetics, Beef CRC research leader Bill McKiernan reports. This is because the growth model that BeefSpecs has used to date has favoured *Bos taurus* breeds.

BeefSpecs is built on Beef CRC research that analysed how feed eaten by cattle is used by the animal's body.

In cattle, as in all animals, incoming energy is "partitioned" by the body to match environmental circumstances. In difficult conditions, most energy is directed towards survival. In comfortable times, energy can go into the production of muscle and fat.

The Beef CRC set out to understand how this partitioning works under different conditions, and in different parts of the body.

Dispelling theories

According to Bill McKiernan, to develop the calculator, researchers first had to dispel a theory that emerged in the 1970s: that if cattle didn't have enough nutrition while they were growing, meat quality would suffer.

The theory was explored in two earlier Beef CRC projects, one that examined the pre-weaning performance of calves from cows given varying nourishment during pregnancy, and the sweeping Regional Combinations project, which looked at how different nutritional patterns affected post-weaning performance.

"Both studies came up with the exact same result, in that moderate restriction of nutrition at any time in

life had no effect on meat yield and only very minor effects on eating quality," Bill said.

"Producers wouldn't get an animal to market as soon if these restrictions lasted too long, and that might have implications on the age of animals and hence eating quality. Otherwise there was nothing unexpected happening."

That left Beef CRC researchers free to explore the question of how animals allocate the nutrition required for growth toward different body parts.

Davis Growth Model

The research, which built upon decades of animal growth science, contributed to the "Davis Growth Model" that currently sits behind the deceptively simple interface of BeefSpecs.

"We ask producers to tell us what sort of animal they have and how fast it's going to grow," Bill said. "We know by inference that if a certain animal is going to grow at a certain rate, what sort of nutrition it's getting, and what component of that nutrition will be used for maintenance and what will be used for growth."

Proof-testing the model on 2000 steers and heifers confirmed the model's effectiveness in *Bos taurus* breeds: its predictions of fatness in *Bos taurus* mobs are within 1-2 millimetres, or similar accuracies as those delivered by fat scans. However, because of the conversion factors used between the Davis Growth Model and BeefSpecs, inaccuracies occurred at the extreme end of animal performance – that is, when animals grew too slowly or quickly.

The MARC cattle growth model

To deal with this, the Beef CRC imported an American cattle growth model from the USDA's Meat Animal Research Center (MARC) in Nebraska and adapted it to Australian conditions.

Under testing, MARC is proving as good as the Davis model in its mid-range predictions, and better when it is stretched to the extremes.

In *Bos indicus*, the model is capable of making predictions to within four millimetres of fat-not quite

BeefSpecs *A tool to assist in meeting market specifications*

Save Data Load Data

Animals Management Performance

Initial Weight (175 - 550kg) 330

Initial PB Fat (2 - 11mm) 3

Sex Steer Heifer

Breed Type Bos taurus Bos indicus Bos taurusxBos indicus

Frame Score (3-9) 4

Do you know hip height? Yes No

Results

Final Liveweight (kg) 420

Final PB (mm) 5.4

HSCW (kg) 218

Print Page

i Note: Rolling your mouse over a heading name will provide explanatory notes that will appear in 'pop-up' boxes
BeefSpecs V2.0

The MLA BeefSpecs calculator assists producer decision making for management of groups of cattle to meet weight and fat specifications for particular markets. The BeefSpecs calculator requires users to input initial live weight, PB fat depth and frame score (an indication of frame size relative to age) to estimate the growth and maturity parameters of cattle on-farm.

as good as desired. Bill observes “but reasonable for bullocks, which may carry in excess of 15 mm of fat, at least until we refine the model further.”

The MARC model will be incorporated into the underpinnings of BeefSpecs over the next six months, opening up the value of the tool to the northern beef industry.

Further innovations to the calculator due by 2012

A series of additional refinements will also be rolled out before the end of the CRC’s term in mid-2012. Thanks to an exhaustive process that involves CAT scanning cuts of meat from research animals, a better knowledge of subcutaneous fat deposition is being developed that should lead to better predictions for Bos indicus and marbling prediction through BeefSpecs.

Bill said the capacity to forecast meat yield through BeefSpecs may also be available by the end of

2011, with Estimated Breeding Values (EBVs) being incorporated into the prediction process by the end of the Beef CRC’s term.

BeefSpecs helps producers predict average outcomes for a mob, but some new tools employ the same model for other outcomes.

“I’m pretty excited about what’s coming up, to be honest,” Bill says.

- **On-Farm Drafting Tool**
The On-Farm Drafting Tool, soon to be released on the internet, allows producers to input individual animals to a spreadsheet and then use the predictive power of the model to draft the mob into groups that meet different market specs.
- **Feedlot Optimisation Model**
A third tool, the Feedlot Optimisation Model,

also drafts animals based on expected performance, but allows economic parameters to be included, like cost of feed and other inputs, balanced against potential returns.

“We’ve already run the feedlot model on some co-operating feedlot datasets, and it would have increased the profitability of those particular pens by 25-30 per cent,” Bill said.

Because of its complexity, however, Bill expects the Feedlot model to only appeal to feedlot consultants.

- **Mobile devices**
In the meantime, commercial producers will see continual refinements to the BeefSpecs interface that make it easier and faster to enter data, and widen its scope to smartphone and tablet applications.

The BeefSpecs calculator can be accessed at MLA’s website: www.mla.com.au/beefspecs

Unlocking the secrets to improved northern herd fertility



Wayne Upton

- **The Northern Female Lifetime Reproduction Beef CRC research project, which is unprecedented in its scope and unlikely to ever be repeated, is uncovering the keys to fertility and profitability in Australia's northern rangelands.**
- **The research shows low calving rates can be lifted by re-thinking genetic selection processes.**
- **By mid-2012, when the results of the project have been fully assembled, northern producers will have the most powerful tools ever put at their disposal for lifting herd performance and profitability.**

Beef CRC researchers have meticulously tracked a thousand Brahman females and 1100 Tropical Composite females, derived from about 100 sires, across six joinings in as many years. The findings of this huge undertaking, the Northern Female Lifetime Reproduction project, will be

delivered to the northern beef industry by June 2012.

Already, though, some game-changing knowledge has emerged.

Wayne Upton, a breeding specialist who manages the extension side of the project, said an early finding is that the north's low calving rates can be lifted by re-thinking genetic selection processes.

There are very good reasons for the north's calving rates to be considerably lower than in the south, Wayne observes, not least survival. In the harsh conditions of the rangelands, the energy needed to conceive and maintain a cow and calf through to weaning may not always be available.

Brahman reproduction patterns

Brahman cattle excel in this environment because they can allocate energy towards survival and adaptation to environmental stressors more efficiently than their *Bos taurus* counterparts. A consequence is that often,

Brahman cows will not conceive with a calf at foot—an evolutionary adaptation that gives more importance to the survival of the cow-calf unit than the annual production of a calf.

But what if it's possible for a cow to produce a calf every year, and survive?

One of the clear messages of the Beef CRC project is that this is achievable. Across the four northern properties running the project's cattle, almost all cows that conceived every year over the six joinings survived and were retained in the breeding herds.

Nutrition + genetics = better conception rates

Nutrition plays a big role, Wayne says, but the Beef CRC has demonstrated that an investment in better nutrition to lift conception rates should be matched by an investment in genetics to properly capitalise on the nutrition.

Female fertility—the number of calves a cow can produce in her lifetime—hinges on two genetic factors: the age at which a heifer will first conceive, and

how soon after one calf she will be ready to conceive another.

Beef CRC researchers have found that across the sire groups used in the lifetime reproduction project, different Brahman sires will produce heifers that differ by up to 150 days in the age at which they reach puberty and are ready to conceive. The spread in age at puberty in the Tropical Composite heifers is about 100 days.

Identifying sire lines for improved fecundity

When researchers looked at the sire influence on how soon cows would begin cycling after their first calf, they found a 130 day difference between the best and worst Brahman sires. The heifers in the worst sire lines do not begin cycling again soon enough to produce a calf in a twelve month cycle. Half the Brahman cows in the project did not cycle while they had a calf at foot.

"There lies one of the north's fertility problems," Wayne says. "On the positive side though, there is also the 50 per cent of Brahman females who will cycle with a calf at foot—and there is a very big genetic component in that."

"So if producers can identify sire lines whose female progeny will re-conceive while they have their first calf at foot without compromising their own survival or the survival of the calf at foot, they are going to change the profitability of their herd. These females have jumped two hurdles: they have been pubertal when they were put into the breeding herd for the first time, and they have reconceived in their second joining period. Heifers who are not pubertal when they enter the breeding herds conceive much later in the breeding season, and most only have a calf every two years. Those females capable of producing a calf every year, year after year within 12 months are extremely valuable animals."

Value for seedstock producers

For this knowledge to influence northern herd profitability, it needs to be used by seedstock producers.

The researchers are identifying fertile cows through ovarian scanning and other high-cost, labour inten-

sive methods. But Wayne says seedstock producers have a much cheaper tool at their disposal.

“The BREEDPLAN EBV for ‘days to calving’ is highly correlated with these expensive measures. It’s not going to give the accuracy that can be achieved if heifers are scanned for these traits, but the days to calving EBV has enough accuracy to bring about significant change in northern herds.”

At the moment, few northern seedstock producers record ‘days to calving’ data. “This CRC research suggests that a culture change is needed. There’s a tool that’s ready to go, and it’s relatively simple. The breeder just has to record the day the bull goes into the paddock, the calving date and the disposal date of any cows that failed to conceive.”

Genetic traits for bulls

The seedstock industry can also take immediate advantage of research that has found the potency of bulls is associated with indicator traits like scrotal size and semen production. This can be readily measured through a bull breeding soundness evaluation (BBSE), which is performed by a vet and produces data that can be recorded in BREEDPLAN.

“If a commercial producer wants to take advantage of these genetic differences—and they can make a massive difference to a herd—then he needs to be putting pressure on his bull breeder to record days to calving and do a BBSE.”

Wayne says there are already herds that have used

this technology, “and made massive strides”.

A more detailed picture of female fertility will emerge by the end of the project, with cycling performance mapped against the physical characteristics of highly fertile cows.

Some cows make enormous sacrifices to rear a calf, Wayne says: in some cases, losses of up to 25-30 square centimetres of eye muscle have been recorded in lactating cows.

The factors that push some lactating cows to the brink of survival but allow others to flourish are now emerging from the data.



Poll gene test for Australian cattle breeds

A world-first gene marker test to identify true polled Brahman bulls



- **The Beef CRC and its partners identified a diagnostic DNA marker that accurately identifies homozygous polled bulls in the Brahman breed**
- **The poll gene test is a simple, cost-effective diagnostic test to classify polled breeding bulls or cows as carrying one (heterozygous) or two (homozygous) copies of the favourable polled marker. A true polled bull (homozygous) produces very few horned calves regardless of the cows to which he is mated. The DNA test distinguishes the homozygous phenotype approximately 84% of the time in Brahman cattle, which is accurate enough to successfully implement a breeding program to increase the incidence of polledness.**
- **The test has now been commercialised for the Brahman breed through the University of Queensland's Animal Genetics**

Laboratory. The test is in the process of being transferred to other companies so they can also provide the test in Australia and internationally.

The Beef CRC and its partners, Meat & Livestock Australia, CSIRO, AGBU and University of Queensland, have discovered and commercialised a new DNA marker test that enables identification of polled (i.e. those that do not grow horns) individuals in Australian Brahman cattle herds.

This test is a world-first for Australian tropical cattle breeds. The new test now offers more than 56% of Australia's cattle producers (i.e. those who breed Brahman or Brahman-derived cattle in Northern Australia) a simple, cost-effective genetic solution to dehorning young cattle.

In the near future, there is potential that animal welfare codes will be changed to require the beef industry to utilise welfare-friendly animal management practices that could, for example, mandate dehorning

of animals before a certain age. Alternately, the dehorning of older animals may in future need to be undertaken under veterinary supervision with use of anaesthetics. This DNA test offers a breeding alternative to dehorning.

Welfare and productivity benefits for the Northern beef industry

Northern Australia is characterised by large, very extensive cattle enterprises and dehorning cattle is of both economic and animal welfare concern. This test can speed up the genetic change towards polled animals that do not require dehorning, thereby avoiding the production losses and animal welfare concerns associated with dehorning animals.

De-horning at young ages is simply not practical in many areas of Northern Australia. Undertaking a routine practice such as de-horning under veterinary supervision would not only be very time consuming for the veterinary practitioner, but excessively expensive for the beef producer. Any change in animal welfare codes of practice associated with de-horning is likely to encourage a much wider use of the Beef CRC's polled gene test particularly across Northern Australia.

The simple, cost-effective Australian poll gene diagnostic test can be used by industry to classify polled breeding bulls or cows as carrying one (heterozygous) or two (homozygous) copies of the favourable polled marker. A homozygous polled bull produces very few horned calves regardless of the cows to which he is mated. The DNA test does not perfectly identify homozygous bulls in Brahman cattle but it distinguishes the homozygous phenotype approximately 84% of the time, which is sufficiently accurate to successfully implement a breeding program to increase the incidence of polledness.

The inheritance of horns in European breeds of cattle is believed to be controlled by a single gene. Although the gene has not been identified, DNA tests associated with polledness are commercially available from the USA for those breeds. However, there were no tests available for *Bos indicus* and *Bos indicus* crosses which dominate the cattle population in Northern Australia. It was believed the mode of inheritance of horns in these breeds was much more complex for *Bos Indicus* cattle than in the European breeds. *Bos indicus* cattle commonly have scurs (incompletely formed horns that are not attached to the skull) and it was believed that another gene, called the African horn gene – although it had never been identified – also controlled the trait in these cattle.

The CRC Marker

The poll gene marker discovered by the CRC, like other tests on the market, is a linked marker. That is, we can't directly measure whatever it is that causes horns, so we measure something that is located close to the causal gene. Mostly, but not always, the close-by measurement is a good predictor of the unknown underlying genotype at the polled locus. Most alleles at the marker are almost always associated with the same allele (either polled or horned) at the polled locus.

However, some alleles at the marker show associations with both polled and horned alleles at the polled locus. For these ambiguous marker alleles the test cannot return an unambiguous result. The frequency of ambiguous marker alleles varies between breeds: in breeds where ambiguous marker alleles are rare the test works very well. In breeds where ambiguous marker alleles are common the test is unable to clearly predict the genotype at the polled locus in a significant percentage of animals.

In August 2010 the Beef CRC and its partners released its test to industry in a validation phase to confirm its accuracy in entirely new cattle populations. Industry responses have been above expectations, with more than 1,200 industry animals being processed between August and December 2010.

In Brahman and Hereford cattle where the test has been evaluated in a large sample size from many sources and a good balance between polled and horned, a clear majority of polled animals tested re-

turn an unambiguous result.

The poll gene marker innovation was recognised nationally in 2009, being awarded a prestigious 'Voiceless Eureka Prize for Scientific Research that Contributes to Animal Protection'.

Ongoing work

To improve the test across a range of breeds, research continues on a number of fronts. As additional samples from animals with phenotypic records are received, the estimated associations between marker alleles and alleles at the polled

locus are refined. Soon we may have breed specific estimates for some marker alleles for some breeds. Currently estimates do not take account of progeny horn phenotypes or of horn phenotypes and marker genotypes on more distantly related animals. Procedures for incorporating this information are under development.

Methods are also under development for shifting a herd from horned to polled in an optimal way, minimising the loss of progress in other economically important traits. Finally, markers close to the one used in this test are being tested to determine whether they add precision to the current test.



Dr Heather Burrow, Beef CRC Chief Executive, Mr Don Heatley, Chair, MLA, and Ms Sarah Meibusch, COO, Beef CRC at the industry release of the poll gene test at the Brisbane Ekka show, August 2010.

Sticking it to the tick

A genomic approach to developing a tick vaccine



- **The Australian cattle (beef and dairy) industry incurs losses of ~\$175m per annum due to the impact of ticks and tick-borne diseases and costs of treatment to ensure compliance with regulatory protocols for interstate and international livestock movement.**
- **Beef CRC researchers are screening genes and sequences from ticks to determine their ability to trigger a cattle's immune system to develop antibodies against ticks.**
- **The aim of this project is to develop vaccine candidates that could in future be used in a cattle tick vaccine to deliver 12 month's immunity duration and 90% efficacy.**
- **Fourteen candidates are currently being trialled in animal experiments, with some encouraging early results. By June 2012, the value of those candidates will be known – however, ongoing research will be required to deliver a commercial vaccine.**

The high costs associated with controlling cattle ticks in Australia and internationally, together with the impact of the use of chemicals to control ticks on food safety and the environment, have meant the cattle industry and governments worldwide have identified the development of a tick vaccine with 12 month's immunity duration and 90% efficacy as a very high priority.

But the tick knows how to stick.

"Cattle ticks have been living on cattle for a long period of time," says Professor Mike Goddard, Beef CRC's research leader who was recently elected as a Fellow of the Australian Academy of Science in recognition of his work with innovative use of genetic markers for agriculture.

"Brahman breeds have a natural immunity to ticks but British-based cattle breeds are very susceptible to ticks. The tick has evolved mechanisms for evading the host's immune response."

Professor Goddard says that, unlike bacteria and viruses which are relatively simple organisms the tick is a complex parasite, which makes it harder to develop a vaccine against.

"There has been a good deal of ongoing effort around the world to make malaria vaccines yet it has been extraordinarily difficult to get a vaccine that will protect people against malaria parasites – and malaria parasites aren't as complicated as ticks!"

The Beef CRC and its partners are researching the efficacy of anti-tick antigens – which when introduced into the body trigger the production of an antibody in the cattle's immune system.

"We are a bit unique in targeting ticks," says Beef CRC Chief Executive, Dr Heather Burrow.

"Ticks are not one of the targets for human vaccines, yet they are a serious problem in the cattle industry."

The cattle tick was first introduced into Australia in 1872 on 12 Brahman cattle imported from Batavia. Tick infestation can reduce beef and milk production, and if severe enough, can cause death. However the

main damage is caused by transmitting tick-borne diseases to the cattle. These diseases are Babesia bovis ('red water' or babesiosis), Babesia bigemina, (red water) and Anaplasma marginale, (anaplasmosis).

The Beef CRC is undertaking animal trials to determine the efficacy of 14 anti-tick vaccine candidates singly and in combination with other antigens/peptides.

"Very preliminary results of 3 antigens (2 of which are cocktails of mixed antigens) of CRC candidates are encouraging," says Dr Ala Lew-Tabor, who heads the tick vaccine research project.

"Although the project is on track with all its milestones to date, the degree of difficulty in achieving viable vaccine candidate(s) is extremely high," says Beef CRC CEO Dr Burrow.

"If the Beef CRC does successfully identify effective vaccine targets through its animal trials, very significant additional funds and several more years research would be required to develop the vaccine into a fully registered commercial product available."

By way of example, Dr Burrow said that it took nine years for two Bovine Respiratory Disease (BRD) vaccines developed in CRCI to pass through all national registration requirements and become commercially available.

It is likely that a successful vaccine would as part of a management program using traditional acaricidal and chemical treatments to protect animals against ticks, and would not replace the use of these chemicals entirely.

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Cattle tick

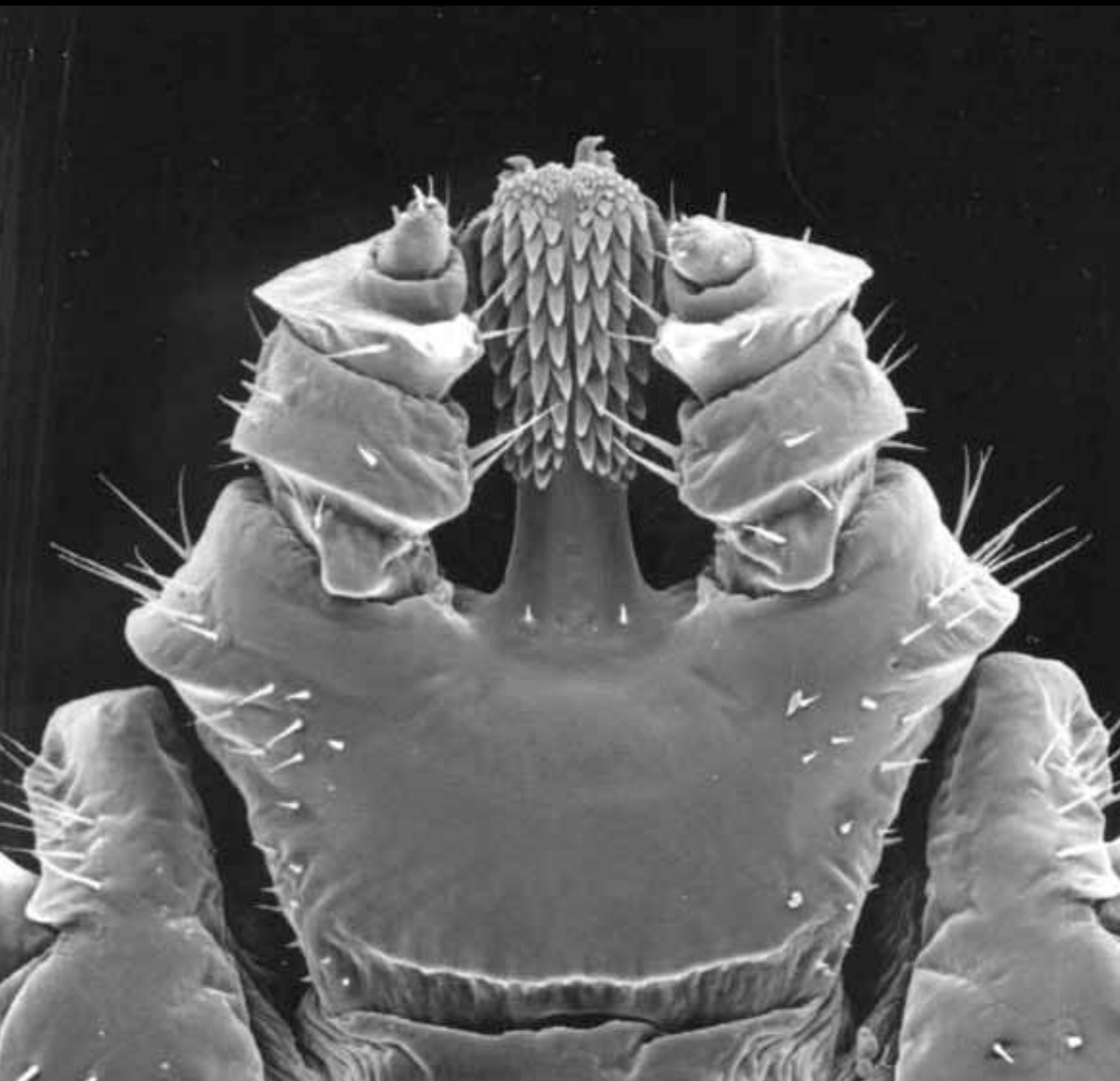
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Cattle tick infested areas of Australia

PREVIOUS PAGE RIGHT:

The cattle tick (Boophilus microplus) is a serious external parasite of cattle in Australia. It transmits tick fevers and, if uncontrolled, can cause serious losses to the industry. Cattle ticks can be seen at any time of the year, but they mainly occur from late spring to mid-winter. Ticks are found mostly on the belly, the shoulder, the neck and ear of the cattle. The illustration shows a cow with tick infestation in the eye

BELOW: Cattle tick – *Boophilus microplus* male, front head bottom
photographer: National Tick Collection



Commercialising genomic EBVs for the beef industry

By Professor Mike Goddard

- **Genomics is the core technology of Beef CRC3. It is high risk science with a potentially high reward.**
- **Genomics for the cattle industry will be commercialised by incorporating validated genomic ‘prediction equations’ into existing EBVs for important traits within BREEDPLAN.**
- **‘Imputing’ is a new strategy being tested by the CRC that uses high density SNP chips to develop more accurate prediction equations across Bos Taurus and Bos Indicus breeds.**

The journey so far

“When we started Beef CRC 3, the prevailing wisdom at the time was that a handful of genes would explain the variation in the traits of interest to producers, such as meat quality, food conversion efficiency and fertility.

However, when real genomic data became available, it was apparent that the number of genes influencing specific traits was vastly greater than was anticipated.

In fact, there can be thousands of genes scattered across the genome that may affect traits of interest in livestock and for most other complex traits.

This dictated that we needed to change our initial strategy of gene discovery – and also to develop a different model for how we were going to deliver for industry. These outcomes were relevant to genomic researchers across species, including humans, and not just related to the beef industry.

Genomic Selection

Instead of focusing on finding a small number of markers, the focus switched to genomic selection, which involves using markers scattered randomly over the entire genome. Genomic selection allows us to identify genes associated with a desired trait, for example marbling, no matter where those genes are located, even if there are thousands of them scattered over the genome.



To identify the location within the genome for these genes, we mark where variations (known as single nucleotide polymorphisms, or SNPs), associated with desired traits occur within the genome.

By assaying SNPs of interest across the genome, we can derive a prediction equation from these SNPs

that will predict the cumulative effect of all the genes affecting a trait like marbling.

This was a major piece of learning and led to a change in strategy in Beef CRC 3 for both our research focus and commercialisation strategies.

SNP chips not accurate enough across beef breeds

The second thing we realised was that the SNP chips available at the time for cattle – a 10,000 SNP chip and, later, the 50,000 chips – did not contain enough SNP data to be sufficiently accurate across different beef cattle breeds.

The 50k chip works well if you want to predict a breeding value in that same breed. It has, for example, been tremendously successful in dairy cattle because of the heavy focus in that industry on a single breed – the Holstein. There are now datasets of tens of thousands of Holsteins and the industry is using this data to predict breeding values. AI studs are decreasing their progeny programs and basing their selection on genomic predictions.

However, the problem for beef cattle is that we have data spread across 7-8 breeds – and we want to be able to make predictions across these breeds. So for us, the 50k chip is not dense enough. You might have a gene for marbling in both Hereford and Angus but in one breed, SNP number 21 is correlated with this gene and in other breed SNP number 1052 is correlated with this gene. Because the association between SNPs varies from one breed to another, it is almost certainly the case that the variation between SNPs and real genes also varies from one breed to another.

Thus, in the beef industry, we have been a somewhat stymied in delivering prediction equations to industry based on the use of these 50k SNP chips. However, higher density SNP chips of around 650k and 800k have recently been released by Illumina and Affymetrix – and we believe these chips are of a high enough density to develop a prediction equation that will work across breeds. This is what the Beef CRC is currently working towards. We are genotyping animals with these high density SNP chips and we will soon be analysing that data to see if we can develop prediction equations that are useful across breeds.

'Imputing' – a new genotyping strategy

One new strategy for developing prediction equations across breeds that is showing some promise is to genotype an animal using one of the new high-density SNP chips, then measure the results against the same genotyping using a smaller 50k chip. Our preliminary data is showing that we can use the data from the 50k SNP chip to impute or make an estimate of the data the high density chip will deliver with a high degree of accuracy (in the order of 90%). If this data proves to be robust, it means we may not have to repeat genotyping using the expensive high-density chip across a whole population of animals, rather focus on genotyping animals in the BIN (Beef Information Nucleus) herds and a smaller number of elite breeding animals.

The Beef CRC has genotyped 6,200 cattle with the 50k SNP chip and is now genotyping 1,750 cattle with the new 800k SNP chip to impute 800k genotypes on all cattle with 50k and generate a discovery population of 7,950 cattle with 800k genotypes and phenotypes for carcase and meat quality traits, NFI or fertility.

Currently this high density genotyping work is being done on samples from all of the breeds where we have lots of data – Angus, Hereford, Shorthorn, Belmont Red, Santa Gertrudis, Brahman and composites from the various pastoral companies.

The difficulty is that the accuracy of these imputed prediction equations depends on the size of the reference database you have – that is, the number of animals that have been measured for the trait and genotyped with the SNP chip. While we would like to have around 30,000 animals within each breed genotyped, this is not possible so our alternative strategy is to build up as many animals as we can, accumulatively, across all the breeds.

This is not the only strategy which can be adopted but, as the Beef CRC represents all breeds, and also because we don't have enough data within any one breed yet to do the job, it is the strategy we are currently working on.

Incorporating genotypes into BREEDPLAN EBVs

The purpose of prediction equations is to estimate the breeding values of individual animals, so that cattle breeders can select the ones that suit them best. BREEDPLAN already performs this task for phenotypic measurements and pedigree information. Cattle breeders don't want to have two different systems trying to do the same thing, so it is very important that the validated prediction equation gets incorporated with phenotypic and pedigree information in BREEDPLAN to deliver a single best EBV.

This will enable the cattle breeder to get the overall best estimate of the breeding value of his or her cattle.

Prediction equations will be derived from work we are currently doing with high density chips. We also have 1,300 DNA samples collected by breed associations that will be genotyped by June and used to validate some of the prediction equations derived from CRC cattle.

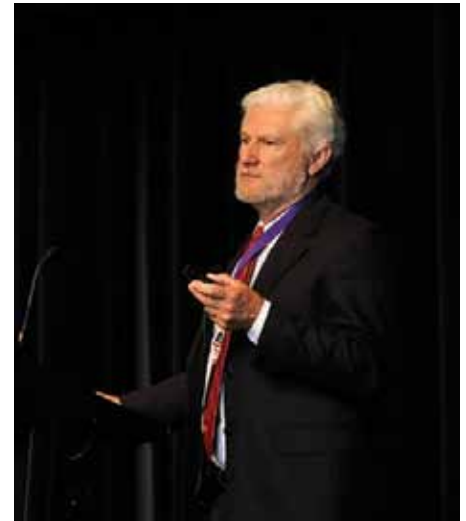
Developing accurate prediction equations

The CRC has dedicated much research into what determines the accuracy of prediction equations. We have developed prediction equations within a certain referenced dataset, where we have a number of animals that have been measured for the traits and genotypes.

Currently we are trying to demonstrate we can use this method to account for 15% of genetic variation between animals – which may not sound like a lot – but it will mean the accuracy of the EBV will be about 40%, which is at a level that is commercially useful.

Prediction equations are not a product the cattle breeders will "see" – rather they represent complex mathematics that will underpin more accurate EBVs. Cattle producers can then access these improved EBVs through BREEDPLAN.

Successfully validated prediction equations for carcase and meat quality traits, NFI and fertility will be transferred to BREEDPLAN and genomics companies in 2012."



Top honour for Beef CRC Chief Scientist

Beef CRC's Chief Scientist Professor Mike Goddard was one of seventeen of Australia's leading researchers to be honoured on 23 March by election to the Australian Academy of Science.

Mike is also a Professorial Fellow in Animal Genetics at the Faculty of Land and Food Resources at the University of Melbourne, where he holds a joint appointment with the Victorian Department of Primary Industries. Election to the Australian Academy of Science recognises a career that has significantly advanced, and continues to advance, the world's scientific knowledge.

Professor Goddard FAA was elected for his distinguished work in quantitative genetics, with innovative use of genetic markers and statistical genetic methods to reveal the genetic architecture of complex traits for agriculture.

Congratulations Mike!

Beef CRC third-term products - overview

Product and industry use	Predicted status at June 2012
DNA Markers Markers for complex traits (growth, feed efficiency, carcass and meat quality, reproductive performance)	
DNA markers will provide beef businesses with a simple and cost-effective method of identifying animals best suited for breeding and/or marketing purposes. Genotype results could in future be linked to NLIS identities so the information can be routinely used for optimal decision-making throughout the animal's life.	1. Prediction equations for growth, feed efficiency, carcass and beef quality and female reproduction attributes that account for at least 15% of the genetic variation for these traits will be delivered to BREEDPLAN by April 2012.
Markers in Meat Standards Australia	
Once DNA marker results can be cost-effectively integrated into MSA, beef processors and retailers will use marker-assisted MSA to reliably grade beef as 3-, 4- or 5-star product, potentially opening up MSA to new suppliers, particularly those in northern environments and those using <i>Bos indicus</i> genetics.	Inclusion of markers in MSA depends on development of options for cost-effectively incorporating DNA information into MSA. It may be possible for DNA markers for tenderness could be included in the MSA model by December 2011.
Poll gene marker	
A diagnostic DNA test will be used by industry to differentiate polled animals used for breeding that carry one (heterozygous) or two (homozygous) copies of the favourable polled marker.	Beef CRC identified a diagnostic DNA marker that accurately identifies homozygous polled bulls in most breeds tested. This test has been released to industry.
SNP discovery from sequencing	
Beef CRC sequenced the genomes of Brahman, Africander & Tuli to discover novel SNPs that were included in high-density SNP panels released by Illumina and Affymetrix in mid-2010.	This research is now complete, but the sequence data will be used for ongoing R&D of new methods (e.g. imputing sequence or high-density SNPs from lower-density SNP panels).
Phenotypic prediction models 'BeefSpecs'	
'BeefSpecs' helps beef producers predict weight and fat specifications of animals destined for store and premium markets to increase carcass compliance rates for fatness and weight targets specific to various beef markets. It is currently limited to predicting the performance of groups, but is being enhanced to predict performance of individual animals.	The calculator is freely available online at www.mla.com.au/beefspecs . Refinements are now being made to the model to allow prediction of performance of individual animals. The individual animal model is expected to be released for industry use by December 2011.
Feedlot performance model	
This model will offer further refinements to the 'BeefSpecs' model, but specifically aimed at feedlot finishing systems and their value chains.	A model specifically designed to allow prediction of group animal performance in feedlot finishing systems will be released to industry by June 2011.
Optimisation model	
This model will offer further refinements to the 'BeefSpecs' model, including an economic component to optimise feed and resource use relative to market specifications and return on investment by supply chain partners	The optimisation model will be released to industry for further validation by June 2011.
Maternal model	
This model will predict cow herd performance and the trade-offs that might be needed in steer performance to optimise profitability and productivity of cow-calf herds initially in temperate production environments, but subsequently in (sub) tropical production systems.	The maternal model is the most scientifically challenging of the CRC's prediction models. The model will be released to industry by March 2012.
Cattle welfare objective measures	
Industry will use the CRC's objective measures of cattle welfare primarily through voluntary or mandatory use of animal welfare protocols, standards and guidelines.	Objective measures of cattle welfare have been incorporated in draft national welfare assessment protocols, standards and guidelines, completed in December 2010.
Genetic parameters for use in BREEDPLAN Trial Marker-Assisted EBVs for tenderness (EBVm)	
To use DNA information in BREEDPLAN, genetic parameters (heritabilities, genetic correlations) are required to underpin the genetic evaluation software.	Genetic parameters for traits associated with beef tenderness (shear force, MQ4 score, flight time, meat colour) and markers for tenderness were estimated and included in a new method to calculate EBVm in BREEDPLAN for industry use in 2008. The method has been adapted for other traits.

Product and industry use	Predicted status at June 2012
i) Female reproductive traits; ii) maternal efficiency traits; iii) male and female indicator traits to improve reproductive performance	
<p>i and ii) Genetic parameters for female reproductive traits and maternal efficiency are designed to directly improve these traits in breeding cows.</p> <p>iii) Early life predictors of fertility in the male will improve the efficiency of selection of sires for reproductive performance, with genetic and economic advantages in identifying new traits in the male (i.e. sires used for breeding purposes) to indirectly improve the fertility of both female and male relatives.</p>	<p>i) Genetic parameters for female reproductive traits in northern Australian herds and their associations with steer traits will be estimated and included in BREEDPLAN by August 2011.</p> <p>ii) Genetic parameters for traits in first and second-calf heifers and their associations with body composition and feed efficiency in southern Australia included in BREEDPLAN by June 2012.</p> <p>iii) If cost: benefit analyses are favourable, genetic parameters for new male reproductive traits will be included in BREEDPLAN for northern Australian herds by April 2012.</p>
Genetic and Management Tools i) Growth path impacts; ii) regional combinations of genetics and management; iii) best-practice management to improve reproductive rates in northern and southern Australia	
<p>i) 'Growth path' results are used by beef producers and feedlotter to balance growth rates of animals against costs to maximise compliance with market specifications.</p> <p>ii) 'Regional combinations' results help southern Australian beef producers best target premium markets using combinations of genetics for retail beef yield and marbling.</p> <p>iii) Results from the 'Maternal Productivity' and 'Lifetime Reproductive Performance' Projects will be 'distilled' as they accrue between 2010 and 2012.</p>	<p>i and ii) Results with direct industry benefit were 'distilled' from specific CRCII projects and delivered as integrated packages of information during the early years of CRCIII.</p> <p>iii) Results from the CRCIII 'Maternal Productivity' and 'Lifetime Reproductive Performance' performance will be 'distilled' as they accrue over 2011-12. Complete messages will be available from the 'Lifetime Reproductive Performance' project by December 2011. The final report for the 'Maternal Productivity' project is not due until September 2012 and will be delivered to MLA by University of Adelaide.</p>
Non-genetic control of cattle ticks Cattle tick vaccine	
<p>The aim of this project is to develop vaccine candidates that could in future be used in a cattle tick vaccine to deliver 12 month's immunity duration and 90% efficacy.</p>	<p>Fourteen candidates are currently being trialed in animal experiments. By June 2012, the value of those candidates will be known, but ongoing research will be required to actually deliver a commercial vaccine to control cattle ticks.</p>
Test for acaricide resistance	
<p>Regulatory authorities now use the CRC's test for acaricide resistance in preference to other tests to identify ticks that are resistant to the synthetic pyrethroids used to control them.</p>	<p>A simple tool that can be used primarily by tick regulatory authorities to identify ticks that are resistant to synthetic pyrethroids was delivered to Queensland's tick control agencies in 2008.</p>
Products to reduce methane emissions Live microbial and bio-active products	
<p>The CRC is developing live microbial and/or bio-active products that restrict methane emissions by rumen microbes and maintain desirable levels of feed digestion. The products could be administered to cattle as a drench or a feed additive.</p>	<p>Candidate protein targets and microbes for live microbial and/or bioactive products have been identified and will be published by June 2011, but development of commercial products from the candidates requires several more years of fundamental research.</p>
Training Materials and Resources i) More Beef from Breeding; ii) Breeder Herd Management; iii) Continuous Improvement and Innovation	
<p>Training materials and tools for undergraduate, vocational and industry audiences will be fully updated and new materials developed, accredited and delivered through existing and new education and training providers by June 2011. The CI&I materials will underpin a sustainable 'Beef Profit Partnerships' (BPP) business model beyond June 2012.</p>	<p>The training materials will be freely available to, or integrated with, resources developed by other educational institutions including universities, agricultural colleges, state departments of agriculture, MLA EDGENetwork and More Beef from Pastures, Northern Pastoral Group of Companies, consultants, breed societies, 'Beef Profit Partnership' networks and regulatory bodies and policy-makers.</p>

MSA – delivering ‘unheard of’ value for consumers

- **Based on Australia-wide surveys to determine average price differential between MSA 3-star and ungraded beef, the cumulative retail-level economic benefit of MSA to the beef industry over the 10 years from 1999 to 2009 was \$366 million, with the annual benefit in 2009 of around \$65 million.**
- **In 2009-10, there were around 1.25 million beef cattle and half a million lambs processed through the MSA scheme, a considerable increase from the ~800,000 beef cattle processed through MSA in 2008-09. This value has not yet been included in value estimations.**
- **The total volume of MSA graded beef is expected to grow by 20% and volumes of lamb are expected to double in 2010-11**
- **MSA provides a unique mechanism to guarantee eating quality of meat, thereby increasing consumer confidence in beef and lamb products. Domestic beef consumption has increased as a result of MSA**



Meat Standards Australia (MSA) is the only grading system globally backed by robust fact-based consumer research.

MSA was developed through the combined research efforts of MLA, Beef CRC and its partners and strong industry collaboration. MSA uses consumer taste panels to verify results that meet consumer expectations for beef and sheepmeat eating quality.

John Thompson, Adjunct Professor in Meat Science at the University of New England said for every \$1 spent on research, MSA has returned approximately \$3.

“It’s basically unheard of, especially for an agricultural innovation, to have that sort of cost benefit particularly when it’s only been delivered over a 10 year time frame,” said Professor Thompson.

“Agriculture is historically slow to take up new innovations. So given we’ve only had MSA since 1999, it’s not bad to return millions of dollars each year.”

Professor Thompson said MSA prevented consumers turning their backs on beef altogether.

“Prior to the introduction of MSA, beef consumption in Australia was in decline,” he said.

“The returns to producers were falling at a rapid rate and if something wasn’t done to turn them around, farm profitability would have gone through the floor.”

During the 1980’s consumers began to voice their dissatisfaction with the consistency of Australian beef.

Increasing competition from chicken and pork products had pushed per capita consumption of beef from 43 kilograms in 1989 to just 38 kilograms per head in a few years.

“We had the majority of beef consumers saying it was a product with real problems. They were telling us you could not reliably and consistently select a

good piece of meat,” he said.

“But the attitudes seem to be changing. While everyone will put their hand up saying they are responsible, obviously MSA has played an important part.”

The first phase of the Beef CRC was responsible for identifying the genetic and non-genetic factors that influence beef quality using meat science, molecular and quantitative genetics and growth and nutrition approaches.

Professor Thompson said this research is the foundation of MSA.

“MSA allows you to accurately describe the eating quality of beef based on a multitude of factors including the animal breed; its sex; growth path; Hormone Growth Promotant (HGP) treatment; how the animal is treated in lairage; chiller conditions; hanging; and marbling and ossification scores,” he said.



“The model also takes into account such things as the cut, how it is cooked, and the length of time it has been aged prior to consumption.”

MSA uses all those inputs to give the meat sample a numeric score.

“If the piece of beef gets 46.5 out of 100 it becomes a three-star grade and is guaranteed tender. Obviously at the lower end there is more risk, but there is still certainty for the consumer in the product they are buying,” he said.

“If it receives a score of above 64 then it goes four-star, all the way up to five-star.”

ProfessorThompson said MSA allows the red meat industry to independently assess

what impact it is having on meat quality.

“Prior to the introduction of MSA, if you spoke to someone about why their meat was bad, they’d blame someone further up or down the supply chain,” he said.

“But MSA allows you to minimize the risk of producing a bad piece of steak.”

“Consumers don’t care how the meat is produced. They take it as a given that the meat is safe but in terms of quality they just want to know that the meat they buy is going to eat as it is described,” said ProfessorThompson.

“That’s the unique thing about MSA.”

It’s that accuracy which means more than 1.3 million carcasses are now graded under the MSA scheme each year. And despite it being a user-pays

system, ProfessorThompson said its popularity is increasing.

One of the major reasons is the premium or penalty that producers receive, depending on whether the carcasses meet the MSA threshold or not.

“It’s all about the hip-pocket. You’ll be surprised how quickly people respond to a high percentage of dark cutters in their carcasses,” said ProfessorThompson.

“You can guarantee the next consignment won’t have as high a pH because they will have changed their pre-slaughter and lairage processes so the cattle are delivered to the abattoir with a full tank of glycogen.”

ProfessorThompson said studies show that if carcasses make the three-star threshold the retailer receives about 40 cents per kilogram on a carcass weight basis.

“At the wholesale level, the increase is about 30 cents per kilo,” he said.

“And we know from other studies the producer gets about 10 cents per kilogram. That equates to about \$40 or \$50 on a carcass, which is enough of an incentive to make people change their practices.”

ProfessorThompson said there is real potential for the MSA grading scheme to become even stronger, particularly if the value chain stops treating MSA as a threshold system and starts using it as the true grading system with different quality grades as was originally intended.

He said MSA has given the beef industry the ability to let people know whether the beef they are buying is good everyday meat, better than everyday or premium beef.

“Despite what industry tells us, consumers aren’t resistant to price if the quality can be guaranteed,” said ProfessorThompson.

“A five-star piece of meat will walk out the door at \$55 or \$60 a kilogram and people will pay it because they are guaranteed it is going to be a great cut of meat.”

ProfessorThompson said if butchers actually start selling three, four and five-star meat as individual

grades and charge more for the higher grades, the scheme will generate even more money.

“MSA will be more sustainable if it generates more money, and there is even greater financial incentive to participate” he said.

Identifying the individual cuts during the boning process will go part of the way to addressing this issue, according to ProfessorThompson.

While some parts of the carcass are graded three-star, ProfessorThompson said other parts can grade four or five-star.

“At the moment they are all lumped in as three-star,” he said.

“What we need is to develop a system that can easily and efficiently identify and harvest the differences in cut quality during the boning process.”

ProfessorThompson said there are new inputs going into the MSA model all the time. Adding gene markers for tenderness is another input that has been shown to improve the eating quality of beef.

“We know gene markers for tenderness work and we know the consumer can taste the difference between a piece of meat that has gene markers for tenderness and one that doesn’t. So it’s logical the markers should be included in the MSA model, because the consumer will get a benefit,” he said.

“What we are struggling with is the effect gene markers have on all the different cuts and whether they interact with other traits such as ageing, hanging or cooking.”

“While the general concept of putting gene markers into MSA is beneficial, there is still a lot of research to do, and we also have to be sure that the potential financial benefits outweigh the costs of testing” said ProfessorThompson.

Improving profitability with Beef Profit Partnerships

- **A major technology adoption strategy of the Beef CRC has been to establish a network of Beef Profit Partnership (BPP) teams across Australia, made up of people interested in improving the profitability of their beef businesses.**
- **The initial target of a BPP is to achieve an additional 5% improvement in annual business profit within two years.**
 - » **CRC economic analyses show that 66% of all BPP partners generated greater (by >5%) improvement in profit than the average beef producer in his/her state as measured by ABARE farm survey data. 65% of those 66% of businesses achieved at least a 20% improvement in profit in at least one year**
 - » **Five north Qld BPPs (26 individual businesses) increased their annual gross margins by an average of \$14/AE for breeding stock and \$43/AE for sale cattle due to CRC interventions, improving profit to these businesses by >\$2.3 million per annum**
 - » **Four businesses in WA improved their profit by >\$300k each per year, with a total improvement in profit in excess of \$1.25 million per year.**

BPP members are supported to track changes in the key drivers of profit (costs, price and throughput), and in those productivity indicators most relevant to their own business improvement, for example, growth rate, reproduction rate and market compliance.

BPP teams meet on a regular basis to focus on opportunities to improve profit and take action to implement some of these opportunities in their businesses. Each team has the support of specialist expertise to guide and assist members.

Established in 2005, the BPP network currently consists of 29 groups located in New South Wales, Queensland, Western Australia, Victoria and New Zealand.

Some cattle producers across the country involved in BPPs have increased annual profits by more than \$70,000.

Project manager, Mrs Cynthia Mulholland said although the BPPs have taken a while to get traction, the results speak for themselves.

“When compared to statistics provided by the Australian Bureau of Agricultural and Resource Economics (ABARE), two thirds of the BPP businesses outperformed the average beef producer in each state, even though their benchmark performance figures showed they were not generally amongst the group of producers considered to be early innovators” Cynthia says.

She said the Beef Profit Partnerships differ from conventional technology transfer projects in that they offer an innovative and stimulating way of achieving rapid, measurable and sustainable improvement in the profitability of beef businesses.

“Traditional extension activities often rely on magazines, fact sheets and field days to deliver new information,” Cynthia says. “Whereas it’s been proven that working in groups often results in a greater adoption of new technology and knowledge.”

Cynthia says the BPP project equips members with a reliable, proven decision-making process and tools, so they can continue to improve their productivity and profitability.

She said the BPP members actually thrive off each other.

“An individual is more likely to look at new things and make changes to their operations if they are surrounded by peers who share a similar background and goal.”

Mrs Mulholland said the BPP groups develop focuses that are relevant to their own businesses. They then implement changes and measure the impact on their business.

The focuses developed by the groups are wide and varied and are not strictly limited to technologies developed by the Beef CRC.

“Besides producing the cattle, pasture management

is one of the biggest components of a beef business,” says Cynthia.

“Some groups in New South Wales have trialed new crops, while groups in WA are utilizing kikuyu in rotational grazing.”

To date, most technologies explored for implementation by the BPPs have had a short- or medium-term focus, to quickly get ‘runs on the board’. Examples of other activities developed by BPP groups include alternative fertilizers, succession planning, wild dog control and controlling pestivirus.

Pestivirus is a major issue in some Australian beef herds, with production losses of between 25 and 40 per cent being recorded due to reduced reproductive performance, death losses and ill thrift.

If pestivirus stays in the herd, annual production losses of between five and 10 per cent commonly occur.

Control of pestivirus was investigated by BPP groups in New South Wales.

Producers in the group supplied blood samples from their herds to the district vet who analysed the samples and presented the case for and against vaccination with the Beef CRC developed vaccine.

“The producers, along with their facilitator, then used the BPP’s Continuous Improvement and Innovation (CI&I) processes to decide whether it was appropriate to vaccinate their whole herd,” says Cynthia.

Although some producers had been independently concerned about pestivirus in their herds, Cynthia said their involvement in the BPP prompted them to take action.

“They told us that speaking to other members of the group as well as the fact they could access the latest information and technical assistance helped them make the changes.”

There are numerous examples of successful changes being implemented right across the BPP network.

In the Esperance group alone, four businesses have increased profits by nearly \$300,000.

“One business implemented intensive rotational grazing on 300 hectares of land and subsequently increased stocking rates from 150 cows to 300 cows and calves,” says Cynthia.

“Originally their gross margin per hectare was roughly \$100. As a result of the changes they increased that to about \$289, adding \$56,000 to their bottom line.”

She said another business also implemented rotational grazing and increased stocking rates for weaners and cows, increasing profits by \$59,000. “The same business shifted their calving dates from March to April thus reducing supplementary feeding,” she said.

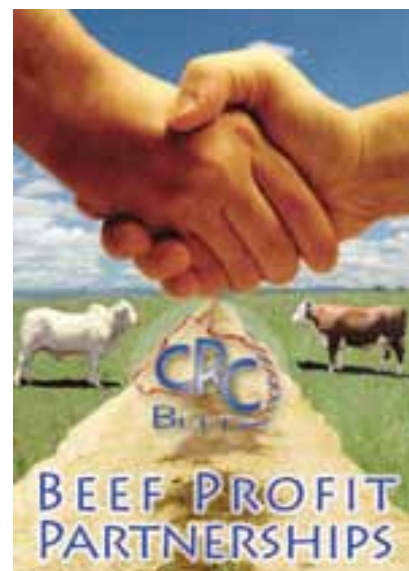
“By doing this, they were able to generate an extra \$24,000 per annum.”

The Beef CRC is currently working on a sustainability plan for the BPPs to ensure they continue after the current Beef CRC ceases operations in 2012.

“Whether they are run by the state agricultural departments or by private consultants, the facilitators are extremely dedicated to the BPP process,” Cynthia says.

“Beef + Lamb New Zealand are now implementing Sheep Profit Partnerships,” Cynthia says.

“That’s something we’d like to see here in Australia. Improving profits shouldn’t just be reserved for the beef industry. We’d like all agricultural industries to benefit from the BPP processes.”



Impact of Beef Profit Partnerships on the Australian Economy

By Garry Griffith

Beef Profit Partnerships (BPPs) have resulted in some significant improvements made by individual businesses, and in specific regions.

Western Australia

In the Esperance BPP in Western Australia, impact analyses undertaken by a local economist indicated an average expected increase in gross margin of around \$175/ha for four BPP producers across eight improvements.

These improvements were all essentially more intensive use of pasture on small parts of their properties, as seasonal pasture quantity and quality is the key driver of herd productivity in this region of WA. The expected economic impact for these four businesses alone, now mostly realised, is in the order of \$275,000 per year.

Victoria

There are some excellent examples of improvements coming out of the Hamilton and Ballarat BPPs in Victoria. For nine businesses in these two groups, the average expected increase in gross margin across 12 different improvements was around \$79/ha or an increase in profit of close to \$6,000 per business per year. This sums to \$68,000 per year for these nine businesses.

Again most of these improvements have been implemented and the benefits have been realised.

North Queensland

The average improvement achieved across five North Queensland BPPs due to BPP interventions was about \$14 per adult equivalent (AE) for breeding stock and about \$43/AE for sale stock. These 26 North Queensland businesses control some 140,000 cattle. Hence the annual improvement in profit achieved in these businesses alone was more than \$2.3 million.



Value of Past Investments in Beef CRC (1993-2005)

Product	Method of Evaluation	Industry Outcome
Science underpinning Meat Standards Australia	Australia-wide surveys of beef retail outlets used to determine average price differential between MSA 3-star and ungraded beef, multiplied by annual volume of MSA beef sold.	<ul style="list-style-type: none"> Cumulative retail-level economic benefit for 10 years to 2009-09 was ~\$366 million (excludes 1.25 million cattle and 0.5 million lambs graded in 2009-10). Total volume of beef and lamb graded expected to grow by 20% and 100% respectively in 2010-11 Unique ability to guarantee eating quality of beef, thereby increasing consumer confidence in beef products Increased domestic beef consumption
New traits in BREEDPLAN	Rates of genetic gain in key cattle breeds across time. Addition of scanned carcass traits in CRCI increased average \$index in Angus breed from \$1.98/yr to \$3.08/yr; inclusion of reproduction increased average \$index value to \$4.30/year; and inclusion of actual carcass traits and NFI increased average \$index value to \$5.28/year. Inclusion of prediction equations based on DNA markers is expected to at least double the rate of genetic gain over coming years. The difference between the 2008 profit value and the profit value that would have occurred if only growth traits were available (~\$60 per cow joined) is the incremental value of the new traits added to BREEDPLAN due to CRC research. The CRC could justifiably claim 50% of that incremental value.	<ul style="list-style-type: none"> Based on the Farquharson et al. (2003) calculations, Beef CRC's share of the incremental value equates to a Net Present Value of several hundred million dollars Cattle that best meet exacting market specifications for growth, carcass and retail beef yield, feed efficiency and eating quality Simple on-farm (indirect) measurement of carcass tenderness in live cattle (through marbling and flight time) Improved reproduction rates per cow joined in northern and southern Australian beef herds Improved use of the natural (grazing) resource base through improved feed efficiency and reproduction Ability to simultaneously improve traits that are antagonistic (due to new knowledge of genetic relationships between the traits) Precise cattle breeding for hard- or expensive-to-measure traits Identification of outstanding beef industry sires based on hard- or expensive-to-measure new traits Evidence of strong genetic relationships between cattle finished on grass vs. grain diets, confirming the need for a single genetic evaluation scheme rather than separate schemes for grass vs. feedlot cattle
Improved genetic gain through crossbreeding and development of composites in Northern Australia	Economic impact assessments based on assumptions of 25% of Brahman herd changed over 10-year period (2003-2013) to either a terminal crossbreeding system or a tropically adapted composite, backed by anecdotal evidence from the Northern Pastoral Companies and Queensland Beef Profit Partnerships that change has occurred (though quantitative evidence of the extent of the change is not available).	<ul style="list-style-type: none"> Economic impact assessments show that changing from Brahman to terminal crossbred/ tropical composite increases gross margins by \$7 and \$24/AE where weaners are sold for finishing When weaners are grain-finished, the extra gross margin was \$38/AE for advantages in growth rate and feed efficiency during finishing, with an additional (conservative) gross margin of \$5/AE for achieving a 10c/kg marbling premium in 10% of steers and \$9/AE for achieving a 5c/kg premium for 60% of grain-finished steers achieving MSA 3-star. These benefits translate at northern industry level to an extra annual benefit in 2013 of \$130 million and an extra Net Present Value (in 2003) of \$730 million; Benefits initially accrue to beef producers, but are eventually spread through entire chain, including consumers. Producers ultimately realise about 1/3 of total benefits Impact of Bos indicus content, ossification scores, grass vs. grain and HGP effects on MSA grading scores
Vaccines to control Bovine Respiratory Disease (Bovilis MHTM and PestigardTM)	Product sales, though a far more effective method of evaluation would be through productivity improvements from reduced animal morbidity or mortality rates or increased reproduction rates through use of the vaccines. The commercialisation companies suggest that vaccinated animals experience significant health benefits in feedlots, including a 68% decrease in deaths; an 82% decrease in deaths due to respiratory disease; a 38% decrease in morbidity; and a 40% decrease in morbidity due to respiratory disease.	<ul style="list-style-type: none"> Total product sales of the two vaccines since commercial release in 2006 through to June 2010 were ~\$14 million, with ~\$6 million of pre-registration sales Increased growth rates & reduced time to market of feedlot cattle Improved feed efficiency and reduced feed costs of feedlot cattle Improved reproduction rates of vaccinated cattle Reduced antibiotic use and improved animal welfare Greater profit to production & feedlot and sectors

Product	Method of Evaluation	Industry Outcome
Pre-boosting strategies to enhance the performance of cattle during growing, finishing and transport (grass- and grain-fed)	Feedback from the feedlot sector indicates most producers selling directly to feedlots now routinely pre-boost their animals through yard-weaning and vaccination strategies, thereby improving the feedlot performance of those cattle.	<ul style="list-style-type: none"> • Improved feedlot performance of cattle • More resilient cattle through reduced stress and improved behaviour • Reduced injury to cattle and their handlers and reduced infrastructure damage • Improved animal welfare
Growth path, transport and genetic effects on beef eating quality and ability to cost-effectively meet beef market specifications	CRC economic impact assessments show that CRC fast-growth rate and time-of-calving results have potential to generate cumulative Net Present Values of ~\$70 million over a 15-year time horizon. Anecdotal evidence from producers in southern Australia and direct evidence from 'Beef Profit Partnerships' show that change has occurred, but the extent of the change has not been able to be formally quantified.	<ul style="list-style-type: none"> • Improved compliance with beef market specifications • Restricted growth early in life does not compromise beef eating quality • Compensatory growth only partially compensates for early life growth checks and economic impacts show most cost-effective strategy is to grow animals as rapidly as possible throughout their lives • Responses to selection for BREEPDLAN EBVs are consistent across a wide range of production environments and growth paths • New knowledge about the impacts of transport and pre-slaughter mixing of cattle on carcass bruising and eating quality • New understanding of the development of marbling deposits in growing and finishing cattle • Increased profit from better nutritional and genetic strategies • Regional prosperity from more profitable beef enterprises across Australia
Responsible recycling of feedlot waste to achieve a sustainable feedlot sector	CRCI data contributed to development of new guidelines that are now routinely used across the feedlot sector	<ul style="list-style-type: none"> • Feedlot waste minimization strategies routinely applied Australia's feedlot sector without compromising animal performance • A new cropping system that uses a combination of manure and inorganic fertilizers to improve crop yields, soil health and soil water storage and reduce runoff and nutrient loss to the environment • Reduced nutrient load to the environment from better use of feedlot waste • Better production from pastures through efficient use of feedlot waste
On-farm and pre-slaughter food safety	Pre-slaughter measurement of enteric pathogens identified new strategies to reduce on-farm pathogen loads. The extent of on-farm practice change to reduce these loads has not been quantified.	<ul style="list-style-type: none"> • On-farm and abattoir best practice to reduce pathogen loads • Increased consumer confidence in beef safety
'Beef Profit Partnerships', a system of partnerships between beef businesses, value chains and the broader beef industry designed to accelerate improvements, innovations and adoption for sustainable impact on business profit	Success of the BPP approach is measured by a combination of outputs, including the number of practice changes and the economic, social and environmental impacts of those changes made by individual businesses over time. Since inception of the project in 2005, >120 improvements and innovations have been implemented and >500 practices, tools and technologies have been trialed, each with measurable impacts on productivity and profitability at individual beef business level.	<ul style="list-style-type: none"> • CRC economic analyses show that 66% of all BPP partners generated greater (by >5%) improvement in profit than the average beef producer in his/her state as measured by ABARE farm survey data. 65% of those 66% of businesses achieve at least a 20% improvement in profit in at least one year • Five north Qld BPPs (26 individual businesses) increased their annual gross margins by an average of \$14/AE for breeding stock and \$43/AE for sale cattle due to CRC interventions, improving profit to these businesses by >\$2.3 million per annum • Four businesses in WA improved their profit by >\$300k each per year, with a total improvement in profit in excess of \$1.25 million per annum
Education and training courses to create a more skilled beef industry workforce		<ul style="list-style-type: none"> • More skilled beef industry workforce • Undergraduate students with direct access to latest beef industry results • More than 80% of Beef CRC post-graduate students retained in livestock research and/or agricultural enterprises in Australia
The world's most comprehensive beef cattle databases of fully-pedigreed cattle recorded for a very wide range of hard- or expensive-to-measure traits	These databases play a critical role in Australia's BREEPDLAN and Meat Standards Australia schemes and are also essential for bovine genomics research.	<ul style="list-style-type: none"> • These databases provide new research opportunities for beef research as new technologies and additional funds become available

BRD vaccine outcomes are nothing to be sneezed at

- **Two vaccines developed and commercialised by the CRC and its partners are continuing to provide long term protection to the Australian cattle industry.**
- **Developed in CRCI, Bovilis MH™ and Pestigard™ are preventing major losses in breeding herds and feedlot cattle.**
- **Other outcomes include increased growth rates, improved feed efficiency, improved reproduction rates, reduced antibiotic use and greater profit to production an feedlot sectors.**

The single most costly disease affecting feedlot cattle is Bovine Respiratory Disease (BRD) which costs the sector an estimated \$60 million annually.

“BRD is a complex disease involving many contributing factors and usually occurs within four weeks of the animal entering the feedlot,” Beef CRC Chief Executive Dr Heather Burrow said.

“The bacteria Mannheimia haemolytica (MH) is a major cause of BRD in Australia and is estimated to cause 50 to 90 per cent of illness and death in Australian feedlots.”

In addition to BRD, pestivirus is an insidious disease causing losses in beef and dairy herds.

Dr Burrow said pestivirus is widespread with about 70 per cent of Australian herds infected by the disease.

“In herds infected with pestivirus, production losses of between 25 and 40 per cent are being recorded mainly because of reduced reproductive performance and losses from death and ill thrift,” said Dr Burrow.

“If pestivirus remains in the herd, annual production losses of between five and 10 per cent commonly occur.”

That’s why the Beef CRC-developed vaccines have become so valuable.

Used together, both vaccines form part of a feedlot ‘pre-boosting’ strategy.

This strategy is recommended by the Australian Lot Feeders Association.

Entering a feedlot can be stressful for the animals which have usually travelled long distances. They are put into a strange new environment with strange new smells and they have to be vaccinated.

If that treatment can be done prior to the cattle leaving the farm it’s one less stressor the animal has to deal with.

While Dr Burrow said success of the vaccines can be measured through product sales, a far greater impact can be seen by the productivity improvements they provide.

She said feedback from the feedlot sector and the commercialisation companies suggest that vaccinated animals have significant health benefits in feedlot environments including reduced morbidity and mortality rates.

Since vaccinations began, feedlots have recorded a decrease in respiratory death loss by 82 per cent since and respiratory morbidity is down 40 per cent.

Dr Burrow said in addition, vaccination is providing other economic benefits.

“Feedlots are witnessing improved average daily weight gains which means the animals are getting to market quicker.”

“Vaccinated animals also have improved feed efficiency, which reduces feed costs and health costs due to reduced antibiotic use.”

Vaccinated cattle are healthier for Willyung Farms

Sandy Lyon from ‘Willyung Farms’ in Albany in the south-west of Western Australia operates 500 breeding cows.

Sandy also backgrounds cattle for his 1000-head feedlot.

He supplies Coles through Harvey Beef on a 70-day feeding regime.

Sandy said he has been using Bovilis MH™ and Pestigard™ in his herd for about four years.

“Although we don’t have a huge rate of losses from respiratory disease we have noticed cattle



are a lot healthier and have a lot fewer runny noses,” said Mr Lyon.

“Our losses in the feedlot were probably up at about 5-6% but since vaccinating, we’ve dropped that to about 3% per cent, so it’s definitely saving us money.”

Mr Lyon said while they don’t use Pestigard™ in the feedlot, they do use it in their breeding cows. “It’s hard to quantify how endemic pestivirus was in our herd, but we did notice some deformed calves,” he said.

“We began to vaccinate and since then our conception rates have increased.”

Mr Lyon said if the cattle are healthier and have less respiratory problems there is definitely a flow on effect to the growth of the cattle.

“We spend about \$3 per head for each vaccine, but with increased growth rates, reduced losses and more calves on the ground, vaccination definitely gives us value for money,” he said.



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