Final report

Tropical Beef Technology Services

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Abstract

The sixth iteration of the Tropical Beef Technology Services (TBTS) project aimed to maximise the understanding and use of genetic technologies in the Northern Australian beef industry. The five project objectives were (1) Develop extension messages for Northern Fertility Projects (2) Provide support to Northern Beef Information Nucleus Projects (3) Undertake extension activities to implement BREEDPLAN related technologies in seedstock herds (4) Undertake extension initiatives to support the application of genomics technology and accelerate genetic progress, and (5) Maintain and support the Tropical breed Selection Indexes. As per the Project's Operational Plan, the upskilling of commercial producers about BREEDPLAN and related technologies has been a major focus. TBTS personnel collectively delivered 152 face-to-face presentations to 5236 attendees during the project. 110 individual seedstock properties were visited, along with 123 commercial operations. TBTS staff have also written numerous articles, delivered webinars and contributed to educational videos. The TBTS project has provided a seamless transfer of information in support of the use of BREEDPLAN and related genetic technologies in the Northern Australian beef industry. In turn, the use of these technologies, with TBTS support, has facilitated genetic change which benefits the whole beef value chain from bull breeders to the end consumers. The 3-year rolling average of the weighted selection index for the stakeholder breeds has increased from $0.75 per cow mated for the 2016 calving year to $2.52 per cow mated for the three years to 2020.

Executive summary

Background

The sixth iteration of the Tropical Beef Technology Services (TBTS) project, which commenced on 1 July 2016, was a joint initiative between Meat and Livestock Australia (MLA), the Agricultural Business Research Institute (ABRI), Queensland Government's Department of Agriculture (DAF) and seven breed associations representing tropical cattle breeds that are predominantly run in Northern Australia. The TBTS project has been running since August 1997, with the aim of delivering a range of innovative extension services and technical support to maximise the use and understanding of BREEDPLAN and related genetic technologies in the Northern Australian beef industry. This TBTS project commenced with one FTE (Paul Williams), however in February 2017 Tim Emery joined TBTS for the remainder of the project on secondment from DAF.

The project has a goal of achieving a $10 increase in the weighted average selection index for the stakeholder breeds by the 2019 calving year.

This project is building on the results of several research projects which have demonstrated the wide variation and relatively high heritability of fertility in tropical breeds. The utilisation of genomic measures of fertility will assist breeders to make genetic progress for fertility. The TBTS project continues to provide technical services and data collection advice for the Northern industry and research projects. Additionally, as detailed in the Project's Operational Plan, the upskilling of commercial producers about BREEDPLAN and related technologies has been a major focus, particularly for Tim Emery. To enable this to occur, resources have been utilised for speaking at and/or attending industry events, establishing networks, and providing ongoing engagement with industry.

Objectives

The objectives of the TBTS project were:

1. Develop and undertake extension initiatives for the Northern Australia seedstock sector based on the availability of genomics tests for fertility in the Brahman breed, the outcomes of the Brahman BIN project and the "Enabling Genetic Improvement in Tropical Breed Cattle" project.
2. Provide support to Beef Information Nucleus (BIN) projects in Northern Australia. This includes overseeing data collection, formatting and submission to the appropriate breed association and BREEDPLAN to ensure data integrity and quality.
3. Undertake extension activities and provide technical support to implement both new and existing BREEDPLAN related technologies in Northern Australia seedstock herds e.g. BREEDPLAN EBVs, Internet Solutions, BreedObject Selection Indexes, TakeStock®, Data Quality Herd Audit, Marker Assisted EBVs, Mate Selection tools and Completeness of Performance.
4. Undertake extension initiatives to inform the seedstock and beef breeding industry in general on the relevance and application of genomics technology for accelerating genetic progress in economically important production traits.
5. Maintain and support the Selection Indexes published by stakeholder breed associations to ensure they remain relevant to current and future markets and production systems. Manage the introduction and impacts of Version 6.2 of BreedObject. Where possible, also

develop and publish Selection Indexes for stakeholder breed associations not currently doing so.

All five project objectives were met successfully.

Methodology

TBTS project personnel completed a wide range of extension initiatives and technical support activities throughout the duration of the project. These included the provision of presentations for both seedstock and commercial beef producers, one-on-one herd consultations with seedstock and commercial producers, and the provision of technical information (written and e-media formats) on a wide range of beef breeding and genetics topics. The TBTS project team also provided day-to-day technical support and advice regarding BREEDPLAN and related genetic technologies to TBTS stakeholder breed associations and their members, along with commercial producers. Finally, TBTS project personnel collaborated with a number of industry organisations in regards to extension messaging, extension events and the development of new extension tools.

Key Findings

TBTS personnel collectively delivered 152 face-to-face presentations to 5236 attendees during the project. 110 individual seedstock properties were visited, along with 123 commercial operations. TBTS staff have also written numerous articles, delivered webinars and contributed to educational videos.

The 3-year rolling average of the weighted selection index for the stakeholder breeds averaged $0.75 per cow mated for the 2016 calving year before rising to $0.98 for the 2017 born animals. Subsequently the 3-year-rolling average increased to $0.95 for the three years to 2018, increased to $1.69 for the three years to 2019 and $2.52 for the three years to 2020.

Benefits to industry

Genetic improvement in the seedstock sector, which has been successfully facilitated by the TBTS project, has significant flow-on effects for the whole beef value chain. New technologies, such as genomically enhanced breeding values and revised BreedObject selection indexes, enhance the ability for commercial producers to have the opportunity to selects more bulls that are genetically superior; in turn, this will produce better commercial progeny for the feedlot and processor components of industry. Upskilling commercial producers to better understand EBVs and practically apply them in their businesses, has contributed to more informed, objective decision making and improvements in productivity and profitability.

Future research and recommendations

With beef genetics an evolving and technical complex space, a strong requirement exists for extension projects that provide a seamless transfer of information between the research and technical operations of the BREEDPLAN genetic evaluations, and those who use genetic improvement technologies in their herds. Thus, the ongoing support of an efficient and effective national extension and technical support network for the Australian beef industry should be prioritised. This would enable the continued utilisation of genetic technologies, and associated rates of genetic improvement, which would lead to significant flow on benefits for the entire beef supply chain.

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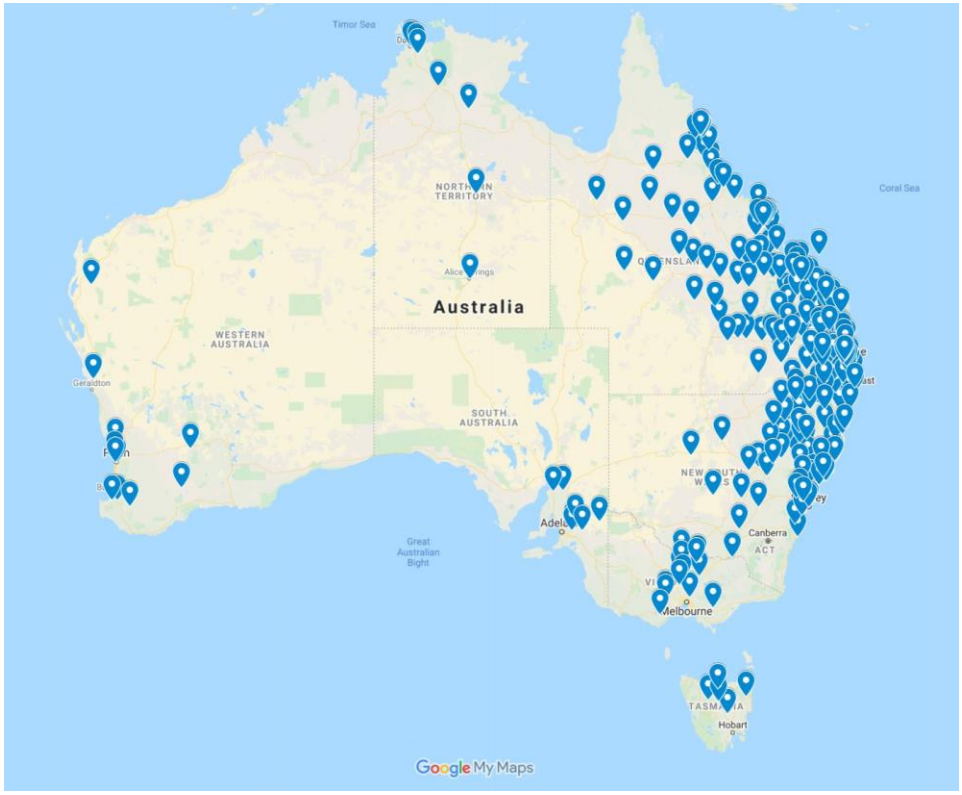
1. Background

The Tropical Beef Technology Services (TBTS) project, which commenced on 1 July 2016, was a joint initiative between Meat and Livestock Australia (MLA), the Agricultural Business Research Institute (ABRI), the Queensland Government's Department of Agriculture and Fisheries (DAF) and seven breed associations representing tropical cattle breeds that are predominantly run in Northern Australia. These breed associations were the Australian Brahman Breeders' Association, Australian Brangus Cattle Association, Australian Simbrah, Belmont Australia, Droughtmaster Australia, Santa Gertrudis Breeders' (Australia) Association and the Australian Senepol Cattle Breeders Association. This TBTS project commenced with one FTE (Paul Williams), however in February 2017 Tim Emery joined TBTS for the remainder of the project on secondment from DAF.

The TBTS project continued the work of five previous projects dating back to the commencement in August 1997. The project provided a range of innovative extension and technical support activities to maximise the use and understanding of BREEDPLAN and related genetic technologies in the Northern Australian beef industry. These activities included the provision of technical support to stakeholder breed associations (via technical committees, boards and/or association staff) and one-on-one support to their seedstock producer members (both remotely and on-property), who were located across the breadth of the country (Fig. 1). Other activities, delivered to a mix of seedstock producers, commercial producers and beef industry personnel, included the facilitation of in-person (e.g. workshops, forums and field days) and electronic (e.g. webinars) events, the provision of written documentation (e.g. bi-annual magazine and individual technical articles) and the production of electronic media (e.g. short videos) on a wide range of cattle breeding and genetics topics. One-on-one consultations with commercial producers on-farm have also been undertaken.

Figure 1. Location of members of TBTS stakeholder breed associations (as of February 2021). Map created using Google My Maps (https://www.google.com.au/maps/about/mymaps/).



The stakeholder breed associations involved in the TBTS project registered an average of 60,664 cattle per year between 2016 and 2020 in their primary and secondary herdbooks, according to statistics published by the Australian Registered Cattle Breeders Association (ARCBA) in 2020 (Table 1). With an average of 62,672 (made up of 50% primary and 50% secondary) cattle registered in tropical breed associations in the same time period, the TBTS project had involvement with 97% of the Australian tropical cattle seedstock industry (Table 1). In a similar manner, the TBTS project involved 29% of the overall Australian seedstock industry (Table 1).

Table 1. The number of cattle registered in TBTS stakeholder, tropical and all breed associations between 2016 and 2020 (ARCBA, 2020). TBTS stakeholder breed association primary and secondary registrations are also shown as a percentage of tropical and all breed association registrations.

	Total number of cattle registered in primary and secondary herdbooks				
Year	**TBTS stakeholder breed associations**	**Tropical breed associations**	**All breed associations**	**Percentage of Tropical breeds**	**Percentage of all breeds**
2016	61,150	64,063	211,979	95	29
2017	60,301	62,261	201,408	97	30
2018	61,578	63,558	211,063	97	29
2019	58,370	59,980	200,410	97	29
2020	61,923	63,952	207,299	97	30
Average	**60,664**	**62,762**	**206,432**	**97**	**29**

In conjunction with the Southern Beef Technology Services project (SBTS; P.PSH.0714) and the Angus Australia extension program, which together represent a further 66% of the Australian seedstock cattle industry (ARCBA, 2020), the TBTS project provided an efficient and effective national extension and technical support network for the Australian beef breeding industry with particular emphasis on the seedstock sector.

2. Objectives

The project objectives were:

1. Develop and undertake extension initiatives for the Northern Australia seedstock sector based on the availability of genomics tests for fertility in the Brahman breed, the outcomes of the Brahman BIN project and the "Enabling Genetic Improvement in Tropical Breed Cattle" project.
2. Provide support to Beef Information Nucleus (BIN) projects in Northern Australia. This includes overseeing data collection, formatting and submission to the appropriate breed association and BREEDPLAN to ensure data integrity and quality.
3. Undertake extension activities and provide technical support to implement both new and existing BREEDPLAN related technologies in Northern Australia seedstock herds e.g. BREEDPLAN EBVs, Internet Solutions, BreedObject Selection Indexes, TakeStock®, Data Quality Herd Audit, Marker Assisted EBVs, Mate Selection tools and Completeness of Performance.
4. Undertake extension initiatives to inform the seedstock and beef breeding industry in general on the relevance and application of genomics technology for accelerating genetic progress in economically important production traits.

5. Maintain and support the selection indexes published by stakeholder breed associations to ensure they remain relevant to current and future markets and production systems. Manage the introduction and impacts of Version 6.2 of BreedObject. Where possible, also develop and publish Selection Indexes for stakeholder breed associations not currently doing so.

All five project objectives were met successfully.

3. Methodology

3.1 Genetic progress

The project had an objective to facilitate an increase in the rate of genetic progress of the stakeholder Breed Associations by increasing the average BreedObject selection index value of animals by $10 per cow mated between the 2014 drop (base year) and the 2019 drop calves. This equates to $2.00 per cow mated per year compared to the weighted rate of genetic progress for the Tropical Breeds of $1.50 per cow mated per year prior to the commencement of the project.

Since the beginning of the current TBTS project (1 July 2016) there have been numerous changes that have affected the measure of average weighted selection index value for the TBTS stakeholder breed associations. These include:

- Changes to the genetic parameters used within the BREEDPLAN analyses for individual TBTS stakeholder breed associations.
- The implementation of a Single-Step BREEDPLAN analysis for several TBTS stakeholder breed associations.
- The implementation of new version 6 BreedObject Selection Indexes for several TBTS stakeholder breed associations.
- New animals and additional performance data coming into the BREEDPLAN analyses for individual TBTS stakeholder breed associations over time. This influences not only the most recent calving year (2020), but also previous years as performance data is collected on older animals.

Consequently, to ensure a valid comparison of the average weighted selection index values across time, all statistics in this report that relate to objective one were calculated using the most recent BREEDPLAN analyses (collated 30 June 2021). Furthermore, as not all TBTS stakeholder breed associations publish BreedObject selection indexes, BREEDPLAN results were only collated for those TBTS stakeholder breed associations (n=4) that published BreedObject selection indexes (Table 2).

The calculation of the average weighted selection index values for TBTS stakeholder breed associations involved a number of steps. Firstly, the average selection index value was calculated for each SBTS stakeholder breed association, by calving year. Where more than one selection index was published for the given breed association, an average of these was used. The average selection index values for each breed were then combined, weighted relative to the number of animals in each breed as a percentage of the total animals in that calving year. These weightings varied across calving years, as the proportion of calves represented by a breed association varied from year to year.

The yearly change was calculated by taking the difference in the average weighted selection index values between the given year and the preceding year. For example, the yearly change for the 2016 year was calculated by subtracting the 2015 average weighted selection index value from the 2016 average weighted selection index value.

The average rate of change (3 year rolling average) was calculated by averaging the yearly rate of change in the weighted selection index for the given year and the preceding two. For example, the average rolling change (3 year rolling average) for the 2016 year was calculated by averaging the yearly rate of change in the weighted selection index from 2014 to 2016.

Table 2. Genetic progress statistics for the TBTS project were calculated using the latest BREEDPLAN genetic evaluation results (as of 30 June 2021) for the four TBTS stakeholder breed associations that published BreedObject selection indexes.

Breed	Number of Indices	Production systems represented
Brahman	2	Jap Ox, Live Export
Santa Gertrudis	2	Domestic Production, Export Production
Brangus	2	Domestic Steer, Export Steer
Belmont Red	2	Domestic, Export

3.2 Develop extension messages from Northern fertility projects

Develop and undertake extension initiatives for the Northern Australia seedstock sector based on the availability of genomics tests for fertility in the Brahman breed, the outcomes of the Brahman BIN project and the **"**Enabling Genetic Improvement in Tropical Breed Cattle" (also known as "Repronomics") projects.

3.2.1 Submission of joining data

TBTS has actively encouraged and assisted seedstock producers in the submission of joining and pregnancy data to increase the number of animals with fertility EBVs. TBTS has helped those breeds that currently don't have an EBV for Days to Calving get to a position of either having or being close to getting a Days to Calving EBV.

3.2.2 Breeding for fertility web page

TBTS created a dedicated area on the TBTS website updating fertility research conducted in Northern Australia - http://tbts.une.edu.au/seedstock-breeding-better-cattle/resources/technical-notes/

3.2.3 BREEDPLAN enhancements and reportability changes

TBTS developed extension messages for both breed society staff and members of the breed society on changes to the BREEDPLAN analysis, the introduction of single step software for Brahman and Santa Gertrudis and the inclusion of new traits and data from the Northern Multibreed Research database.

3.2.4 Technical advice to breed society Technical Committees

TBTS has representation on breed society technical committees and advises those committees on new enhancements to the BREEDPLAN analysis arising from the Repronomics Project results and other projects and makes recommendations from these outcomes to the technical committees.

3.2.5 Involvement in research projects

TBTS staff have assisted the Brahman BIN, Repronomics, Northern Genomics and Trans-Tasman beef cow productivity projects with the selection of future sires, data collection, training research staff in ultrasound scanning and with the setting of protocols for the collection of fertility traits such as post-partum anoestrus at first calf and age to first corpus luteum data.

At the commencement of the project, TBTS personnel were encouraged to provide support to MLA's Producer Demonstration Site program, particularly in relation to breeding and genetics related demonstrations. In early 2017, Tim Emery was approached to be a PDS coordinator/facilitator for a demonstration focused on artificial insemination in commercial beef operations in South-East, Southern and Western Queensland. A preliminary application was submitted and accepted in principle, but due to extremely unfavourable seasonal conditions, the PDS was put on hold and to date is still yet to commence.

3.2.6 Articles

TBTS wrote articles for breed society magazines, keeping members up to date on developments with Genomics and research projects.

3.2.7 Presentations

TBTS presented Brahman BIN and Repronomics Project overviews and preliminary results to a range of audiences from breed society boards and technical committees to industry run events.

3.3 Provide technical support to BIN projects in Northern Australia

TBTS provided support to Beef Information Nucleus (BIN) projects in Northern Australia. This included overseeing data collection, formatting, and submission to the appropriate breed society and BREEDPLAN to ensure data integrity and quality.

3.3.1 Brahman BIN

TBTS supervised collection and submission of data to the Brahman BREEDPLAN to ensure data integrity and quality. This involved identifying data collection dates, preparing data collection material and preparing data for submission to BREEDPLAN. TBTS created articles and presentations updating Brahman staff and members on the project.

3.3.2 Northern BIN

TBTS supervised collection and submission of data to the Brahman BREEDPLAN to ensure data integrity and quality. This involved identifying data collection dates, preparing data collection material, preparing data for submission to BREEDPLAN. Written articles and presentations were developed for the purpose of updating Brahman Association staff and members on the project.

3.4 Extension initiatives

A wide range of broad and targeted extension initiatives were undertaken over the duration of the TBTS project. These extension initiatives focused on improving the use and understanding of BREEDPLAN and related genetic improvement technologies across the Northern Australian cattle industry.

Extension initiatives undertaken in the TBTS project are described in more detail below. The priority placed on undertaking each of the extension activities varied across the duration of the project, to reflect the priorities of TBTS stakeholder breed associations and their members.

3.4.1 Extension to new and existing BREEDPLAN members

A range of extension activities and technical support initiatives to implement both new and existing BREEDPLAN related technologies in North Australian seedstock herds have been undertaken. For example, the Phase II Genetic Improvement Benchmarking reports provide a comprehensive herd level report including numerous benchmarking statistics in relation to genetic improvement and progress. The statistics are displayed in several sections being:

- Current genetic position
- Genetic Trends
- Genetic Improvement Key Drivers
    - Selection Intensity
    - Genetic Variation
    - Generation Length
- Phenotypic Trends

The Genetic Improvement Benchmarking report forms the basis of the Phase II on-property consultations with influential seedstock herds. Herd consultations provided an opportunity for seedstock producers to discuss performance recording and genetic progress in their own herd with a member of the TBTS project team, and to raise any questions they may have had regarding BREEDPLAN and related genetic technologies.

Each herd consultation was typically two to three hours in length. The majority were delivered in person, either on-property or at an event that both TBTS personnel and the producer were attending e.g. Regional forums or other workshops.

At each herd consultation, the seedstock producer was provided with several reports. These included:

- *A BREEDPLAN Completeness of Performance report:* This report outlined the quantity of pedigree and performance data that the seedstock herd had recorded for the 15 previous calving years. This report was used as a supporting document for discussions on how the seedstock herd could improve their performance recording levels.
- *A Genetic Progress Benchmarking report:* This report contained detailed information about the herd's breeding program and included statistics on the herd's current genetic position, their genetic trends and key genetic improvement drivers, all benchmarked against the relevant breed. This report was used as a supporting document to discuss genetic progress and opportunities for future improvement.

- And reference documents:
  - "Maximising Genetic Improvement" TechNote.
  - "Understanding Selection Indexes" Tip Sheet.
  - "A Guide to Performance Recording" Booklet.

3.4.2 SBTS & TBTS Update magazines

The SBTS & TBTS Update magazine was a joint initiative of the SBTS and TBTS projects. Produced on a bi-annual basis, the Update magazine was an effective extension avenue for keeping stakeholder breed associations and their seedstock producer members informed on current developments in the genetic technologies area whilst also providing information on any upcoming extension initiatives.

Each SBTS & TBTS Update magazine was distributed in the following ways:

- A hard copy version was posted to all BREEDPLAN members of SBTS & TBTS stakeholder breed associations.
- An electronic version was distributed via e-news mailing lists to BREEDPLAN and non-BREEDPLAN members of the SBTS and TBTS stakeholder breed associations with an email address.
- An electronic version was distributed via e-news mailing lists to a list of personnel working in the Australian beef industry. This included ultrasound scanners, staff from beef research institutions (e.g. AGBU, CSIRO and the University of Queensland), beef extension personnel (e.g. private consultants, NSW LLS and state DPI staff), MLA and Sheep Genetics Australia (SGA) staff and genotyping service providers (e.g. Neogen and Zoetis).
- An electronic version was made available on the SBTS and TBTS websites and via the SBTS and TBTS social media platforms (Section 3.4.4). Since 2019, individual stories that had been published in the SBTS & TBTS Update magazines were also shared via the SBTS and TBTS social media platforms.
- In addition, an electronic copy was provided to each stakeholder breed association for wider distribution via their own electronic mailing lists.

A range of statistics relating to the electronic SBTS & TBTS Update magazine distribution to SBTS and TBTS stakeholder breed association members and beef industry personnel were collected. These included the total number of opens of each SBTS & TBTS Update magazine, and the total number of reads for each individual article. There was no way to collect similar statistics for hard copy distribution.

While all SBTS and TBTS project personnel contributed written articles for each SBTS & TBTS Update magazine, SBTS project personnel were primarily responsible for the production, including editorial roles, and distribution of each SBTS & TBTS Update magazine.

3.4.3 General industry events

Throughout the duration of the project, TBTS personnel were invited to present at a number of beef industry events. This allowed the TBTS team to present genetics extension messages to a wide audience, including seedstock producers, commercial producers, agents, youth and industry service providers. Throughout most of the project, these presentations were typically presented in-person.

Industry events where TBTS personnel presented in-person included:

- *Events run by TBTS stakeholder breed associations:* These included conferences, annual general meetings (AGMs) and youth events, and were typically attended by members of the relevant association. Consequently, these types of events were usually focused on extension to seedstock beef producers.
- *Events run by individual members of a TBTS stakeholder breed association:* These included field days run by an individual seedstock producer and were typically attended by commercial producer clients and agents. Consequently, these types of events were usually focused on extension to commercial beef producers.
- *Scientific conferences:* These were attended by a range of researchers, extension personnel and, in some cases, where industry days were included on the program, seedstock beef producers. Presentations at these types of events were either focused on extension to seedstock producers or focused on the role of the TBTS project in extension messaging.
- *MLA events:* These included Breeding EDGE workshops, BredWell FedWell workshops and BeefUp Forums and were mainly attended by commercial producers, but also seedstock producers and service providers.
- *Events run by other industry organisations:* These included field days, information days, workshops, conferences, project meetings and producer group meetings. Most of these events were targeted at commercial producers, but were also attended by seedstock producers and service providers.

Industry events where TBTS personnel presented via electronic means included:

- *Webinars run by government organisations:* As was the case with in-person events of this type, these webinars were typically attended by commercial beef producers. Consequently, extension messaging was targeted at commercial beef producers.
- *Webinars run by MLA:* Extension messaging was targeted mainly at commercial producers, with seedstock producers and service providers also able to benefit from viewing.
- *Webinars run by Angus Australia:* This was a collaborative approach to upskilling Northern service providers, with support from MLA.

3.4.4 Social media

The TBTS project utilised several social media platforms as additional channels to disseminate information relating to the application and utilisation of genetic technologies to beef producers around Australia.

3.4.4.1 SBTS & TBTS Facebook account

A joint Facebook account (https://www.facebook.com/SBTSTBTS) was run in conjunction with the SBTS project. The Facebook channel was used to share a range of content, including:

- Information about upcoming SBTS and TBTS project activities, such as Regional Forums (Section 3.4.5).
- SBTS & TBTS publications and resources, including the SBTS & TBTS Update magazine (Section 3.4.2) and e-media content.
- Other information of relevance, such as articles produced by the Australian media which related to the use and understanding of genetic technologies.

3.4.4.2 SBTS & TBTS Twitter account

A joint Twitter account (https://twitter.com/SBTSTBTS) was run in conjunction with the SBTS project and was used to share content similar to that described for the Facebook channel (Section 3.4.4.1).

3.4.4.3 SBTS & TBTS YouTube channel

The TBTS and SBTS projects used a joint YouTube channel (https://www.youtube.com/sbtstbts) to share e-media content produced by the teams. This included both recordings of webinars (Section 3.4.6) and short videos.

3.4.5 Regional forums

Three single-day regional forum programs were delivered at multiple locations around Australia by TBTS and SBTS project personnel. These regional forum programs were designed for seedstock beef producers and covered a range of topics relevant to BREEDPLAN and related genetic technologies. Each regional forum program was designed to be interactive, with discussion encouraged throughout the day. This allowed producers to learn not just from the facilitators but also from each other, and to share their own experiences on how to best utilise BREEDPLAN in their businesses.

Electronic feedback devices were used at each regional forum to collect a range of demographics, feedback and also to measure learning outcomes. These learning outcomes were obtained by asking attendees a number of questions both before and after each regional forum and measuring the percentage of attendees who correctly answered each question at each time point.

With members of TBTS stakeholder breed associations located across much of Australia (Fig. 1), regional forum locations were selected to ensure that the majority of stakeholder breed association members were within a three hour drive of a regional forum venue.

3.4.5.1 2017 & 2018 regional forums

The first of these regional forum programs was offered at a number of locations around Australia throughout 2017 and early 2018. While initially regional forums were only offered throughout the 2017 year, several of the regional forums scheduled for 2017 had to be cancelled due to a lack of registrants.

The 2017 and 2018 regional forum program was designed for seedstock producers and covered a wide range of BREEDPLAN topics (Table 3). The regional forum was designed with a broad range of seedstock producers in mind; from those that had recently joined BREEDPLAN through to those who had been using BREEDPLAN within their businesses for some time.

Table 3. Topics covered at the 2017 & 2018 Regional Forums.

Order	Topic	Duration (minutes)
1	Welcome	15
2	BREEDPLAN 101: Recording Performance Information in Your Herd.	45
3	BREEDPLAN Contemporary Groups & Genetic Linkage.	45
4	Making BREEDPLAN Work For You: Common Performance Recording Problems and How to Avoid Them.	60
5	How Much Performance Data Do You Collect? Interpreting Your Completeness	45

	of Performance Report.	
6	Are You Making Progress: Interpreting Your Genetic Progress Report.	45
7	Single-Step BREEDPLAN: What Does Genomics Mean For You?	60
8	Closing Remarks.	15

3.4.5.2 2019 regional forums

Following the success of the single-day regional forum program delivered in 2017 and 2018, two single-day regional forums were developed by the SBTS project, with some input from TBTS personnel. The decision to offer two distinct programs was made following feedback from a number of stakeholder breed association members. These programs were delivered across two consecutive days at multiple locations around Australia in 2019, with the first day covering BREEDPLAN fundamentals and the second day focusing on DNA technologies.

The BREEDPLAN Fundamentals program on day one was designed for seedstock producers who were new to BREEDPLAN recording or who wished to refresh their BREEDPLAN knowledge. It covered a range of topics (Table 4), including the role of genetics in beef breeding and the data collection and submission process. Attendees also learnt how to interpret BREEDPLAN reports for their herds.

Table 4. Topics covered at the BREEDPLAN Fundamentals regional forum.

Order	Topic	Duration (minutes)
1	Welcome.	15
2	The Role of Genetics in Beef Breeding.	30
3	BREEDPLAN: From Paddock to EBVs.	60
4	BREEDPLAN: Analysis and Beyond.	45
5	Making BREEDPLAN Work for You.	45
6	BREEDPLAN Resources.	30
7	BREEDPLAN Completeness of Performance.	60
8	Utilising BREEDPLAN to Improve Your Herd.	60
9	Feedback & Closing Remarks.	15

The Getting the Most Out of BREEDPLAN: DNA Technologies program on day two was designed for seedstock beef producers who wished to gain a deeper understanding of the application of DNA technology for beef breeding. A range of topics were covered (Table 5), including parentage verification, genetic conditions and the use of DNA information in BREEDPLAN analyses. Attendees were also provided with a genetic progress report, which allowed them to benchmark their current genetic position and identify whether their level of genetic progress for each trait.

The 'Getting the Most Out of BREEDPLAN: DNA Technologies' program on day two was designed for seedstock beef producers who wished to gain a deeper understanding of the application of DNA technology for beef breeding. A range of topics were covered (Table 5), including parentage verification, genetic conditions and the use of DNA information in BREEDPLAN analyses. Attendees were also provided with a genetic progress report, which allowed them to benchmark their current genetic position and identify their level of genetic progress for each trait.

While TBTS strongly encouraged beef producers to attend both days of the 2019 regional forum program, attendees could opt to attend a single day only (either day one or day two) if they preferred. TBTS also encouraged multiple attendees from a single beef operation to attend. This was encouraged through pricing incentives.

Table 5. Topics covered at the 'Getting the Most Out of BREEDPLAN: DNA Technologies' regional forum.

Order	Topic	Duration (minutes)
1	Welcome.	15
2	BREEDPLAN Refresher.	30
3	Benchmarking Your Herd: CoP and Genetic Progress.	60
4	DNA Technology for Beef Breeders: Parentage Verification.	45
5	DNA Technology for Beef Breeders: Genetic Conditions.	45
6	DNA Technology for Beef Breeders: Single-Step BREEDPLAN.	75
7	What Does DNA Technology Mean for You?	45
8	Feedback & Closing Remarks.	15

3.4.5.3 2020 regional forum

Following the success of the previous regional forum programs delivered in 2017, 2018 and 2019, the decision was made to offer a one-day Regional Forum in Malanda on the Atherton Tablelands. The program was a mixture of the BREEDPLAN fundamentals and DNA technologies previously presented in 2019. Topics discussed are listed in Table 6.

Table 6. Topics covered at the Malanda Regional Forum.

Order	Topic	Duration (minutes)
1	Welcome.	15
2	The Role of Genetics in Beef Breeding.	30
3	BREEDPLAN: From Paddock to EBVs.	45
4	BREEDPLAN: Analysis and Beyond.	30
5	Making BREEDPLAN Work for You.	30
6	BREEDPLAN Resources.	30
7	Utilising BREEDPLAN to Improve Your Herd.	30
8	DNA Technology for Beef Breeders: Parentage Verification.	30
9	DNA Technology for Beef Breeders: Genetic Conditions.	30
10	DNA Technology for Beef Breeders: Single-Step BREEDPLAN	45
11	What Does DNA Technology Mean for You?	30
12	Feedback & Closing Remarks.	15

3.4.5.4 Regional forum follow-up survey

In 2020, although TBTS were not directly involved, the SBTS team conducted a follow-up survey with those individuals that had attended one of the SBTS & TBTS regional forums held in 2019 (Section 3.4.5.2). This survey was undertaken to identify any practice change that a regional forum attendee may have undertaken in the six to 12 month period following their attendance at a 2019 SBTS &

TBTS regional forum. Those surveyed were also asked a number of questions to assist with future planning of SBTS & TBTS regional forums. This included how often they believed a regional forum should be held, how far they were willing to travel, whether they were prepared to listen to preparatory material prior to the event and their interest in a range of potential topics.

The follow-up survey was undertaken using Qualtrics (https://www.qualtrics.com), a web-based survey program. Responses were anonymous unless the individual chose to identify themselves.

3.4.6 Webinars

In 2016, TBTS personnel (Paul Williams) ran a webinar series in conjunction with SBTS personnel. The webinar series included six webinars of 60 minutes in length, which each covered a different topic relating to the use of BREEDPLAN information in breeding decisions and/or collection of performance data for BREEDPLAN (Table 7). The webinars were run on a fortnightly basis and were scheduled for the evening to allow those in states such as Western Australia to join once they had finished work for the day. They were delivered using the online webinar platform GoToWebinar (https://www.gotomeeting.com/en-au/webinar). Feedback was gathered from attendees at the conclusion of each webinar. Each webinar was recorded, and the recording was made available for viewing via the SBTS & TBTS YouTube channel (Section 3.4.4.3).

Table 7. Six webinars were run by TBTS and SBTS project personnel over the duration of the project.

Webinar	Year	Webinar Topic	Webinar Presenter (Organisation)
1[A]	2016	Choosing Bulls to Suit Your Program	Catriona Millen (SBTS) & Paul Williams (TBTS)
2[B]	2016	Getting It Right: Management Groups & Contemporary Groups	Alex McDonald (SBTS) & Catriona Millen (SBTS)
3[A]	2016	Making BREEDPLAN Work for You: Performance Recording Problems to Avoid	Catriona Millen (SBTS) & Paul Williams (TBTS)
4[A]	2016	Fertility Matters: Recording Fertility Information with BREEDPLAN	Paul Williams (TBTS) & Alex McDonald (SBTS)
5[B]	2016	Collecting Abattoir Carcase Information for BREEDPLAN	Alex McDonald (SBTS) & Catriona Millen (SBTS)
6[B]	2016	Where to With Genomics?	Catriona Millen (SBTS) & Boyd Gudex (SBTS)

[A] Run in conjunction with SBTS project personnel. [B] Run by SBTS staff.

3.4.7 Attendance at industry events

In addition to attending beef industry events where they had been invited to present (Section 4.4.4 and 4.7.1), TBTS personnel attended a number of other industry events throughout the duration of the project, including beef industry workshops, scientific conferences, breed conferences, MLA events, herd recording days and producer forums. TBTS attendance at these industry events served a dual purpose; firstly, attendance at these events allowed TBTS project personnel to keep updated on developments and research relevant to the beef industry. This had obvious implications for the development of timely and relevant extension messaging to the wider beef industry. Secondly, attendance at these events allowed TBTS personnel to forge stronger relationships with TBTS stakeholder breed association staff and their seedstock producer members, as well as others in

attendance at these events. While difficult to quantify, the benefits of maintaining strong professional relationships with those you are directing extension messaging towards cannot be overstated. Additionally, having a presence at industry events provided the platform to raise further awareness of the TBTS project.

3.4.8 Articles for TBTS stakeholder breed association publications

Throughout the duration of the TBTS project, a number of articles covering a wide range of topics relating to BREEDPLAN and the use of genetics in cattle breeding were prepared by TBTS personnel for stakeholder breed association publications. Articles were written on a request basis, and included articles for stakeholder breed association magazines, newsletters, sale catalogues and websites.

Where possible, articles prepared for stakeholder breed association publications were sourced from previously existing documentation (e.g. individual SBTS & TBTS Update magazine articles); however, this was not always possible and a number of these articles were prepared from scratch. In these cases, the TBTS team aimed to maximise the reach of these articles by using them as widely as possible (e.g. in future SBTS & TBTS Update magazines and/or in other stakeholder breed association publications).

3.4.9 Written documentation

In addition to the SBTS & TBTS Update magazine (Section 3.4.2), the TBTS project team collaborated with the SBTS project team to produce a number of short stand-alone technical articles. These were made available via the TBTS website. Additionally, a number of these articles were produced in hard copy format and distributed at events that the SBTS and TBTS project teams attended e.g. Beef Australia 2018 and Beef Australia 2021 (Section 3.4.7). These technical articles took two main formats, namely the SBTS & TBTS Technical Notes and the 'A Seedstock Producer's Perspective' Case Studies:

- *SBTS & TBTS Technical Notes*

  The SBTS & TBTS Technical Notes were an easy-to-read series of articles that covered a range of topics relating to the use of genetic technologies in cattle breeding. Across the duration of the TBTS project, several new SBTS & TBTS Technical Notes were developed. These included articles that had been previously written for the SBTS & TBTS Update Magazine (Section 3.4.2); reproducing these articles in a stand-alone format made them accessible to a wider audience as they could be found without having to search through the entire magazine.

  In addition, all existing SBTS & TBTS Technical Notes were updated into a new format in the first year of the TBTS project. The SBTS project team took primary responsibility for this reformatting, and also maintained the SBTS & TBTS Technical Notes for the duration of the project.

- *'A Seedstock Producer's Perspective' Case Studies*

  The 'A Seedstock Producer's Perspective' Case Studies were developed from 2020 onwards, as a response to requests for extension material that included seedstock producer case studies. While a specific member of the TBTS and SBTS project teams took primary responsibility to work with an individual seedstock producer to produce the case study, all members of the SBTS and TBTS project teams were involved in identifying case study topics. Each of these case studies

was initially published in the SBTS & TBTS Update magazines (Section 3.4.2); however, for similar reasons to those discussed above for the SBTS & TBTS Technical Notes, they were subsequently published as stand-alone articles.

3.5 Technical advancement and support

TBTS undertook extension initiatives to inform the seedstock and beef breeding industry in general on the relevance and application of genomics technology for accelerating genetic progress in economically important production traits.

For the duration of the TBTS project, TBTS project personnel provided technical support and advice to assist with the implementation of new genetic improvement technologies and to increase the uptake of existing technologies for TBTS stakeholder breed associations and their seedstock members.

3.5.1 Technical support for TBTS stakeholder breed associations

Throughout the duration of the TBTS project, TBTS project personnel provided dedicated technical support and advice to stakeholder breed associations. This was done through the provision of technical papers and telephone and/or email consultation and attendance at breed association board and/or technical meetings.

Technical support and advice provided by TBTS project personnel included, but was not limited to:

- *Support and advice regarding upgrades to the stakeholder breed association BREEDPLAN analysis:* Technical upgrades made to some stakeholder breed association BREEDPLAN analyses during the TBTS project included:
    - New BREEDPLAN EBVs.
    - Revised analytical software and/or parameters.
    - Revisions to how crossbred animals are handled within the BREEDPLAN analysis (e.g. changing from a purebred BREEDPLAN analysis to a crossbred BREEDPLAN analysis).

  TBTS Technical Officers worked with stakeholder breed associations to ensure that the implications of these changes were understood by stakeholder breed association staff and boards, and provided technical explanations which were disseminated to TBTS stakeholder breed association members.
- *Support and advice in utilisation of DNA technologies*: This included discussions around parentage verification and advice on genetic tests for disease and/or qualitative traits. Support was also provided to TBTS stakeholder breed associations as they transitioned towards Single-Step BREEDPLAN, including advice on the development of a reference population and considerations to maintain a reference population into the future.
- *Support of and advice on additional ABRI products relating to genetic improvement:* This included advice on Completeness of Performance, GeneProb and MateSel services. Advice took the form of assistance in the interpretation of results and the provision of technical information to be disseminated to stakeholder breed association members.
- *Support and development of BreedObject Selection Indexes*: This included development of Selection Indexes using new version 6 BreedObject software for TBTS stakeholder breed

associations and the creation of associated extension material for dissemination to stakeholder breed association members.

3.5.2 Technical support for TBTS stakeholder breed association members

TBTS project personnel provided technical support and advice to members of TBTS stakeholder breed associations for the duration of the TBTS project. In most cases, support was provided via day-to-day telephone and email consultation. In-person support was also provided at events run by or attended by TBTS project personnel and during property visits.

Technical support and advice provided by TBTS project personnel included, but was not limited to:

- Support in understanding, interpreting and utilising BREEDPLAN EBVs.
- Support in understanding, interpreting and utilising BreedObject Selection Indexes.
- Provision of general advice on performance recording and assistance in assigning management groups in complex situations.
- Support in utilising the 'Internet Solutions' search facility and the tools available (e.g. the Mating Predictor).
- Provision of EBV diagnostics (e.g. explanation of why a particular animal had a particular EBV and/or why a particular EBV had changed between BREEDPLAN analyses). These enquiries had the potential to get quite complex and often took up a significant amount of time for the investigating TBTS Technical Officer. Some complex diagnostic enquiries also required the investigating TBTS Technical Officer to collaborate with BREEDPLAN and/or AGBU staff.
- Assisting producers to understand and interpret their BREEDPLAN Completeness of Performance reports. This often included advice on how an individual herd could collect additional performance data to improve their Completeness of Performance star rating.
- Support in understanding and interpreting the MateSel product. This included the provision of advice to those that were considering using MateSel, and, for those that had used MateSel, assistance in interpreting MateSel results.
- For members of TBTS stakeholder breed associations that had not yet implemented genomics, assistance in understanding how genomics would work, test options and the benefits that genomics was expected to bring to producers.
- For members of TBTS stakeholder breed associations that had implemented genomics, advice and support in deciding which animals to genotype and in understanding the effect that genomics was having on their EBVs. For some producers, support was also provided to explain why genotypes were excluded from the analysis.
- Assisting producers to understand how to display BREEDPLAN information in sale catalogues.
- Support in understanding what is available in their member download area and what particular aspects they should pay attention to e.g. outlier reports.

3.5.3 General articles

TBTS provided written articles to go into breed societies magazines and online publications. This included updates on Northern Research Projects, new advancements with DNA parentage and introduction of genomics into the BREEDPLAN analysis. In addition, documents targeted at commercial producers and one to two pages in length were generated for handing out at events and included in forum booklets. Furthermore, articles featuring TBTS personnel appeared in the MLA

Feedback magazine, Beef Central and the Queensland Country Life. The general topics covered were searching for EBVs online and bull buying considerations.

3.6 Maintain, support and development of selection indexes

TBTS provided support and development of BreedObject Selection Indexes: This included development of Selection Indexes using new version 6 BreedObject software for TBTS stakeholder breed associations and the creation of associated extension material for dissemination to stakeholder breed association members.

3.7 Additional approaches for driving the adoption of BREEDPLAN in Northern Australia

The TBTS Operational Plan included a critical objective of targeting commercial producers to increase their knowledge and understanding of BREEDPLAN and related genetic technologies. TBTS staff member, Tim Emery, spent significant time focussed on this objective and used a range of approaches to drive adoption, including:

- Not promoting the adoption of genetic technologies/tools as the 'silver bullet', but more so as one part of the process, and talked about in conjunction with other key aspects of the business, to improve productivity and profitability. When discussing bull buying considerations, EBVs were always discussed alongside breeding objectives, BULLCHECK, temperament and structure, and research project insights.
- Presenting EBV proof of profit examples from rigorous research projects, BINs and producer demonstration sites that have been undertaken across years, locations, breeds and investigated various production traits. By doing so, the audience gained confidence in the practical application of EBVs more broadly.
- Attaining an understanding of the audience's knowledge of EBVs prior to delivery, or early on in the presentation, in order to tailor the technical level of the presentation and create stronger engagement with the audience.
- Preparing presentations that could be delivered using power point/ a white board/flip charts/tip sheets or a combination of both as prompts, or delivered without any prompts. Access to power and internet can often be limited at locations across regional Australia and so it is important to have multiple options available to illustrate a process or message. Throughout the project, navigating BREEDPLAN was often done live on the internet but the backup options included screenshots on slides or large-scale flip charts/individual tip sheets.
- Accepting invitations to present at both face-to-face and online events despite the small scale nature of some audiences. If someone is willing to commit time to learning, it's important to try and support them.
- A willingness to deliver presentations after hours and on weekends so that those beef businesses who receive an off-farm income have a better chance of attending the event.
- Being open to teaming up with various industry service providers so that producers have the chance to hear about multiple relevant topics at one event, and are making best use of their time off-farm.
- Visiting individual producers or producer groups on-farm multiple times to build rapport, gain a detailed understanding of their business/property/future direction and provide follow up support. Producers were taken through a 'step by step' process of navigating Internet Solutions to identify animals aligned with their breeding objectives.

- Making a conscious effort to attend industry events, bull sales and regular cattle sales, to provide producers with the opportunity to have follow up conversations or initial conversations in person.
- Providing follow up telephone calls/emails to producers after events to ascertain if they require further clarification on technical content or would like to be sent additional resources.
- Upskilling industry service providers who heavily influence the decision making of producers. By doing so, they can provide ongoing on-farm support.
- Taking up every opportunity to provide event attendees with BREEDPLAN related documentation. The two most widely circulated documents to producers were 'Do EBVs really work?' and 'Where does this animal rank? Introducing the EBV Percentile Graph'.
- Promotion of the EBV percentile graph as a quick way to ascertain the genetic merit of an animal for various traits.

4. Results

4.1 Genetic progress

Facilitate an increase in the rate of genetic progress of the Stakeholder Breed Associations by increasing the average BreedObject selection index value of animals by $10 per cow mated between the 2014 drop (base year) and 2019 drop calves. This equates to $2.00 per cow mated per year compared to the current weighted rate of genetic progress for the Tropical Breeds of $1.50 per cow mated per year.

The average weighted Selection Index value for the stakeholder breed societies has been re-calculated based on the latest BREEDPLAN genetic evaluation results available as of June 2021. These results come from the breed societies with selection indices published - Brahman, Brangus, Santa Gertrudis, and Belmont Red.

The average weighted selection index and the weighted rate of change (3-year rolling average) for each calving year since 2014 are reported in Table 8. The average weighted selection index for the 2014 calving year was $21.24 and the average annual increase over the four previous years was $1.14. To achieve the goal of increasing the weighted average selection index by $10 over five years, the weighted average selection index for 2019-born animals needs to increase to $31.24. At the current time the average index value for 2019-born animals is $26.90.

Table 8: Summary of genetic progress for the calving years 2014 to 2020

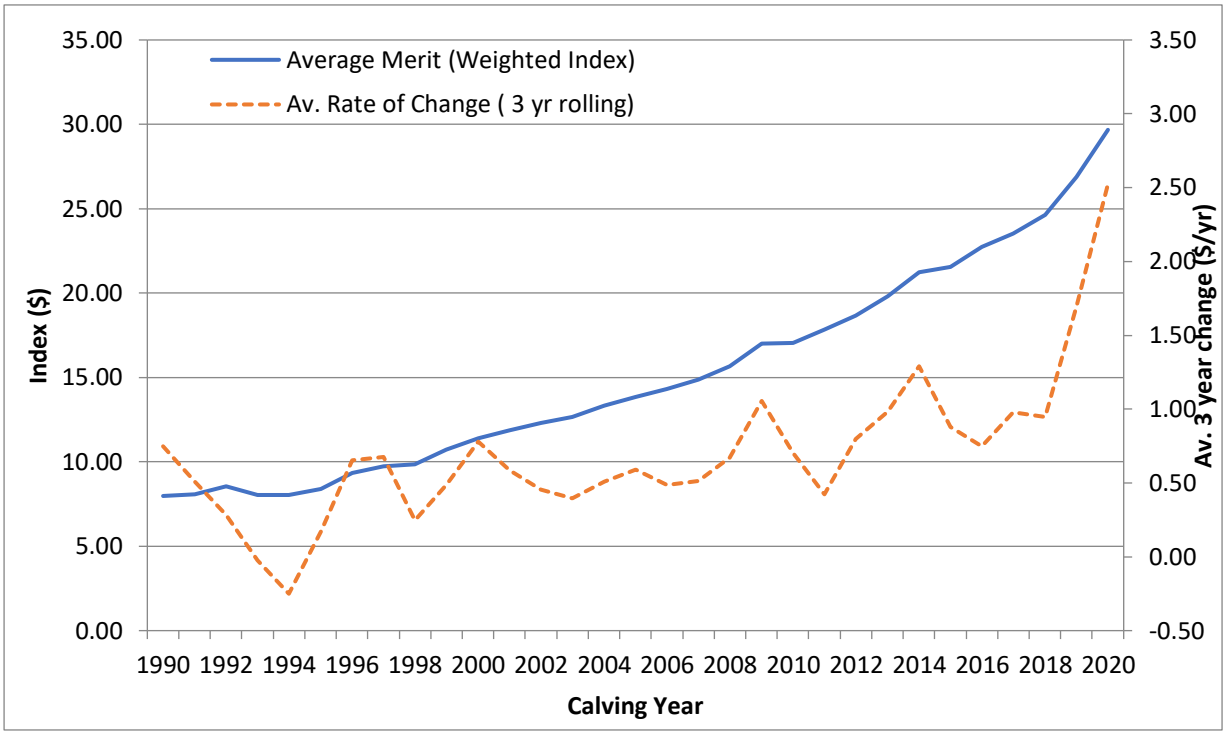
Calving Year	# Animals	Av. Weighted Selection Index ($)	Av. Weighted ΔG ($)
2014(base)	24,441	21.24	1.29
2015	24,162	21.56	0.88
2016	25,402	22.73	0.75
2017	25,561	23.51	0.98
2018	25,208	24.63	0.95
2019	24,723	26.90	1.69
2020	19,451	29.62	2.52

The 3-year rolling average of the weighted selection index for the stakeholder breeds has averaged $0.75 per cow mated for the 2016 calving year before rising to $0.98 for the 2017 born animals. Subsequently the 3-year-rolling average has increased to $0.95 for the three years to 2018, increased to $1.69 for the three years to 2019 and $2.52 for the three years to 2020.

Care should be taken when interpreting the 2020 figures as there are currently less 2020-born animals being analysed than in the previous calving years. This number will increase as additional animals and performance are analysed for the 2020 born animals in future analyses. It is likely that the rate of increase will align more with the past years as more data is included.

Fig. 2 shows the average weighted selection index from the 1990 to 2020 calving years and the 3-year rolling average change. The weighted average increased from $7.98 per cow mated in the 1990 calving year to $29.62 per cow mated in the 2020 calving year.

Figure 2. Average weighted selection index for Tropical Beef Technology Services stakeholder breeds with selection indices published (as of June 2021).



4.2Develop extension messages from Northern Fertility Projects

Develop and undertake extension initiatives for the Northern Australia seedstock sector based on the availability of genomics tests for fertility in the Brahman breed, the outcomes of the Brahman BIN project and the ”Repronomics” project.

The identification of genetic differences in fertility for both puberty and post-partum anoestrus has been one of the major outcomes from both the CRC and Repronomics Projects. As a result, during on–property consultations with influential seedstock herds, a focus has been on recording performance data for the current fertility EBVs - Days to Calving and Scrotal Size.

4.2.1 Submission of joining data

There has been a significant increase in the number of performance records submitted for the Brahman breed’s Days to Calving EBV analysis, with over 90 000 natural joining records submitted since the start of the project in 2016. Table 9 shows the number of fertility-related records added annually from 2016 to 2021 for the main tropical breeds. TBTS has spent a large amount of time during property visits and in presentations talking about the importance fertility plays in the

northern beef industry. Results out of the Repronomics and Brahman BIN projects have had a large effect on the number of records being submitted to BREEDPLAN as described below. Brahmans have continued to have a large number of joining records submitted to BREEDPLAN over the last five years, with over 50,000 records submitted.

Table 9. Summary of submissions of female fertility records by breed.

	2016	2017	2018	2019	2020	2021
Brahman						
Natural	11,881	9,633	6,016	10,986	8,668	7,174
AI	3,203	1,217	113	495	152	13
Preg test	6,313	6,032	2,548	5,891	5,223	3,734
Total	21,397	16,882	8,677	17,372	14,043	10,921
Brangus						
Natural	175	116	0	6,339	107	78
AI	0	1	0	805	1	0
Preg test	0	96	0	66	76	67
Total	175	213	0	7,210	184	145
Droughtmaster						
Natural	2,068	222	2,243	0	577	41
AI	798	0	98	0	56	0
Preg test	2,841	0	468	0	385	0
Total	5,707	222	2,809	0	1,018	41
Santa Gertrudis						
Natural	6,776	1,865	6,511	4,075	2,055	1,285
AI	557	111	360	664	60	4
Preg test	667	1,016	2,404	1,269	549	3
Total	8,000	2,992	9,275	6,008	2,664	1,292
Belmont Red						
Natural	0	755	2,153	1,467	264	1442
AI	0	35	243	2	0	0
Preg test	0	270	960	1,388	264	817
Total	0	1060	3356	2857	528	2259

- The number of records submitted for Santa Gertrudis have been encouraging but the level of submissions variable. Santa Gertrudis breeders have submitted over 23,000 during the current project.
- Hopefully the introduction of the Days to Calving EBV for Droughtmaster in 2020 will lead to an increase in data submitted by this breed. Before 2016 approximately 1,000 records had been submitted to BREEDPLAN but over the duration of the project an additional 5,000 records have been submitted to BREEDPLAN.

- Belmont Red had no records submitted in 2016 but resumed submitting records during 2017 and increased again in 2018-19. In2021, it is extremely positive to see that 100% of females had joining records submitted.
- Brangus are attempting to submit the required number of calving records for AGBU to look at the Days to Calving analysis and therefore the possible introduction of the Days to Calving EBV for the breed. Encouragingly, the joining records submitted for Brangus have increased from a few hundred records prior to 2016 to over 6,500 records submitted during the last five years.
- In addition to the joining records, TBTS has been actively engaged in advising seedstock producers to also submit pregnancy test results with the joining records if they have recorded it. This data will be used by AGBU as research data looking at the possibility of incorporating that information into improving the Days to Calving EBV. Over 40,000 pregnancy test results have been submitted over the last five years as well the joining records.
- Joining records from the Repronomics Project (over 5,000 records between Brahmans, Droughtmaster and Santa Gertrudis) are not reflected in Table 9 as they are not submitted to society databases, but are stored in the Northern Multibreed Research Database.

4.2.2 Breeding for fertility web Page

A section dedicated to breeding for fertility is on the TBTS website (http://tbts.une.edu.au/seedstock-breeding-better-cattle/resources/technical-notes/). This web page currently includes a range of tip sheets related to genetic improvement for fertility and several recorded webinars covering "*Genetics for Reproduction – The Male Influence*", "*Genetics for Reproduction – the Female Influence" and "Fertility Matters: Recording Fertility Information with BREEDPLAN".* At the time of writing this report, these three webinars have been viewed 609, 750 and 204 times respectively.

4.2.3 BREEDPLAN analysis enhancements and reportability changes

Incorporation of Single-Step into BREEDPLAN

The Australian Brahmans Breeders' Association was the first breed society in Australia to have a Single-Step BREEDPLAN analysis in April 2017. Santa Gertrudis introduced the Single-Step BREEDPLAN analysis in March 2021 and Droughtmasters are in the process of moving towards single step soon. Currently the number of animals that have genomics analysed in the BREEDPLAN analysis are 28,724 for Brahman and 5,945 for Santa Gertrudis.

Overall, the most important effects of the switch to Single-Step BREEDPLAN are that:

- Genomic information will contribute to all EBVs that are calculated within the main multi-trait BREEDPLAN analysis.
- The Days to Calving EBV now incorporates information from research data on two genetically correlated traits – first lactation anoestrous interval and heifer age at puberty.
- Unknown parents may be identified (provided the animals have genomic information available).
- Genomic information will contribute to not only the EBVs of the animal that has been genotyped, but will also contribute to the EBVs for the animal's relatives (e.g. parents,

progeny). This is unlike blending where the genomic value was only included into the individual's own EBV (not its parents or progeny).

- With a traditional pedigree-based approach, the relationships between animals within BREEDPLAN are determined by pedigree alone. For example, pedigree would predict that the genetic relationship between full siblings (i.e. animals with the same sire and dam) is 0.5. This means that full siblings are predicted to have 50% of genes in common when calculating traditional pedigree-based breeding values. Now in single step the relationship between individuals is determined using their SNP genotypes and will vary from the previously assumed average relationship. In the case of full sibs this may now vary from 0.35 to 0.65. Similarly, pedigree may assume that two animals are unrelated, but in reality, the animals may share common genes, and have a genomic relationship greater than 0.

Since the introduction of the Brahman Single-Step analysis there has been a large increase in the number of bulls being sold at Brahman Week with EBVs for Days to Calving and Scrotal Size. In 2016, in the first year of the current project, only 7% of 890 bulls in the Brahman Week catalogue had a Days to Calving EBV and 15% had a Scrotal Size EBV. Of those 890 bulls, 40% now have an EBV for Days to Calving and 46% for Scrotal Size in the July 2021 BREEDPLAN run. When looking at the 2020 Brahman Week sale, of the 860 bulls in the catalogue, 57% had an EBV for Days to Calving and 60% for Scrotal Size. This equates to over 430 more Brahman Week bulls that could be selected for fertility in 2020 than 2016.

Inclusion of data from Northern Multibreed Research Database

Inclusion of intensive phenotypic records collected as part of the Repronomics Project over six years, has now been included in the Brahman, Droughtmaster and Santa Gertrudis evaluations. This comprehensive dataset represents over 250 sires across the three breeds, many of which previously had no EBVs available. The data includes over 5,000 animals (Droughtmaster, Brahman and Santa Gertrudis) that have been recorded for the full range of BREEDPLAN traits including: gestation length, birth weight, 200, 400, 600 day weights, mature cow weight, ultrasound scans, flight time, and abattoir carcase and meat quality traits. The females have days to calving records, along with the new measures of heifer age at puberty and lactation anoestrous interval of first-calf cows, but until Droughtmaster go to single-step, these new measures are not included. Most of these animals also have SNP genotypes and the inclusion of this data will add significantly to the size of the genomics reference population and will help drive increased EBV accuracies through the single-step evaluation.

4.2.4 Technical advice to breed society Technical Committees

TBTS continued to discuss and advise breed society Technical Committees on the relevance of Repronomics and Northern BIN outcomes at a breed level. This has involved presentations and discussion on the incorporation of single step technology into the BREEDPLAN analyses which includes scrotal size, post-partum anoestrus period from first calf and age to first corpus luteum. It is understood that each of the stakeholder breed society technical committees have found it valuable to have access to the knowledge and skills of the TBTS staff throughout the project. TBTS personnel were also in attendance when AGBU presented the Data Quality Herd Audit for the various breeds.

4.2.5 Involvement in research projects

TBTS staff have assisted with the Brahman BIN, Repronomics, Northern Genomics and Trans-Tasman beef cow productivity projects in the selection of future sires, assisting in data collection, training research staff in ultrasound scanning and setting protocols for the collection of fertility traits such as post-partum anoestrus at first calf and age to first corpus luteum.

TBTS staff member, Paul Williams, assisted the Repronomics Project in 2019 by filling in as the AI technician when the regular AI technician was injured and unable to work. This involved performing the AI for two fixed time AI programs – 130 head at Brian Pastures (Gayndah) and 240 head at Spyglass (Charter Towers). TBTS has also assisted with training project staff members in ovarian scanning within the Repronomics project and design of ovarian scanning protocols within the Trans-Tasman beef cow productivity project. For the Northern Genomics Project, Paul Williams, attended an on-farm collaborator event where he provided valuable insight into how to score various traits such as body condition score, buffalo fly score, and temperament assessments.

4.2.6 Articles

Bi-annual SBTS & TBTS Update

Messages continued to be extended in the bi-annual SBTS and TBTS Update newsletter. In the Summer 2016 edition this included a relevant article titled "*Brahman BIN Project coming to an end*". In the Winter 2016 edition this included a relevant article titled "*The REPRONOMICS Project - Enabling Genetic Improvement in Reproduction in Northern Australia".* The Summer 2015 edition included an article on the results for female reproduction from the Brahman BIN. Copies of the SBTS and TBTS Updates can be viewed on the website http://tbts.une.edu.au/ under Technical Documents.

General Articles

A TBTS article titled "*The REPRONOMICS Project - Enabling Genetic Improvement in Reproduction in Northern Australia"* was published in the Brahman News and Droughtmaster Digest It is also available to view on the Brahman website. The article, *"Recording mating details for female reproduction*" was published in the Australian Brangus magazine and Droughtmaster Digest.

4.2.7 Presentations

TBTS has presented a project overview and preliminary results from the Brahman BIN and Repronomics Projects in Queensland, New South Wales, Western Australia and the Northern Territory. These have been at MLA BeefUp Forums, breed society field days, Zoetis ReproActive field days, Breed Society Delegates conferences and general field days as shown in Fig. 4.

Project updates were provided at the Brahman Technical committee meeting and at the Droughtmaster Board meetings.

Of the TBTS staff, Paul Williams has been the main deliverer of the Brahman BIN and Repronomics Project findings throughout the TBTS project, however in recent years, Tim Emery has provided further awareness of the projects and key messages to producers at events at which he has delivered.

4.3 Provide technical support to BIN projects in Northern Australia

4.3.1 Brahman BIN

The Australian Brahman Breeders' Association (ABBA) undertook an initiative known as a Beef Information Nucleus (BIN). The Brahman BIN is a well-structured progeny test program undertaken with co-funding assistance from Meat & Livestock Australia (MLA). Young bulls of high genetic merit were joined by AI or naturally to a commercial cow base to produce progeny which are managed commercially as one cohort and measured for a range of economically important traits. The high-quality performance data provides head-to-head comparison between the young sires progeny which is analysed through BREEDPLAN for the respective breed. This in turn provides high accuracy Estimated Breeding Values (EBVs) on relatively young sires which will assist in finding the up and coming "Super" Sires earlier than would be possible through standard performance recording undertaken in the seedstock sector.

The Brahman BIN has contributed a significant amount of birth, weaning, yearling and 600 day performance data to the Brahman BREEDPLAN analysis. This includes over 200 birth weight records and approximately 1800 each of AI dates (for gestation length), weaning weight, yearling weight, final weight, ultrasound carcase scanning data, flight time records, and carcase data from the abattoir.

TBTS staff member, Paul Williams, provided high-level technical assistance to the Brahman BIN, including:

- Input into sires selected from a range of nominated sires.
- Recommendations on traits recorded including appropriate age ranges and contemporary grouping to maximise the effectiveness of the performance information collected.
- Collate data for submission to BREEDPLAN.
- Assistance with the set-up of the herd recording databases which were used to store all pedigree and performance data and communicate electronically with the breed association and BREEDPLAN.
- Assist in reports to the owners of the sires used in each round in the Brahman BIN.
- Articles in Brahmans News on the Round 3 results regarding EBV changes and outcomes for the Brahman BIN.
- Update on results from round 1,2 and 3 Sires at the Brahman BIN Field Day at Banana Station.

4.3.2 Northern BIN

The Northern BIN project is a collaboration between Australian Brahman Breeders' Association, Droughtmaster Australia and a consortium of Santa Gertrudis breeders and involves the purchasing of the steer progeny (Brahman, Droughtmaster and Santa Gertrudis) from the MLA "Repronomics" project and commenced in 2014. This BIN involves growing out and finishing of the steers and the collection of comprehensive growth and carcase data. To date, 3,034 steers have been purchased in the Northern BIN project. A summary of the number of animals from the Northern BIN projects and the carcase data submitted is summarised in Table 10.

Table 10: Summary of the Northern BIN animals and carcase performance data.

BIN Herd	Calving year	# Animals	Carcase scan	Carcase data
Spyglass Brahmans	2013	59		59
Spyglass Droughtmaster	2013	47		47
Spyglass Brahmans	2014	95	95	95
Spyglass Droughtmaster	2014	66	66	66
Spyglass Brahmans	2015	99	99	99
Spyglass Droughtmaster	2015	107	107	106
Spyglass Brahmans	2016	135	135	126
Spyglass Droughtmaster	2016	127	127	127
Spyglass Brahmans	2017	111	109	107
Spyglass Droughtmaster	2017	105	105	104
Spyglass Brahmans	2018	107	107	107
Spyglass Droughtmaster	2018	128	128	126
Spyglass Brahmans	2019	131	131	131
Spyglass Droughtmaster	2019	118	118	118
Spyglass Beefmaster	2019	6	6	6
Spyglass Brahmans	2020	146	139	
Spyglass Droughtmaster	2020	109	108	
Spyglass Beefmaster	2020	3	3	
Spyglass Brahmans	2021	99		
Spyglass Droughtmaster	2021	81		
Spyglass Beefmaster	2021	1		
Brian Pastures Brahmans	2015	55	55	55
Brain Pastures Droughtmaster	2015	37	37	36
Brian Pastures Santa Gertrudis	2015	63	63	63
Brian Pastures Brahmans	2016	50	50	50
Brain Pastures Droughtmaster	2016	53	53	53
Brian Pastures Santa Gertrudis	2016	65	65	65
Brian Pastures Brahmans	2017	50	50	50
Brian Pastures Droughtmasters	2017	42	42	42
Brian Pastures Santa Gertrudis	2017	54	54	53
Brian Pastures Brahmans	2018	60	60	60
Brian Pastures Droughtmasters	2018	59	59	56

Brian Pastures Santa Gertrudis	2018	51	49	48
Brian Pastures Brahmans	2019	73	72	72
Brian Pastures Droughtmasters	2019	54	54	54
Brian Pastures Santa Gertrudis	2019	81	79	79
Brian Pastures Brahmans	2020	59	59	
Brian Pastures Droughtmasters	2020	36	36	
Brian Pastures Santa Gertrudis	2020	63	62	
Brian Pastures Beefmaster	2020	4	4	
Brian Pastures Brahmans	2021	47		
Brian Pastures Droughtmasters	2021	40		
Brian Pastures Santa Gertrudis	2021	56		
Total		**3032**	**2586**	**2260**

TBTS staff (Paul Williams in particular) has provided high-level technical assistance to the Northern BIN project with the collection of data in the field and carcase data for BREEDPLAN analysis for the Brahman, Droughtmaster and Santa Gertrudis. TBTS's role in the Northern BIN Project has included assisting in the design and decisions on when and what data is to be collected in the Northern BIN Project. It has also included liaising with the Northern BIN coordinator, Queensland Department of Agriculture and Fisheries (QDAF) and breed societies involving the purchase of cattle, collection of data and assisted in helping find agistment to run the steers.

Figure 3. Location of Properties (blue markers), Feedlots (red markers) and Abattoirs (black markers) used in the Northern BIN Project. Map created using Google My Maps (https://www.google.com.au/maps/about/mymaps/).

To date, the Northern BIN steers have been backgrounded on six different properties within Central Queensland as shown as blue in Fig. 3. The aim of the project was to turn the steers off on grass, but due to seasonal conditions, all but two cohorts have had to go to a feedlot to finish. Two feedlots have been used in the project, Smithfield Feedlot near Proston and Barmount Feedlot in Central Queensland (shown as red in Fig. 3). The Northern BIN steers have been slaughtered at three different abattoirs, John Dee Warwick, Teys Rockhampton and Teys Biloela shown in black on (Fig. 3).

TBTS also oversaw the collection of data in the field and carcase data collected in the abattoir. Data collected in the field included: 400 and 600 day weights, structural scoring, carcase scanning for P8, rib and EMA. Post slaughter measurements involve full MSA data collected and meat samples taken and sent to the Meat Science lab at UNE where Meat Colour, Shear Force and extracted IMF measurements are recorded. These carcase records from the abattoir are the first carcase data measurements for Droughtmaster and first carcase data for Santa Gertrudis since 1993.

TBTS also collated the data collected within the project, ensuring it was correct, in the right format and sent to AGBU who submit the data to BREEDPLAN to go on the Northern Multibreed Research Database for analysis.

TBTS staff also ran preliminary analysis on the results and presenting these results at Field Days and Breed Technical and Board meetings. TBTS has presented to both the Brahman and Droughtmaster Boards on several occasions, giving an update on the Northern BIN Project and provided preliminary results at these presentations. TBTS has also presented to the Brahman, Droughtmaster and Santa Gertrudis technical committee meetings regarding project overview and preliminary results.

Figure 4. Locations TBTS (Paul Williams) has given presentations on the Repronomics and Northern BIN Project. Map created using Google My Maps (https://www.google.com.au/maps/about/mymaps/).

TBTS has presented a project overview and preliminary results from the Northern BIN and Repronomics Projects at MLA BeefUp Forums, breed society field days, Zoetis ReproActive field days, Breed Society Delegates conferences and general field days as shown on (Fig. 4).

Update articles have been written for breed society magazines - BIN Update articles written for Droughtmaster Digest and Brahman News.

4.4 Extension initiatives

4.4.1 Extension to new and existing BREEDPLAN members

During the first six months of 2020, TBTS personnel were working remotely due to the COVID-19 situation in Australia and were unable to travel during this period. TBTS staff resumed on-property consultations in August 2020, however travel has been restricted to Queensland for most of the time since.

Figure 5. Location of the 180 herds that had a herd consultation conducted over the duration of the TBTS project. Map created using Google My Maps (https://www.google.com.au/maps/about/mymaps/).

TBTS project personnel conducted 180 herd consultations with seedstock producers over the duration of the project, of which 70 were conducted as part of the SBTS & TBTS Regional Forums (Section 4.4.5). Of the 110 individual seedstock property visits, Tim Emery undertook 64 and Paul 46. Of the 64 on-farm consultations conducted by Tim Emery, 51 were from stakeholder breeds and 55 BREEDPLAN members. The 180 herd consultations involved herds located in Queensland, New

South Wales, Western Australia, and the Northern Territory, with the majority in Queensland as shown in Fig. 5.

With a range of broad and targeted extension initiatives that focused on the application of genetic improvement technologies undertaken for Northern Australia throughout the project, objective three of the TBTS project has been successfully achieved. Further details on the completion of these extension initiatives are described below.

4.4.2 SBTS & TBTS Update magazines

Ten editions of the SBTS & TBTS Update magazine, containing 149 articles (averaging 15 articles per magazine) were published over the duration of the project (Table 11). A combined 44,507 copies (average 4,451 copies per magazine) were distributed to members of SBTS and TBTS stakeholder breed associations and beef industry personnel (Table 11). This included a total 13,569 hard copies (averaging 1,357 hard copies per magazine) and a total 30,938 electronic copies (averaging 3,094 electronic copies per magazine).

Table 11. Ten editions of the SBTS & TBTS Update magazine were published during the project.

SBTS & TBTS Update Edition	Publish Date	No. of Stories	No. Hard Copies	No. Electronic Copies	Total No. Copies
Winter 2016	September 2016	17	1,258	2,925	4,183
Summer 2016	February 2017	14	1,244	2,681	3,925
Winter 2017	August 2017	13	1,358	3,084	4,442
Summer 2017	March 2018	10	1,465	3,096	4,561
Winter 2018	July 2018	19	1,416	3,365	4,781
Summer 2018	March 2019	14	1,370	3,030	4,400
Winter 2019	September 2019	16	1,450	3,303	4,753
Autumn 2020	February 2020	13	1,458	3,039	4,497
Spring 2020	September 2020	15	1,256	3,230	4,486
Autumn 2021	March 2021	18	1,294	3,185	4,479
AVERAGE		**15**	**1,357**	**3,094**	**4,451**
TOTAL		**149**	**13,569**	**30,983**	**44,507**

Averaged across all ten editions, 37% of the entire audience opened the electronic versions of the SBTS & TBTS Update magazine. Very similar results were obtained when considering members of TBTS stakeholder breed associations only; on average, 37% of this audience also opened the electronic versions of the SBTS & TBTS Update magazine. Interestingly, no significant difference in open rate was observed between BREEDPLAN members and non-BREEDPLAN members of TBTS stakeholder breed associations (37% versus 38% respectively). Pleasingly, this appears to indicate that the SBTS & TBTS Update magazine content was of interest to a wide range of seedstock producers, regardless of whether they were actively submitting performance data to BREEDPLAN.

The top ten most popular articles (by unique electronic reads) covered a wide range of cattle breeding and genetics topics (Table 12). With no clear pattern in article types revealed by the top ten most popular articles, this highlights the importance of the SBTS and TBTS projects covering a variety of topics in the SBTS & TBTS Update magazines. Furthermore, the top ten most popular articles were from all but one of the ten SBTS & TBTS Update magazine editions (Table 12), with only 15% being front page stories. This indicates that individuals who read the SBTS & TBTS Update

Magazine are actively engaged and searching through the magazine for content of interest, rather than just opening the first article they see and ignoring the rest.

Each SBTS & TBTS Update publication is distributed in the following ways:

- Mailed to all BREEDPLAN members of the SBTS & TBTS stakeholder breed societies (approximately 1,360 businesses).
- Electronically distributed via e-news mail list to BREEDPLAN and non-BREEDPLAN members of the SBTS & TBTS stakeholder breed societies with an email address (approximately 3,000 businesses).
- Electronically distributed via e-news mail list to a list of personnel working in the beef industry. This includes ultrasound scanners, staff from beef research institutions (e.g. AGBU, CSIRO and UQ), beef extension personnel (e.g. private consultants, NSW LLS and state Departments of Primary Industries (DPI) staff), MLA and SGA staff and genotyping service providers (e.g. Neogen and Zoetis).

All previous editions of the SBTS & TBTS Update magazine, including those published in this iteration of the TBTS project, can be accessed via the TBTS website: http://tbts.une.edu.au/seedstock-breeding-better-cattle/resources/sbts-tbts-updates/.

Table 12. The top ten most popular articles (by unique electronic reads) from the SBTS & TBTS Update magazines published over the duration of the project.

Most Popular Articles	SBTS & TBTS Update Edition	Article Title
1	Winter 2018	The Maternal Female: What Makes A Good Cow?
2	Spring 2020	Trans-Tasman Study Finds Half of *Bos taurus* Heifers Pre-Pubertal at Mating
3	Winter 2019	ET Flush Siblings Are Not Identical Twins
3	Autumn 2020	The Case for Genotyping Females
4	Summer 2016	An Introduction to Genomics
4	Autumn 2021	BREEDPLAN Top Tips: Understanding Milk EBVs
5	Winter 2016	Making Bull Selection Decisions for Heifer Matings
6	Autumn 2021	A Seedstock Producer's Perspective On: Breeding for Fertility
7	Autumn 2021	Genotyping the Keepers: It's All in the Timing
8	Summer 2017	Moving Towards SNP Parentage Verification
8	Spring 2020	A Seedstock Producer's Perspective On: Using BREEDPLAN in a Smaller Herd
9	Winter 2018	Performance Recording in Drought Conditions
10	Winter 2017	Alex McDonald Steps Down

4.4.3 General industry events

During the duration of the project, TBTS staff member Paul Williams was involved in over 60 industry events with over 2500 people in attendance, with the main involvement being presenting on genetic improvement technologies such as BREEDPLAN EBVs, Selection Indexes, genomics, BIN outcomes and Repronomics project outcomes. A distribution of the industry and technical events involving Paul can be seen in Fig. 6. Some of the main industry events presented at include:

- Yearly CQU Agriculture students BREEDPLAN Lecture
- UQ Agriculture students BREEDPLAN lecture
- Beef Up Forums in Alice Springs, Coral Bay and Mundubbera
- Yearly Gyranda Open Day (70 attendees)
- Repronomics Update Meetings (Northern BIN update)
- Teys Australia Information Day
- Zoetis ReproActive days
- Brahman, Droughtmaster and Santa Gertrudis Staff BREEDPLAN training (with Tim Emery)
- NBRUC
- Regional Forums
- Breed society member's field days
- Breed society organised meetings and field days
- Beef Australia 2018 and 2021
- Beef Genetics Champions Network Workshop

Figure 6. Location of the Industry Events Paul spoke at or attended over the duration of the project. Map created using Google My Maps (https://www.google.com.au/maps/about/mymaps/).

Paul Williams has been the representative for all breed societies on the Beef Australia Properties Tour Committee for Beef Australia 2018 and 2021. TBTS identified four properties to host Beef Australia property tours that were focusing on use EBVs and improving fertility in Northern Australia. Those four properties were:

- Kaiuroo (Brahman stud) 2018.
- SC Droughtmasters 2018 (Tim Emery presented).
- CBV Brahmans 2021.

- Jarrah Reds and Herefords 2021.

Duties included:

- Liaising with and assisting with preparation and running of the property tour.
- Attending monthly meetings, discussing these and other suitable property tours that were run in conjunction with the tours for which TBTS was responsible.
- Representing Beef Australia on the property tours and assisting with making sure the tour ran smoothly.

Tim Emery's statistics and explanation of presentations delivered (face to face and online), commercial property visits, documents written, enquiries and known cases of adoption, is comprehensively covered in Section 4.7 and the Appendix.

4.4.4 Social media

4.4.4.1 SBTS & TBTS Facebook account

The number of individuals who engaged with the SBTS & TBTS Facebook page grew substantially over the duration of the project. This is shown by the increase in "page likes", which rose from 429 at the start of the project (1 July 2016) to 860 at the conclusion of the project (30 June 2021). This equates to a two-fold increase in the number of "page likes" over the five-year project.

There were 359 posts on the SBTS & TBTS Facebook page over the five-year project, which equates to one post every 5.1 days (Table 13). Given TBTS project personnel had a working week of five days, this equates to an average of one post per working week. A full breakdown of posts on the SBTS & TBTS Facebook page by project year is provided in (Table 13).

Table 13. The number of posts on the SBTS & TBTS Facebook account and the average number of days between these posts, is shown for the overall project and by each project year.

Project Year	Total No. of Facebook Posts	Average No. of Days Between Posts
Year 1	60	6.1
Year 2	56	6.5
Year 3	100	3.7
Year 4	64	5.7
Year 5	79	4.6
TOTAL	**359**	**5.1**

4.4.4.2 SBTS & TBTS Twitter account

In a similar manner to that seen for the SBTS & TBTS Facebook account (Section 4.4.4.1), the number of individuals who engaged with the SBTS & TBTS Twitter account also grew over the duration of the project. This is shown by the increase in account "followers"; these rose from 203 at the start of the project (1 July 2016) to 341 at the conclusion of the project (30 June 2021). This equates to a 1.7-fold increase in the number of Twitter "followers" over the five year project.

There were 309 "tweets" on the SBTS & TBTS Twitter account over the five-year project, which equates to one "tweet" every 5.9 days (Table 14). A full breakdown of activity on the SBTS & TBTS Twitter account by project year is provided in (Table 14).

Table 14. The number of "tweets" on the SBTS & TBTS Twitter account and the average number of days between these, is shown for the overall project and by each project year.

Project Year	Total No. of "Tweets"	Average No. of Days Between "Tweets"
Year 1	66	5.5
Year 2	49	7.4
Year 3	70	5.2
Year 4	62	5.9
Year 5	62	5.9
TOTAL	**309**	**5.9**

4.4.4.3 SBTS & TBTS YouTube channel

A total of 30 new videos were published on the SBTS & TBTS YouTube channel over the duration of the project (Table 15). These included both recording of SBTS & TBTS webinars (Section 4.4.6) and specifically developed short e-media videos such as the 'Recording for BREEDPLAN' video series. With a number of videos from previous project iterations already published on the SBTS & TBTS YouTube channel, the publication of these 30 videos took the total number of videos on the SBTS & TBTS YouTube channel developed by the two projects to 71. A further three playlists, which contained content developed by external organisations, were also created over the duration of the project (Table 16). These included 16 videos created by MLA as part of the MLA Genetics Campaign, and a webinar recording delivered by SBTS project personnel for NSW Local Land Services (Table 16).

Table 15. The number of views, watch time (hours) and videos published on the SBTS & TBTS YouTube channel is shown for the overall project and by each project year.

Project Year	Total Views	Watch Time (hours)	No. Videos Published
Year 1	4,176	405.8	6
Year 2	3,471	246.5	0
Year 3	2,741	202.3	2
Year 4	2,841	196.9	1
Year 5	6,290	334.0	21
TOTAL	**19,519**	**1,385.5**	**30**

Table 16. The SBTS & TBTS YouTube channel had three playlists which contained 17 videos developed by external organisations.

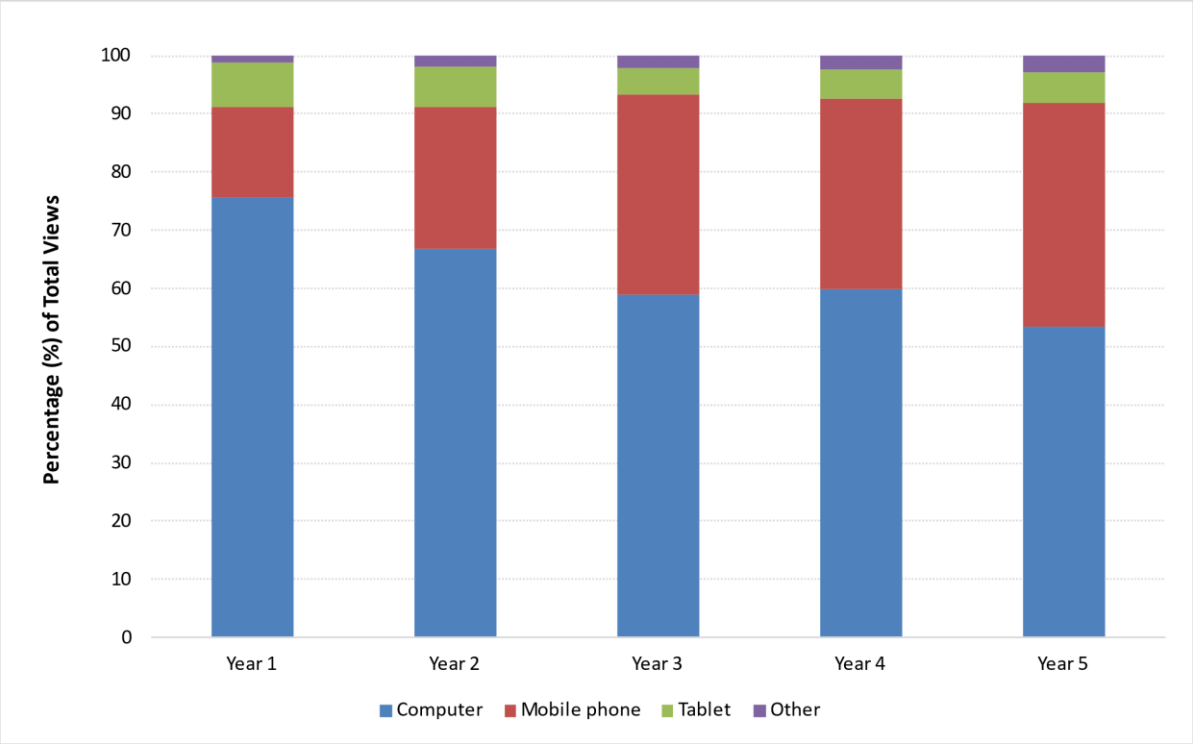
Playlist	No. Videos	External Organisation
MLA Genetics Campaign - Temperate Cattle	13[A]	MLA
MLA Genetics Campaign - Tropical Cattle	13[A]	MLA
High Steaks: Using Performance Data in Breeding Decisions	1	NSW Local Land Services

[A] Ten videos were published in both playlists as they were applicable for both tropical and temperate cattle producers.

The 71 videos on the SBTS & TBTS YouTube channel were viewed a total of 19,519 times over the duration of the five-year project (Table 15). These 19,519 views equated to 1,385.5 hours of watch time (Table 15). Interestingly, the way in which individuals view the SBTS & TBTS YouTube channel content has changed over the duration of the project. The use of mobile phones to view the SBTS & TBTS YouTube channel content has increased over the project; accounting for just 16% of total views in the first project year to 38% of total views in the final project year (Fig. 7). At the same time, the use of computers to view the SBTS & TBTS YouTube channel content has decreased, from 76% of

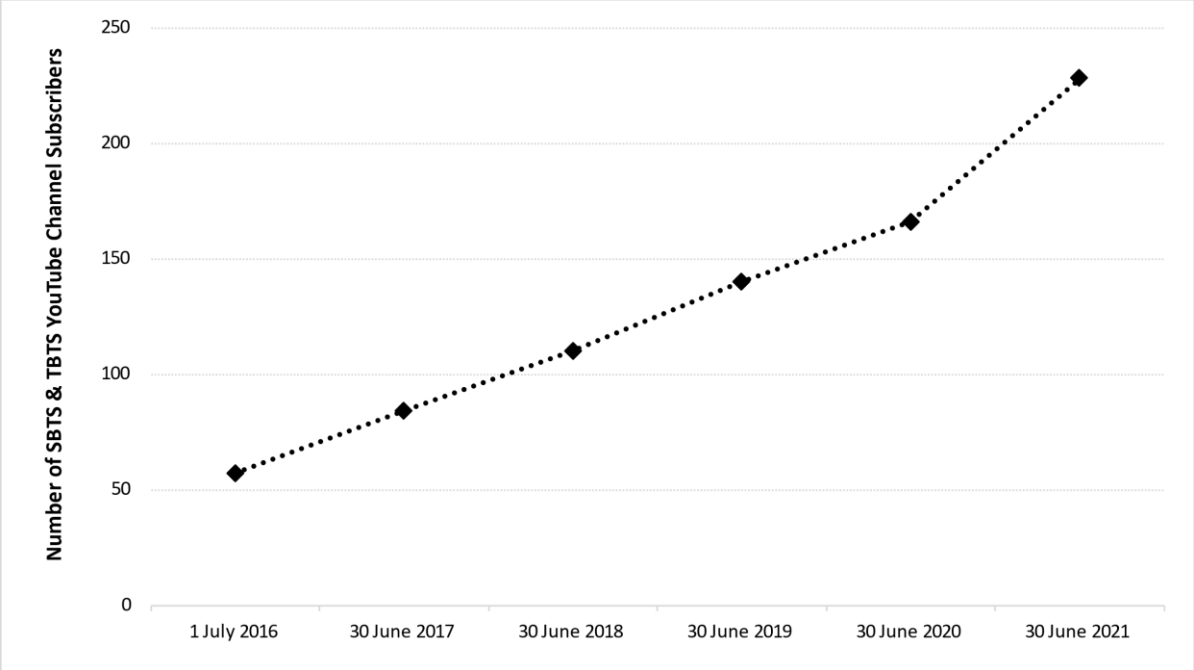
total views in the first project year to 53% in the final project year (Fig. 7). While these trends likely reflect changes to the way in which individuals are choosing to engage with social media content, the increased use of mobile devices to observe e-media content on the SBTS & TBTS YouTube channel goes someway to validating the decision by the SBTS & TBTS project teams to concentrate efforts on the production of shorter e-media content.

Figure 7. The percentage (%) of total views of the SBTS & TBTS YouTube channel by device type for each year of the project.



The number of individuals who subscribed to the SBTS & TBTS YouTube Channel increased four-fold over the duration of project, from 57 at the start of the project (1 July 2016) to 228 at the conclusion of the project (30 June 2021; Fig. 8). The rise in new subscribers was tracking along steadily between the start of the project and the conclusion of the fourth project year (30 June 2020); however, the number of new subscribers in the final year of the project was double that seen in previous years (Fig. 8). This may reflect the dramatic increase in published content and/or the move to shorter, more accessible videos on the SBTS & TBTS YouTube channel during this time.

Figure 8. The number of SBTS & TBTS YouTube channel subscribers across the duration of the TBTS project.



4.4.5 Regional forums

4.4.5.1 2017 and 2018 regional forums

In the 2017 calendar years, ten regional forums were conducted in the Eastern states (Fig. 9). A further four regional forums were offered in South Australia and Western Australia but were cancelled due to minimal registrations (Fig. 9). In conjunction with other TBTS activities), three regional forums were conducted in Western Australia in the 2018 calendar year (Fig. 9), including at two locations that had been cancelled in the previous year. The success of the rescheduled Western Australian regional forums may illustrate that the time of year was an important factor in attendance (May 2017 versus January 2018). Furthermore, a targeted but resource heavy marketing push to encourage those based in Western Australia to attend the 2018 regional forums may also have impacted on registration levels.

A total 141 individuals registered, and 132 individuals attended, the 13 regional forums held in 2017 and 2018. Overall feedback indicated that these 13 regional forums were well received, with 91% of attendees rating these regional forums as excellent (56%) or very good (35%). In addition, 95% of attendees said that they felt they had a better understanding of BREEDPLAN following their attendance at the regional forum.

Figure 9. Thirteen regional forums were held around Australia in 2017 (light blue markers) and 2018 (dark blue markers). Four regional forums were cancelled (red markers). Map created using Google My Maps (https://www.google.com.au/maps/about/mymaps/).

Learning outcome data shows that attendees displayed an average 36% increase in knowledge as a result of their attendance at the regional forum. With levels of prior knowledge varying greatly for the learning outcome questions (from 12% to 68%), in general, the biggest gains in knowledge were seen in areas where prior knowledge was lower. The two areas with the biggest improvements in knowledge were understanding contemporary group formation for maximising effectiveness of data (56% improvement) and understanding genomics (50% improvement).

A more detailed breakdown of registrations, attendance, feedback and learning outcomes from the 2017 and 2018 regional forums can be found in Appendix 1.

4.4.5.2 2019 regional forums

Twelve two-day regional forums were conducted around Australia in the 2019 calendar year (Fig. 10). Two further regional forums were offered in South Australia and Victoria but were cancelled due to minimal registrations (Fig. 10). A total of 168 individuals registered, and 153 individuals attended, the 12 regional forums. Of the 153 individuals that attended, 73% opted to attend both days, 8% opted to attend Day One (BREEDPLAN Fundamentals) only and 17% selected to attend Day Two (DNA Technology: Getting the Most from BREEDPLAN) only (Fig. 11). With TBTS project personnel having strongly encouraged beef producers to attend both days of the 2019 regional forum program during the promotion stages, this was a pleasing result.

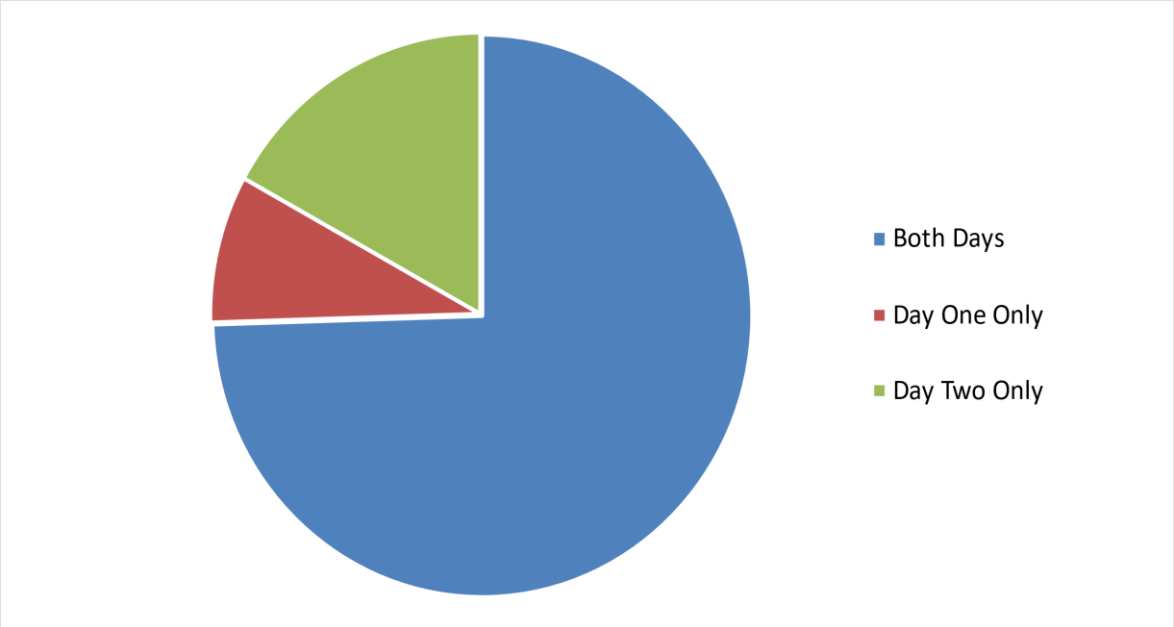
Figure 10. Twelve regional forums were held around Australia in 2019 (blue markers). Two regional forums were cancelled due to minimal registrations (red markers). Map created using Google My Maps (https://www.google.com.au/maps/about/mymaps/).

Overall feedback on the 2019 regional forums was very positive. At the completion of Day One, 91% of attendees rated the BREEDPLAN Fundamentals program as excellent (55%) or very good (36%). When asked, 96% of attendees said that they felt they had a better understanding of BREEDPLAN as a result of their attendance at Day One of the regional forum. Similar results were achieved for Day Two, with 90% of attendees rating the DNA Technology: Getting the Most from BREEDPLAN program as excellent (53%) or very good (37%). A total 98% of Day Two attendees also agreed that they felt they had a better understanding of the use of DNA technologies in cattle breeding after attending the regional forum.

Learning outcome data shows that attendees displayed an average 31% and 28% increase in knowledge as a result of their attendance at Day One and Day Two of the regional forum, respectively. As was the case for the 2017 and 2018 regional forums (Section 4.4.5.1), levels of prior knowledge varied greatly for the learning outcome questions on both Day One (from 25% to 94%) and Day Two (from 14% to 77%). Consequently, the biggest knowledge gains were typically seen for questions that had a lower starting base. On Day One, the biggest knowledge gains were in understanding Completeness of Performance reports (49%) and applying breeder defined management groups (47%), while for Day Two the biggest knowledge gains were observed for understanding of the parentage verification process (56%) and Single-Step BREEDPLAN (36%).

A more detailed breakdown of registrations, attendance, feedback and learning outcomes from the 2019 regional forums can be found in Appendix 1.

Figure 11. 153 individuals attended a 2019 regional forum; 73% attended both days, 8% attended Day One only and 17% attended Day Two only.



4.4.5.3 2020 regional forum

Following on from the previous Regional Forums, a one day forum was held by TBTS in Malanda.

A total of 14 individuals registered of which 13 individuals attended the regional forum.

4.4.5.4 Regional forum follow-up survey

The regional forum follow-up survey was sent to 118 unique email addresses belonging to those that had attended a 2019 SBTS & TBTS regional forum (in some cases, one email address belonged to multiple attendees). A total of 26 responses (23%) were received from the 113 email addresses still in use. Of these 26 respondents, 85% of had attended both days, while 4% had attended Day One only and 12% had attended Day Two only.

A total of 96% of survey respondents agreed that the 2019 SBTS & TBTS regional forums were good value for money. Some of the highlights of the 2019 SBTS & TBTS regional forums as identified by survey respondents included the ability to learn from presenters and the ability to hear other attendees' points of view. The importance that attendees placed on hearing from others illustrates the benefits of hosting live events where participants can freely interact. Other attendee highlights included learning about the role of DNA in cattle breeding and the overall purpose of BREEDPLAN. Those that had received Completeness of Performance and Genetic Progress reports also found these to be valuable. In addition, 100% of those that had attended both days enjoyed the two day format.

When asked whether they have enacted practice change within their herd as a result of attending a 2019 SBTS & TBTS regional forum, 81% of the survey respondents stated that they had. Examples of practice change undertaken in survey respondents' herds include recording more and/or better quality data for BREEDPLAN, management group allocation, better sire selection and commencing DNA testing of their animals.

Most respondents (46%) agreed that regional forums should be held every two years, with the next most popular frequency being annually (35%). Distance that individuals were prepared to travel to attend a regional forum varied widely. While travelling up to two hours to attend a regional forum was the most popular response (32%), this varied from those that were prepared to travel up to one hour (16%) to those who were prepared to travel over four hours (20%) to attend a regional forum. Listening to preparatory material prior to the event did not receive any negative feedback; 58% of respondents were prepared to do so and the remaining 42% might. Of the ten potential future topics presented in the survey, all were popular, with between 55% and 82% of respondents interested in each (Appendix 1). Several respondents also suggested other potential topics; these included multi-breed EBVs and using BREEDPLAN as a small herd.

4.4.6 Webinars

A total of 334 registrations were received for the 2016 webinar series; these represented 191 unique individuals who had registered to attend one or more of the six webinars. There were 152 webinar attendees; these represented 99 unique individuals who attended one or more of the six webinars. The majority of these 99 individuals were beef producers (95%), with the remainder working in beef industry roles (e.g. extension personnel and DNA service providers). Of the beef producers that attended at least one webinar, 60% were BREEDPLAN members.

Feedback from the 2016 webinar series attendees was largely positive. Averaged across all six webinars, 86% of webinar attendees strongly agreed (12%) or agreed (74%) that they had found the webinar useful. Additionally, across all six webinars, an average 85% of attendees agreed that they had a greater understanding of the topics presented as a result of their webinar attendance.

Recordings of each webinar were made available for viewing via the SBTS & TBTS YouTube channel. As at 30 June 2021, the six webinars had a combined 1,316 post-webinar views. This translates to a nearly nine-fold increase in views compared to all live webinar attendees (n=152), and a 13-fold increase in views compared to unique webinar attendees (n=99). These results show the value of webinars is not so much as a live event but as a recorded resource that can be accessed at a time that suits the individual producer . However, while there were 1,316 post-webinar views, those viewing the webinar recordings did not watch the webinar recording in its entirety. Rather, the average view duration for these six webinar recordings ranged from 8% to 22% (average 15%) of the entire webinar.

A more detailed breakdown of registrations, attendance, YouTube views and feedback for the 2016 webinar series can be found in Appendix 2.

4.4.7 Attendance at industry events

As well as presenting at 60 industry events Paul Williams over the duration of the project, he attended an additional 40 industry events. The majority of these were beef industry events attended by beef producers, but also scientific conferences attended by researchers.

Being based in Rockhampton meant that Paul could easily access national bull sales, enabling the opportunity to have discussions with a large number of seedstock producers in attendance regarding BREEDPLAN and any other genetic related queries they had.

In addition to the industry events Tim Emery presented at throughout the project, he attended a further 33 industry events (22 QLD, 6 NSW, 2 VIC, 1 WA, 1 NT, 1 SA) containing breeding and

genetics content. The events in NSW were typically combined with trips to Armidale for meetings/training. By attending these events, Tim was able to keep up to date with the genetic messages getting out to producers and to raise further awareness of TBTS and the role Technical Officers play.

As a further opportunity to liaise with producers and industry service providers, Tim Emery attended an additional 18 industry events (17 Qld, 1 WA) throughout the project. Like Paul Williams, Tim got to briefly attend a number of bull sales held at the Roma (local) saleyards to have BREEDPLAN related discussions with seedstock and commercial producers.

4.4.8 Articles for TBTS stakeholder breed association publications

The TBTS project prepared a total of 35 articles for stakeholder breed associations over the duration of the project.

These 35 articles covered a wide variety of cattle breeding and genetics topics, which included:

- Collection of performance data for the BREEDPLAN analysis.
- Benchmarking the levels of performance recording for BREEDPLAN within the breed.
- Breeding objectives (e.g. MSA compliance, heifer bulls and maternal females).
- Genomics, including introductions to Single-Step BREEDPLAN, selection of animals for genotyping and case studies outlining the impacts of genomics within a breed.
- DNA parentage.
- Northern Research Project updates.

4.4.9 Written documentation

A variety of written documentation was created and/or maintained throughout the duration of the TBTS project. This included:

- *SBTS & TBTS Technical Notes*

  Seventeen new SBTS & TBTS Technical Notes (Table 17) were developed over the duration of the TBTS project, bringing the number of available SBTS & TBTS Technical Notes to 32. In addition, the 15 existing SBTS & TBTS Technical Notes (developed in prior iterations of the TBTS project), were reviewed and updated into a new format during the first year of the TBTS project. One of these ('Searching for Genetics Online') was further updated in the fifth year of the TBTS project to reflect additional changes to this process. All 32 of the available SBTS & TBTS Technical Notes can be accessed via the TBTS project website: http://tbts.une.edu.au/seedstock-breeding-better-cattle/resources/technical-notes/.

Table 17. 17 new SBTS & TBTS Technical Notes were developed over the duration of the project.

SBTS & TBTS Technical Note Title	Publication Date
An Introduction to Genomics	December 2016
Do Estimated Breeding Values (EBVs) Really Work?	December 2016
Identifying Curve Bender Animals	March 2018
Importance of Recording the Performance of Your Cattle	March 2018
Making Bull Selection Decisions for Heifer Matings	March 2018
Meat Standards Australia: Breeding for Improved MSA Compliance and Increased MSA Index Values	March 2018
Moving Towards SNP Parentage Verification	March 2018

Performance Recording for Small Herds	March 2018
Scan Data for Heifers is Valuable	March 2018
The Importance of Whole Herd Recording	March 2018
Where Does This Animal Rank? Introducing the EBV Percentile Graph	March 2018
The Maternal Female: What Makes a Good Cow?	July 2018
ET Flush Siblings Are Not Identical Twins	September 2019
Breeding For Production System Efficiency	February 2020
Rebuilding Herds After Adversity	February 2020
The Case for Genotyping Females	February 2020
Breeding For Environmental Efficiency	September 2020

- *'A Seedstock Producer's Perspective' Case Studies*

Three versions of the 'A Seedstock Producer's Perspective' case studies were created during the current iteration of the TBTS project (Table18). All three versions can be accessed via the TBTS project website: http://tbts.une.edu.au/seedstock-breeding-better-cattle/resources/technical-notes/.

Table 18. The 'A Seedstock Producer's Perspective' articles were a new initiative for the TBTS project, developed in 2020. Three of these were published during the TBTS project.

'A Seedstock Producer's Perspective' Articles	Publication Date
Using MateSel	February 2020
Using BREEDPLAN In A Smaller Herd	September 2020
Breeding for Fertility	March 2021

4.5 Technical advancement and support

TBTS undertook extension initiatives to inform the seedstock and beef breeding industry in general on the relevance and application of genomics technology for accelerating genetic progress in economically important production traits**.**

TBTS staff have actively updated the seedstock and beef breeding sector on the relevance and application of DNA technology.

4.5.1 Technical support for TBTS stakeholder breed associations

TBTS project personnel provided a range of technical advice and support to TBTS stakeholder breed associations over the duration of the project. General support provided to all TBTS stakeholder breed associations included:

- Representation of TBTS stakeholder breed associations at quarterly BTLG meetings. These took place until the fifth year of the TBTS project, with TBTS personnel attending seven BTLG meetings.
- Review preliminary results from BREEDPLAN analyses for TBTS stakeholder breed associations and provision of associated permission to release the results on their behalf.
- General liaising and advice with staff, technical committees and boards of TBTS stakeholder breed associations. This included attendance at approximately 20 board and/or technical committee meetings over the duration of the project. TBTS personnel regularly provided technical papers and/or presentations at these meetings, in addition to general advice.

- Compiled technical articles for TBTS stakeholder breed association publications.

More specific technical advice and support provided to TBTS stakeholder breed associations over the duration of the project is described below.

Support and advice regarding upgrades to the stakeholder breed association BREEDPLAN analysis.

TBTS provided support to a number of TBTS stakeholder breed associations as they received upgrades to their BREEDPLAN analyses over the duration of the project. Specifically, this included:

- Providing support to three TBTS stakeholder breed associations as they transitioned to the newer generation of ABRI's breed registry software, known as ILR2. The new software included several new features, including the running of monthly BREEDPLAN analyses, production of enhanced BREEDPLAN reports and access to the mating optimisation tool MateSel.
- Providing support and assistance to a number of TBTS stakeholder breed associations as revised analytical software and/or parameters were implemented for their BREEDPLAN analyses.
- Providing support and assistance to a TBTS stakeholder breed association as they transitioned from a partial crossbred BREEDPLAN analysis to a full crossbred BREEDPLAN analysis.

TBTS personnel also worked with the BREEDPLAN team to provide advice on the reportability of EBVs, including reporting additional BREEDPLAN EBVs (i.e. new traits). Where data recording was not sufficient to switch on a new trait, TBTS personnel provided advice on how the stakeholder breed association could collect additional performance information for the relevant trait. This included providing information that could be disseminated to members to encourage trait recording.

Support and advice in utilisation of DNA technologies.

TBTS personnel provided technical advice and support on the utilisation of DNA technologies to a number of TBTS stakeholder breed associations over the duration of the project. This advice covered the three main applications of DNA technology in cattle breeding: parentage verification, management of qualitative traits and genetic conditions and the use of genomics information in the BREEDPLAN analysis (i.e. Single-Step BREEDPLAN).

As many TBTS stakeholder breed associations were transitioning from microsatellite technologies to Single Nucleotide Polymorphism (SNP) technologies, TBTS personnel attended a number of meetings with TBTS stakeholder breed associations and DNA service providers (e.g. Neogen, Zoetis). This allowed TBTS personnel to provide advice on 'bundle' test options for TBTS stakeholder breed association members (i.e. SNP genotype panels that covered parentage, qualitative traits and/or genetic conditions, and would be suitable for genomics), as these would have multiple applications for cattle producers whilst also allowing TBTS stakeholder breed associations to prepare for the genomics era.

To assist TBTS stakeholder breed associations as they prepared for genomics, TBTS personnel, in conjunction with AGBU staff, provided a detailed explanatory document for all TBTS stakeholder breed associations. In addition, TBTS personnel worked in a one-on-one capacity to provide tailored advice to individual TBTS stakeholder breed associations. This advice often focused on how to build a reference population (animals with both genotypes and phenotypes), and, once that reference population was in existence, how to maintain it into the future. Thus, breed-specific advice provided

by TBTS personnel to TBTS stakeholder breed associations included genotyping strategies to increase the number of animals with genotypes, and assistance in prioritising animals for genotyping. Strategies to increase the number of animals with phenotypes, including considerations for society run progeny test programs, were also discussed with a number of TBTS stakeholder breed associations.

Finally, TBTS personnel provided support and advice to a number of TBTS stakeholder breed associations in regard to managing qualitative traits and/or genetic conditions . In addition to providing general advice, TBTS personnel also provided breed-specific advice to a number of stakeholder breed associations on management (e.g. testing) and elimination (where possible) strategies.

Support of and advice on additional ABRI products relating to genetic improvement

TBTS personnel provided technical advice and support on the implementation and use of additional ABRI products that related to genetic improvement, including the Completeness of Performance product, GeneProb and MateSel. This included providing TBTS stakeholder breed associations with assistance in interpreting and disseminating results to members.

Technical support and advice provided by TBTS project personnel included, but was not limited to:

- *Support and advice regarding upgrades to the stakeholder breed association BREEDPLAN analysis:* Upgrades made to some stakeholder breed association BREEDPLAN analyses during the TBTS project included:
    - New BREEDPLAN EBVs.
    - Revised analytical software and/or parameters.
    - Revisions to how crossbred animals are handled within the BREEDPLAN analysis (e.g. changing from a purebred BREEDPLAN analysis to a crossbred BREEDPLAN analysis).

- *Support and development of BreedObject Selection Indexes*: This included development of Selection Indexes using new version 6 BreedObject software for TBTS stakeholder breed associations and the creation of associated extension material for dissemination to stakeholder breed association members.

4.5.2 Technical support for TBTS stakeholder breed association members

TBTS project personnel provided technical support and advice to members of TBTS stakeholder breed associations for the duration of the TBTS project. In the majority of cases, support was provided via day-to-day telephone and email consultation. In person support was also provided at events run by or attended by TBTS project personnel and at herd consultations. This technical support and advice included, but was not limited to:

- Support in understanding, interpreting and utilising BREEDPLAN EBVs.
- Support in understanding, interpreting and utilising BreedObject Selection Indexes.
- Provision of general advice on performance recording and assistance in assigning management groups in complex situations.
- Support in utilising the 'Internet Solutions' search facility and the tools available (e.g. the Mating Predictor).
- Provision of EBV diagnostics (e.g. explanation of why a particular animal had a particular EBV and/or why a particular EBV had changed between BREEDPLAN analyses). These enquiries

had the potential to get quite complex and often took up a significant amount of time for the investigating TBTS Technical Officer. Some complex diagnostic enquiries also required the investigating TBTS Technical Officer to collaborate with BREEDPLAN and/or AGBU staff.

- Support in the interpretation of GeneProb results, and the provision of advice on how to use GeneProb results in mate selection. This also included discussions on management of genetic conditions, including how to best manage genetic conditions while making genetic gain in production traits.
- Assisting producers to understand and interpret their BREEDPLAN Completeness of Performance reports. This often included advice on how an individual herd could collect additional performance data to improve their Completeness of Performance star rating.
- Support in understanding and interpreting the MateSel product. This included the provision of advice to those that were considering using MateSel, and, for those that had used MateSel, assistance in interpreting MateSel results.
- For members of TBTS stakeholder breed associations that had not yet implemented genomics, assistance in understanding how genomics would work, test options and the benefits that genomics was expected to bring to producers.
- For members of the two TBTS stakeholder breed associations that had implemented genomics (Australian Brahman Breeders' Association and Santa Gertrudis Breeders (Australia) Association), advice and support in deciding which animals to genotype and in understanding the effect that genomics was having on their EBVs. For some producers, support was also provided to explain why genotypes were not included in the analysis.
- Assisting producers to understand how to display BREEDPLAN information in sale catalogues.
- Support in understanding what is available in their member download area and what particular aspects they should pay attention to e.g. outlier reports.

4.5.3 General articles

- "An *Introduction to Genomics*" - Brahman, Brangus, Droughtmaster and Santa Gertrudis.
- Update on the Repronomics project "*The Repronomics Project, Enabling Genetic Improvement in Reproduction in Northern Australia"* has been published in the SBTS & TBTS Update and has been published in the Brahman News and Droughtmaster Digest.
- *"Recording mating details for female reproduction"* - Droughtmaster and Brangus.
- *"DNA Parent Verification"- Brahman*, Brangus, Droughtmaster and Santa Gertrudis.*Phenotypic Data from the Northern BIN Project vital to Genomic Success* – Brahman News.
- *Understanding DNA Technology* - Droughtmaster and Brangus.
- *"Update on Northern BIN Project"* Brahman News and Droughtmaster Digest and in the SBTS & TBTS Update.
- "A Seedstock Producer's Perspective On: Breeding for Fertility".

TBTS staff, in particular Tim Emery, have made a significant contribution to the reviewing, updating, and presenting of the genetics modules of the MLA Breeding EDGE package.

4.6 Maintain, support and development of selection indexes

Maintain and support the Selection Indexes published by stakeholder breed associations to ensure they remain relevant to current and future markets and production systems. Manage the introduction and impacts of Version 6.2 of BreedObject. Where possible, also develop and publish Selection Indexes for stakeholder breed associations not currently doing so.

Four TBTS breed society stakeholders currently have BreedObject selection indices published, totalling four Indices (Table 19).

For each of the selection indices, TBTS staff maintain a detailed set of technical documentation that provide details on the key profit drivers, EBV weightings and response to selection that can be expected when selecting animals using the Selection Index. This documentation is available from the BREEDPLAN website and forms part of the breed-specific documentation providing explanations of EBVs, Indices and accuracy for each breed's web services (Internet Solutions).

Table 19: BreedObject selection indices published by stakeholder breeds.

Breed	Number of Indices	Production systems represented
Brahman	2	Jap Ox, Live Export
Santa Gertrudis	2	Domestic Production, Export Production
Brangus	2	Domestic Steer, Export Steer
Belmont Red	2	Domestic, Export

Update selection indices to Version 6

- **Brahman:** TBTS staff have started updating the two Brahman Indices and met with the Brahman technical committee twice so far.
- **Brangus**: TBTS has had preliminary talks with Brangus Board members and staff to assist the Brangus breed to update Domestic Steer and Export Steer Indexes to Version 6.
- **Belmont Red:** TBTS has presented to the Belmont Red board on proposed upgrading of the current Indices to Version 6. Progress has been made on theses Indices and they are in the final stages of completion.
- **Santa Gertrudis**: TBTS staff are assisting in updating the two current Santa Gertrudis indices and the development of a new Terminal Index. These Indices are in the final stages of completion.
- **Droughtmaster**: TBTS has had preliminary talks with Droughtmaster Board members and staff to assist Droughtmaster develop indices for Jap Ox and Live Export based on the trial indices TBTS helped develop in Version 4 software. The development of these indices has been able to advance with the addition of new traits to the Droughtmaster analysis including Days to Calving.

4.7 Additional approaches for driving the adoption of BREEDPLAN in Northern Australia

As previously mentioned, Tim Emery's role in the TBTS Project primarily focused on educating commercial producers across QLD, NT and WA about BREEDPLAN and related genetic technologies. Over time he gave a number of presentations, and had in-depth conversations both on and off-farm with a wide range of producers and industry service providers. In addition to this, he has received many breeding and genetics related enquiries, conducted field work for the Northern BIN Project and attended several industry events to establish networks and provide ongoing engagement with industry.

4.7.1 Face to face presentations

Throughout the project, a major effort has been made to engage with an array of industry organisations across Northern Australia. This has enabled many opportunities to arise, particularly the chance to deliver BREEDPLAN focused presentations to producers. During his 4.5 year secondment, Tim Emery delivered 92 face-to-face presentations, which involved 3287 participants (Fig. 12). The majority were undertaken in Qld, with four in WA, four in NSW and one in NT. He was scheduled to give a further nine presentations, but due to COVID-19 restrictions in the first half of 2020, they were cancelled.

Figure 12. Locations where Tim delivered 92 face-to-face presentations across Northern Australia during the project. Map created using Google My Map (https://www.google.com.au/maps/about/mymaps/).

A full list of these presentations, including the date, event type, presentation description, event location and number of participants can be found in Appendix 3. Within Appendix 3, MLA run workshops/events and those events held on-farm have been identified. As expected, the number of attendees at events varied considerably, from five/six (two Grazing BMP workshops and a Breeding EDGE workshop) to 200 (Brian Pastures field day). It should be noted that despite the small number of attendees at the three workshops, there were businesses in attendance running 1500 head. Also to be expected, the demographic attending the events varied considerably, from university students

to 80 year old producers. A vast array of knowledge and experience with using EBVs was also evident in event attendees.

Presentations varied in length from 30 minutes to co-presenting three-day workshops. Despite the presentation length, EBVs were always discussed alongside breeding objectives, BULLCHECK, temperament and structure, and research project insights. In Tim's first 15 months in the project he presented in many different regions of Qld as part of the Grazing BMP program. He delivered the animal production module (which contained breeding and genetics content) at eight separate events. Tim also got the opportunity to co-present the Breeding EDGE workshop across three states during the project (12 in Qld, 4 in WA and 1 in NT). These workshops attracted both smaller producers (150 head on 60ha) and large-scale operators (up to 25,000 head on 1.5 million ha) and one business was willing to travel 1500km to attend. With workshops running over three days, this provided presenters with the opportunity to better know the participants. Tim was asked to co-present a series of three MLA BredWell FedWell (BWFW) pilot workshops (Jandowae, Banana, Einasleigh) with Dr Jason Trompf. A further BWFW workshop was run at Chinchilla just prior to the end of the TBTS project. The workshop is now being reviewed, but it's envisaged that it will be delivered across Northern Australia in the coming years.

It was rewarding for Tim to be asked to present at the same event in successive years e.g. Intercollegiate Meat Judging (ICMJ), as well as be asked to present EBV follow up sessions after delivering at multi topic events such as the Brian Pastures field day. Tim received positive presenter feedback on multiple occasions: 9.5 and 9.6/10 at Breeding EDGE workshops; 4.8/5 at ICMJ and 8.83/10 at the Roma BeefUp Forum. Positive written feedback as part of feedback forms was also received "Tim was great – it got me really interested in genetics and using the data available" (ICMJ 2021). Additionally, "I didn't get to meet you yesterday but I found your presentation very informative and will use many of your ideas in my small enterprise" (Zoetis ReproActive day).

4.7.2 Online presentations

Throughout the project, Tim delivered seven online presentations on slightly varied topics and to a mixture of audiences across Northern Australia, including:

- Two DAF organised 'Zoom' sessions for Jundah and Aramac producers (September 2018)
- Co-delivered a one hour webinar with MLA's Clara Bradford on 'How to shop for a high-performing bull' (26 August 2019)
- E-Beef online producer group meetings for Ilfracombe and Muttaburra (April 2020); 18 attendees in total
- Northern Service Providers Online Workshop in collaboration with Angus Australia and MLA – (10 December 2020); 54 registrations. Paul Williams also presented.
- Northern Service Providers Online Workshop in collaboration with Angus Australia – (15 June 2021); 37 registrations Paul Williams also presented.

For many of the attendees on the producer group sessions in Western Qld, this form of extension delivery method was relatively new and thus web meeting functionalities were kept to a minimum and not too many questions were asked live. Being able to deliver BREEDPLAN content remotely meant that two ~15-hour round trips were not undertaken, and the educational session could proceed despite travel restrictions in place. The webinar with Clara Bradford evolved as part of the MLA genetics campaign and led to some producer enquiries seeking further, more detailed information. The Northern Service Provider sessions eventuated from a discussion with Angus

Australia, after they had run multiple face-to-face and online service provider events in the south and a single run of stand-alone branded workshops in the north. The decision was made to collaborate with TBTS in order to help strengthen and streamline engagement with industry service providers.

4.7.3 Commercial property visits

Visiting commercial producers on-farm was deemed a favourable strategy to drive adoption of BREEDPLAN. During his secondment, Tim Emery visited 123 different properties across Northern Australia (113 in Qld, 5 in NT and 5 in WA) – see Fig. 13. This number would have been higher if it wasn't for COVID-19 restrictions and TBTS personnel not being able to travel for approximately five months in 2020.

Figure 13. Locations of the 123 different commercial properties Tim visited across Northern Australia during the project. Map created using Google My Map (https://www.google.com.au/maps/about/mymaps/).

As to be expected, some properties were visited on multiple occasions over time as a way to provide further follow up and build rapport. General topics covered whilst on farm included: understanding EBVs and their practical application (a live demonstrations of Internet Solutions was often conducted on their home computer), breeding programs, the fundamentals of genetic progress and basic herd recording to determine reproductive performance of a breeding herd. Given Tim Emery's Beef Extension Officer background, he was also able to also discuss producer queries that surfaced around breeder management and decision support tools.

4.7.4 Producer enquiries and known adoption as a result

Throughout the project, TBTS personnel received numerous enquiries from both seedstock and commercial producers either in person or via phone/email/text. Some enquiries came about

through breed society referrals but also through referral from other producers who'd had previous interactions with TBTS, indicating that the service offered by TBTS personnel was of value. A number of common enquiry examples received from seedstock producers has been mentioned in Section 3.5.2, however a comprehensive list of enquiries that Tim Emery has received and recorded over time (from both seedstock and commercial producers) appears as Appendix 4. As can be seen, the enquiries were recorded as either relating to BREEDPLAN and genetic technologies or breeding. Enquiries varied in length from a two minute phone conversation through to a half day comprehensive explanation of EBVs on-farm. Some enquiries required the need to seek further information from SBTS, ABRI, AGBU, genotyping laboratories, industry organisations and also producers in the TBTS network. Compiling a database of enquiries enabled the TBTS & SBTS teams to use this information to further develop relevant extension material, both articles and presentation slides, to use at events and have on hand for future producer enquiries.

Keeping track of every on-farm practice change that occurs as a result of educational support (such as enquiries) is a well-recognised challenge. Both Paul and Tim have noticed and been made aware of examples of practice change in the seedstock and commercial sector as a result of addressing producer enquiries and providing following up. From a seedstock perspective, a number of BREEDPLAN members are now measuring more traits and animals, more seedstock herds are becoming BREEDPLAN members (e.g. six new Brangus members in 2021) and many are embracing the use of DNA testing. Over the last two financial years (2020 and 2021), TBTS stakeholder breeds had a 3.2% and 3.4% increase respectively in the total number of animals analysed in BREEDPLAN per year. For Brangus, the growth per year was 4.6% and 6.5%, while Brahman was 3.9% and 4.7%.

From a commercial perspective, producers are known to have refined their breeding programs and commenced buying better bulls suited to their breeding objectives. Throughout the project, Tim has had 83 producers and five agents seek support to go through a comprehensive, facilitated process to identify bulls with genetic merit suitable for achieving their breeding objectives. To date, Tim has been made aware that 445 bulls and 115 semen straws were purchased during the project's duration as a result of these interactions. Of the 445 bulls, 100 were purchased by three bigger producers who previously hadn't utilised EBVs as part of their bull buying process. A further example of known practice change involves Tim providing ongoing EBV support to a north Qld based veterinarian, who was then able to impart his new found knowledge onto a large-scale client during a property visit. The producer is known to have now commenced purchasing bulls from a BREEDPLAN herd with elite Days to Calving EBVs and using these sires in their nucleus herd to breed bulls for their own use.

4.7.5 Various educational avenues

4.7.5.1 Articles

As mentioned in Section 3.5.3, TBTS worked collaboratively with a number of organisations who generate educational material for producers. Articles targeted at commercial producers that Tim Emery had involvement with include:

- MLA Feedback article 'Objectivity breeds better results' (July/August edition 2017).
- BredWell FedWell Pilot workshop/s summary article for the Qld Country Life (May 2019).
- 'Six steps to better bull buying' article for the MLA Feedback magazine (June/July 2019).
- Bull buying/EBV related article destined for the QCL/The Land.
- Beef Central article relating to 'Increasing the opportunities for genetic selection in Droughtmasters'.

Additional commercially orientated documentation written by Tim Emery included:

- 'Reaping the benefits of the information available' article written for the Brangus journal.
- One page handout for the 'Mt Elsa' property tour as part of Beef 2018.
- 'Searching for EBVs online' document for three MLA BeefUp Forums; modified versions appeared in two breed society magazines.
- 'Bull buying considerations' one pager for the Tips & Topics event near Mitchell.

4.7.5.2 Short videos

Short videos are becoming an increasingly popular way to help drive adoption of technologies/practices by producers. With this mind, the MLA Genetics Campaign heavily featured short videos about breeding objectives, understanding EBVs and selection indexes. As previously mentioned, TBTS were heavily involved in the development of campaign materials. This was mainly in the way of script development, but also Tim Emery originally recorded the navigating BREEDPLAN and Internet Solutions process, along with providing appropriate northern focused examples.

4.7.5.3 Discussion paper

In mid-September 2019, Droughtmaster Australia members were surveyed and it became evident that there were both varied views and understanding surrounding the broader topic of DNA testing and its application within the beef industry. In response to this, Droughtmaster Australia, with the assistance of TBTS, prepared a White Paper for distribution to its members. The White Paper was refined over several months by both the Droughtmaster Australia Board and TBTS to provide members with useful information about DNA testing and the genomics era, and how it may relate to the future of the Droughtmaster breed. Tim Emery spent considerable time on the White Paper and was provided with valuable feedback internally and from AGBU. The paper has had a positive influence on increasing the knowledge of members and was appreciated for its independent take on DNA technologies. At the final TBTS Annual General Meeting, it was mentioned that the White Paper has increased the adoption of DNA collection by members and Droughtmaster Australia is now putting DNA policies in place.

5. Conclusion

5.1 Key findings

The Australian beef breeding sector is very diverse, not just in geographical spread, but also in breeding objectives and target market endpoints, individual learning styles, and levels of prior knowledge about and experience using genetic evaluation systems such as BREEDPLAN. There are also individual breed nuances and localised production system differences to contend with. Given this, a wide range of extension activities that cater to the diversity within the sector are required to maximise the uptake and understanding of genetic improvement technologies in the Australian beef industry.

Throughout the duration of the TBTS project, delivery of extension services and technical support were key components. With the onset of COVID-19 in early 2020, the importance of these two components didn't change, however the approach taken by TBTS personnel had to evolve to meet the needs of the northern industry and successfully achieve the project objectives. For example, a number of face-to-face presentations were modified to suit electronic delivery and simply more time was spent on the phone and Zoom, providing one-on-one support to producers, instead of

conducting property visits. Producers were quite understanding when it came to the restrictions placed on TBTS personnel and over time became more confident in using online platforms.

Some key findings from the project include:

- By delivering extension activities and actively providing follow up support, a number of BREEDPLAN members are now measuring more traits and animals, more seedstock herds are becoming BREEDPLAN members, more seedstock producers are embracing the use of DNA testing and the average weighted selection index for the stakeholder breed societies has increased from $21.24 (2014-born calves) to $26.90 (2019-born calves). To support the statement of more animals being measured, in the 2020 and 2021 financial years, the TBTS breeds on average had a 3.2% and 3.4% increase in the total number of animals analysed in BREEDPLAN per year. Interestingly, the growth per year for Brangus for the same periods was 4.6% and 6.5%, while Brahman was 3.9% and 4.7%. Furthermore, by taking commercial producers through a facilitated process using BREEDPLAN, more bulls have been purchased with EBVs that align with their breeding objectives.
- TBTS personnel collectively delivered 152 face-to-face presentations to 5,236 attendees during the project. These numbers have been corrected to account for when both team members presented at the same event. In total, 110 individual seedstock properties were visited, along with 123 commercial operations. A further 70 consultations were undertaken with seedstock producers at the Regional Forums where the TBTS team were involved. To provide further support to producers and industry service providers, keep abreast of industry messages and promote the TBTS project more broadly, 91 industry events (on top of the 152 where the team presented) were attended by TBTS personnel.
- The introduction of the Brahman Single-Step BREEDPLAN analysis has shown that the difficulties of collecting data in Northern Australia may have hindered the uptake of BREEDPLAN in the past. This is shown with an increase of around 25% per year over the last two years in the number of animals with genotypes that are now being analysed in Brahman BREEDPLAN.
- Results out of the Repronomics and Brahman BIN project have had a large effect on the number of joining records being submitted to BREEDPLAN.
- Having TBTS involved in data management for large scale projects e.g. the Northern BIN has assisted in the project running smoothly and key research findings being made available in a timely fashion.
- Producers have been appreciative of being provided with key research project findings in the context of what it can mean for their business, instead of having to read extensive, detailed reports and scientific papers for the information.
- Delivering proof-of-profit slides from various projects, years, locations, breeds, and focused on a number of different production traits, was well received by producers and gave them increased confidence in the science.
- It is deemed important to have technical/extension personnel involved in research projects from the beginning and be involved on an ongoing basis. This helps extension outputs to be considered from the start and allows staff to keep up to date with key messages that can be extended to industry.
- Producers are more responsive to hearing about EBVs when they are discussed in conjunction with other key business components such as nutrition and reproduction.

- In order to really drive the adoption of BREEDPLAN, it has been pivotal for TBTS staff to build rapport and trust with producers, along with creating strong relationships across industry with researchers, industry service providers, stakeholder breed society staff and educational providers.
- To accelerate the increase in BREEDPLAN members, it's important to continue to further educate commercial producers about the benefits of using EBVs so they can create demand from the ground up.
- It's important to provide educational support to industry service providers who heavily influence the decision making of producers. By doing so, practice change will eventuate sooner as a result of the service provider supplying ongoing on-farm support.
- On the whole, the younger generation of producers are more open to wanting to learn more about EBVs and their practical application. This was evident on day two of the Cloncurry Genetics Muster when over 30 young producers stayed on to receive more intense, small group-based learning and individual support.
- Genuine practice change has been shown to occur the same day as a result of an educational session, but it's also known that producers have taken five plus years to implement change.
- Property visits are definitely appreciated by producers (See Appendix 5) and they typically provide support personnel with a better understanding of their management, systems in place, and technology utilised, and promote more in depth conversations.
- The value of having a physical presence at industry events cannot be underestimated. It allows for professional relationships to be both created and strengthened, an opportunity to keep abreast of industry messaging and provides a platform for raising further awareness of roles and projects.
- Some producers are more inclined to travel to an event if there is various topics being discussed instead of just one.
- When it comes to delivering content, it's always good to have multiple backup plans (e.g. slides, white board, flip charts), as access to power and internet can sometimes not eventuate or fail inconveniently.
- The EBV percentile graph has been well received by many producers as a quick way to ascertain the genetic merit of an animal for various traits.
- Hard copy documentation still has a place in providing educational information to producers.

5.2 Benefits to industry

The TBTS project has successfully delivered a wide range of extension activities that were designed to maximise the uptake and understanding of genetic improvement technologies in the Australian beef industry. With the average weighted selection index for the stakeholder breed societies increasing from $21.24 (2014-born calves) to $26.90 (2019-born calves) over the duration of the project, the flow on effects will be felt across the beef supply chain.

The introduction of genomically enhanced (Single-Step) breeding values and revised (version 6.2) BreedObject selection index software are high profile examples of new and/or revised technologies that had significant flow on effects for the whole beef value chain. While the initial effect of these technologies is in the seedstock sector, they enable the selection of genetically superior bulls better suited to commercial production systems. In turn, this will produce better commercial progeny for the feedlot and processor components of the industry. Given that both Single-Step and BreedObject

are based on highly technical methodology, significant TBTS project resources were required for the technical support and extension messaging of these technologies.

Through delivering 152 face-to-face presentations during the project, TBTS played a major role in assisting getting results and recommendations from Northern Research Projects on fertility and carcase attributes out to both seedstock and commercial producers. Some benefits from this have been an increase in the number of joining records submitted to BREEDPLAN, along with producers refining their breeding programs and buying better bulls suited to their breeding objectives. It is known that as a result of undertaking a facilitated process with 83 producers and five agents, 445 bulls and 115 semen straws with suitable genetic merit aligned with breeding objectives were purchased during the project. It is envisaged that this number will continue to grow over time as a result of producers and industry service providers having been up-skilled during this project about EBVs and their practical application.

Significant time was spent educating producers on the BREEDPLAN fundamentals. Some topics frequently covered by extension personnel included explaining why breeding values change, how to interpret EBV accuracy, the recording age ranges for each trait and the importance of correctly assigning management groups. Producer understanding of these fundamentals is required to ensure that the data submitted to and analysed by BREEDPLAN is of high quality, allowing the production of accurate breeding values and facilitating the selection of genetically superior animals.

In conclusion, the TBTS project has provided a wide range of innovative extension and technical support activities to maximise the use and understanding of BREEDPLAN and related genetic technologies in the Northern Australian beef industry. As such the project facilitated the seamless transfer of information from genetic evaluation researchers and service providers to the end users of genetic improvement technologies.

6. Future research and recommendations

With beef genetics being a constantly evolving and technically challenging space, there remains a strong requirement for personnel and projects that operate in the space between the research and technical operations of the BREEDPLAN genetic evaluations, and those who use genetic improvement technologies in their herds. Furthermore, research projects (current and future) require a careful and considered extension program to ensure key research findings are adequately explained and uptake maximised in the wider Australian beef industry. Extension projects such as TBTS are well placed to act as the link between researchers and the wider beef industry and have the necessary experience and contacts to disseminate important extension messages.

The current iteration of the TBTS project has been challenged by the limited resources (e.g. 2 FTEs) available to undertake extension work to a diverse and geographically spread beef seedstock sector. Due primarily to the financial assistance of the DAF, the project benefited from the secondment of Tim Emery, whose role predominantly focused on driving adoption in the commercial sector. This input assisted the project to achieve its five objectives. However, the resourcing available for any future iterations should be carefully considered, as additional resources would give such a project greater scope and ability to achieve success.

Future project iterations should continue to include messaging and resources for commercial beef producers, and incorporate tailored solutions for those involved in wider industry roles, such as agents, processors, veterinarians and those involved in the formal education space (e.g. researchers, lecturers and agricultural teachers). The Beef Genetics Champions Network, that was led by the

SBTS Project in its last iteration (with TBTS personnel playing a supporting role), has helped fill the knowledge transfer gap left for extension personnel since the previous Beef CRCs, and is a successful example on which such tailored solutions could be modelled. Greater reach of genetics extension across the whole industry supply chain would be of significant benefit to producers and industry personnel around Australia; however, such programs would need to be carefully structured and funded to reach their full potential.

Future research:

- Throughout this project iteration, a number of producers have mentioned to TBTS personnel about wanting multi-breed EBVs to be a reality in the very near future. The Repronomics Project, Northern BIN and relatively new Southern Multi Breed Project are all contributing significantly to this goal, and it is deemed imperative that these projects are supported in the long-term. Northern producers have shown great interest in the findings to date from the Repronomics Project and Northern BIN, with there being numerous known cases of on-farm practice change e.g. better sire selection for genetic superiority. A desire that has surfaced repeatedly is that of including additional breeds and crossbreeding in the aforementioned research projects. Undoubtedly this would involve major resourcing, however it is envisaged it would be offset by the substantial benefits to the Australian beef industry.
- Explore establishing an EBV Proof of Profit Producer Demonstration Site in northern WA, similar to those conducted overtime in Qld. The Qld demonstrations have been known to influence the genetic selection decisions of many producers, in particular those producers who hosted the demonstrations.

Challenges to genetic progress and/or adoption of EBVs:

- At present, there are minimal examples of a relationship existing between sale price received and the genetic merit of an animal. Numerous buyers continue to be drawn to the physical attributes displayed by an animal and raw data such as live weight. Large numbers of bulls continue to be sold with minimal objectively described genetic information and often achieve higher sale averages than those with EBVs. Given the time, effort and expense of undertaking performance records for BREEDPLAN, this can be disheartening for BREEDPLAN members and has been known to influence producers cease their BREEDPLAN membership.
- The demand for polled cattle is stronger than ever and predicted to keep growing. There is however a number of producers who are somewhat single trait selecting for polledness and this may be contributing to the low levels of genetic progress being made for other economically important traits.
- Producers are being perceived by other producers to be buying bulls using EBVs only and disregarding structural soundness, temperament and breed character. This is contributing to a portion of industry reluctant to support the use of EBVs.
- A large portion of Northern Australia poses challenging environmental conditions for beef production. Use of bulls that can adapt and thrive are highly sought after, regardless of whether or not they have EBVs. The desire to create 'adaptation' EBVs as such has been raised amongst industry.

- Producers in WA have shown interest in using EBVs to select bulls with desirable genetic merit, however they have found themselves somewhat restricted in the genetic options available to them. This is due to minimum Johne's Beef Assurance Score (J-BAS) requirements needed for their state and some seedstock producers in the eastern states not wanting to endure the costs and risks of undertaking J-BAS testing.
- The presence of mickey bulls in Northern Australia is still a reality and with this comes competition that can impact genetic progress being made.
- Producer perceptions about EBV accuracy; a number of producers have commented over time that unless it's 50% or higher the EBV isn't worth looking at.
- Extreme climatic events such as droughts and floods (along with bushfires) have negatively impacted the industry in so many facets. From a genetics perspective, some genetics no longer exist as a result of animal deaths and the destruction of semen tanks. There has also been forced sales and a reduction in data recording due to financial and labour constraints.
- Although there are conversations currently taking place within industry on the topic of remuneration/incentives for those seedstock producers submitting phenotypes for genetic evaluation, it is deemed necessary for this to occur promptly, otherwise some of these producers may cease submitting data. Particularly in those breeds with single-step BREEDPLAN, these seedstock producers are now competing in the market place with those producers who are supplying EBVs to commercial producers based on genomics only.

Possible new adoption activities/approaches going forward:

- Implement a mentoring program where long-term BREEDPLAN members (with a high Complete of Performance star rating) provide support to new BREEDPLAN members.
- Establish BREEDPLAN focused producer groups that promote adult learning principles and create an environment that stimulates on-farm practice change; concept launched by MLA at Beef 2021.
- Undertake a yearly or bi-annual producer tour that showcases how BREEDPLAN is adding value along the whole supply chain; tours would look to alternate between states.
- Devise more short videos that include BREEDPLAN members and how they utilise the technology in their business and the benefits it provides them.
- Independently survey seedstock herds that were previously BREEDPLAN members but aren't now and try ascertaining why they are no longer members; likely to provide some insight into how to further grow BREEDPLAN membership going forward.
- Implementation of a genetics focused Profitable Grazing Systems in Northern Australia; a pilot program has recently commenced in southern Australia.
- Establish a formalised group of international extension/technical staff to share learnings on various approaches being used to drive the adoption of BREEDPLAN; initial conversations to date.

In conclusion, the ongoing support of an efficient and effective national extension and technical support network for the Australian beef industry should be prioritised. This would enable the continued utilisation of genetic technologies, and associated rates of genetic improvement, which would lead to significant flow on benefits for the entire beef supply chain.

7. Acknowledgements

ABRI would like to acknowledge the contributions to the Project of the following organisations, groups and individuals;

- MLA funding
- Queensland Government – Department of Agriculture and Fisheries co-funding
- Stakeholder Breed Societies
    - Australian Brahman Breeders Association
    - Australian Brangus Cattle Association
    - Belmont Australia
    - Droughtmaster Breeders Society
    - Santa Gertrudis Breeders (Australia) Association
    - Senepol Cattle Breeders Association
    - Simmental Australia - Simbrah
- Southern Beef Technology Services extension team
- ABRI staff
- AGBU scientists

8. References

Australian Registered Cattle Breeders Association 2020, *ARCBA 2020 Registration Report*, Armidale, New South Wales.

9. Appendix 1

9.1 2017 and 2018 regional forums

9.1.1 Registrations and attendance

Table 1.1. Summary of registrations and attendance at each of the regional forums.

Location	Date	No. Registered	No. Attended
Armidale[B]	23 March 2017	18	18
Albury[B]	3 April 2017	14	13
Seymour[B]	4 April 2017	6	6
Warragul[B]	5 April 2017	14	12
Hamilton[B]	6 April 2017	7	6
Launceston[B]	7 April 2017	7	7
Dubbo[B]	6 June 2017	4	4
Orange[B]	7 June 2017	6	5
Goulburn[B]	8 June 2017	8	8
Toowoomba[A]	18 July 2017	18	15
Albany[B]	17 January 2018	11	11
Bunbury[B]	19 January 2018	15	14
Perth[B]	22 January 2018	13	13
TOTAL		**141**	**132**

[A] Delivered in conjunction with SBTS project personnel. [B] Delivered by SBTS project personnel.

9.1.2 Feedback

Table 1.2. Attendees were asked to rate how useful they found each of the regional forum sessions.

Please Rate How Useful You Found Each Session	Extremely Useful	Very Useful	Somewhat Useful	Not Very Useful	Not At All Useful
BREEDPLAN 101: Recording Performance Information in Your Herd.	40%	44%	14%	2%	0%
BREEDPLAN Contemporary Groups & Genetic Linkage.	51%	41%	8%	0%	0%
Making BREEDPLAN Work For You: Common Performance Recording Problems and How to Avoid Them.	36%	51%	12%	1%	0%
How Much Performance Data Do You Collect? Interpreting Your Completeness of Performance Report.	39%	48%	12%	0%	1%
Are You Making Progress: Interpreting Your Genetic Progress Report.	37%	49%	13%	1%	0%
Single-Step BREEDPLAN: What Does Genomics Mean For You?	41%	43%	16%	0%	0%
AVERAGE	**41%**	**46%**	**13%**	**1%**	**0%**

Figure 1.1. Attendees were asked whether they felt they had a better understanding of BREEDPLAN as a result of attending the regional forum.

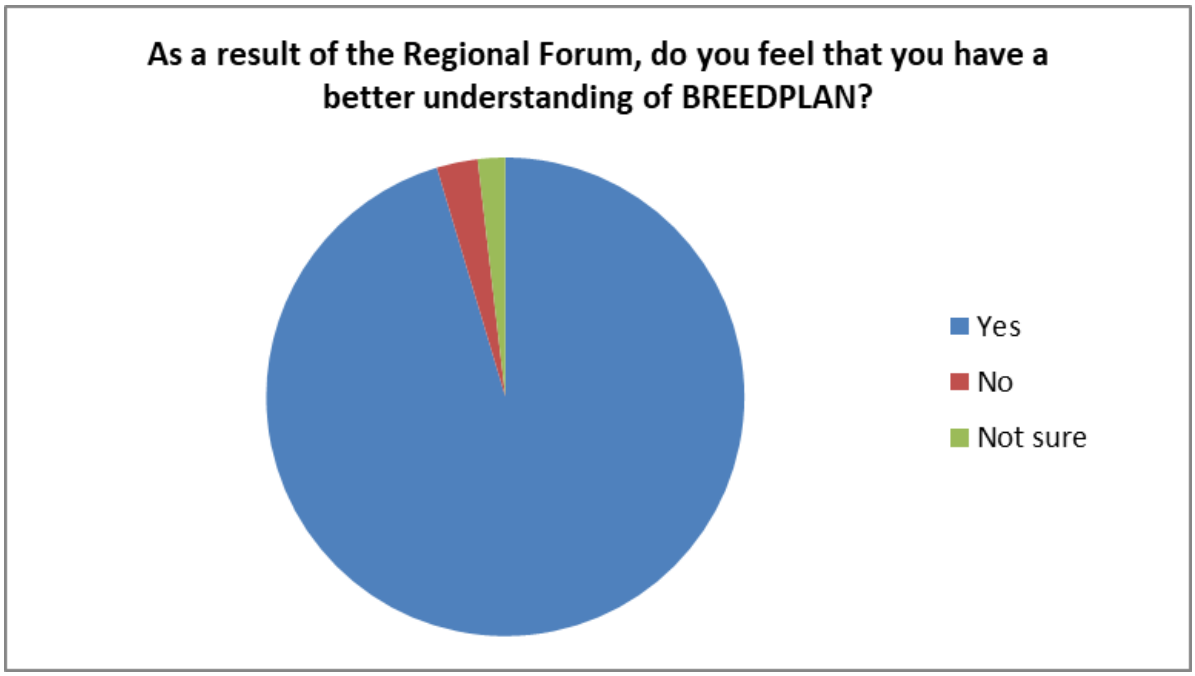
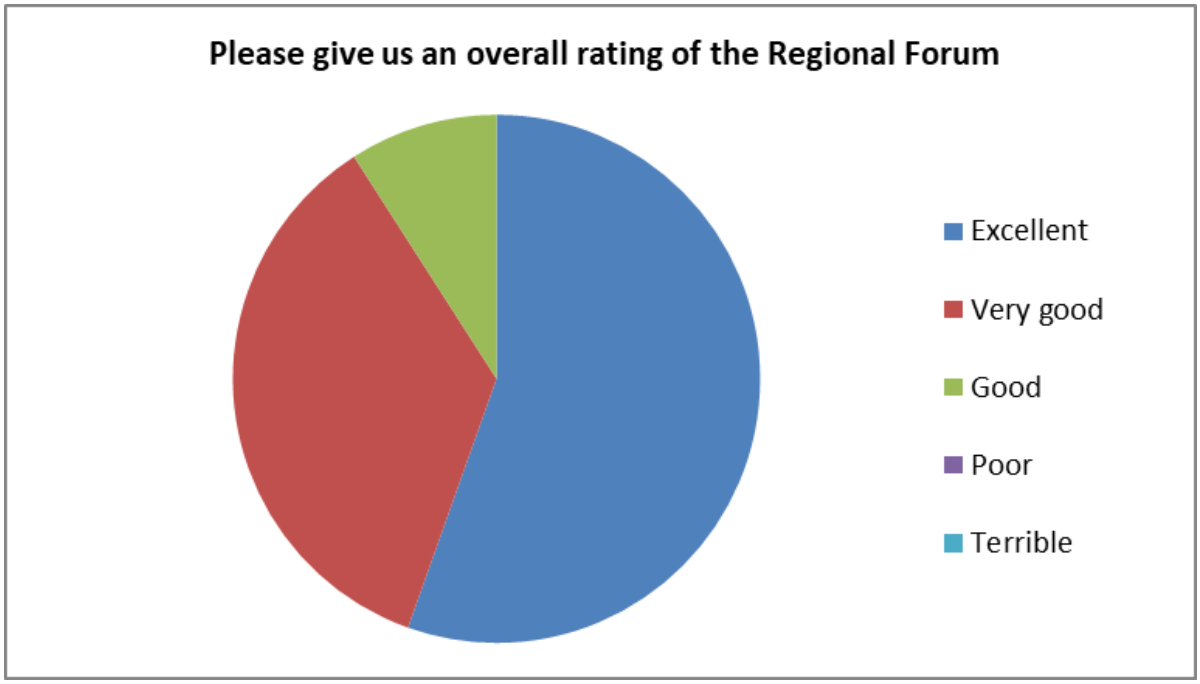


Figure 1.2. Attendees were asked to give an overall rating of the regional forum.



9.1.3 Learning outcomes

Table 1.3. Attendees were asked a number of questions at the start and end of the regional forum, to gauge whether their knowledge of BREEDPLAN increased as a result of their attendance at the regional forum.

Question	Percent attendees with correct answer		Improvement
	Pre-Forum	Post-Forum	
Which Trait(s) Does BREEDPLAN Recommend You Collect at Weaning?	20%	44%	24%
When Should You Record Mature Cow Weight?	50%	90%	40%
Are Bull and Heifer Calves Compared in the Same Contemporary Group?	67%	93%	26%
What Should You Be Aiming For (as a minimum) in Your Contemporary Groups?	12%	67%	56%
What Happens if an Outlier is Not Verified?	45%	85%	40%
Why Is Selective Recording a Problem?	61%	81%	20%
What Does Your Completeness of Performance Report Tell You?	18%	62%	44%
Genomics Works Best When?	30%	80%	50%
Should You Stop Performance Recording When Genomics is Available For Your Breed?	68%	89%	21%
AVERAGE	**41%**	**77%**	**36%**

9.2 2019 regional forums

9.2.1 Registrations and attendance

Table 1.4. Summary of registrations and attendance at each of the regional forums.

Location	Date	Topic	No. Registered	No. Attended
Armidale[B]	26 March 2019	BREEDPLAN Fundamentals	18	16
Armidale[B]	27 March 2019	DNA Technology	21	18
Albury[B]	29 April 2019	BREEDPLAN Fundamentals	11	11
Albury[B]	30 April 2019	DNA Technology	11	10
Toowoomba[A]	20 May 2019	BREEDPLAN Fundamentals	36	35
Toowoomba[A]	21 May 2019	DNA Technology	35	33
Launceston[B]	27 May 2019	BREEDPLAN Fundamentals	7	7
Launceston[B]	28 May 2019	DNA Technology	7	7
Rockhampton	5 June 2019	BREEDPLAN Fundamentals	14	14
Rockhampton	6 June 2019	DNA Technology	19	17
Muswellbrook[B]	8 July 2019	BREEDPLAN Fundamentals	8	7
Muswellbrook[B]	9 July 2019	DNA Technology	9	8
Orange[B]	10 July 2019	BREEDPLAN Fundamentals	10	8
Orange[B]	11 July 2019	DNA Technology	10	8
Albany[A]	25 July 2019	BREEDPLAN Fundamentals	9	8
Albany[A]	26 July 2019	DNA Technology	10	10
Bunbury[A]	29 July 2019	BREEDPLAN Fundamentals	7	6

Bunbury[A]	30 July 2019	DNA Technology	6	6
Perth[A]	31 July 2019	BREEDPLAN Fundamentals	5	3
Perth[A]	1 August 2019	DNA Technology	9	6
Warragul[B]	3 September 2019	BREEDPLAN Fundamentals	8	8
Warragul[B]	4 September 2019	DNA Technology	10	9
Hahndorf[B]	7 November 2019	BREEDPLAN Fundamentals	4	4
Hahndorf[B]	8 November 2019	DNA Technology	8	8

[A] Delivered in conjunction with SBTS project personnel. [B] Delivered by SBTS project personnel.

9.2.2 Feedback

Table 1.5. Attendees were asked to rate how useful they found each session at the BREEDPLAN Fundamentals regional forum.

Please Rate How Useful You Found Each Session	Extremely Useful	Very Useful	Somewhat Useful	Not Very Useful	Not At All Useful
The Role of Genetics in Beef Breeding	45%	42%	12%	1%	0%
BREEDPLAN: From Paddock to EBVs	46%	43%	11%	0%	0%
BREEDPLAN: Analysis and Beyond	40%	41%	18%	0%	0%
Making BREEDPLAN Work For You	46%	43%	11%	0%	0%
BREEDLAN Resources	40%	45%	14%	1%	0%
BREEDPLAN Completeness of Performance	39%	44%	16%	1%	0%
Utilising BREEDPLAN to Improve Your Herd	52%	41%	6$	1%	0%
AVERAGE	**44%**	**43%**	**14%**	**1%**	**0%**

Table 1.6. Attendees were asked to rate how useful they found each session at the DNA Technologies regional forum.

Please Rate How Useful You Found Each Session	Extremely Useful	Very Useful	Somewhat Useful	Not Very Useful	Not At All Useful
BREEDPLAN Refresher	33%	44%	18%	2%	2%
Benchmarking Your Herd: CoP and Genetic Progress	46%	48%	4%	0%	1%
DNA Technology for Beef Breeders: Parentage Verification	52%	47%	7%	1%	0%
DNA Technology for Beef Breeders: Genetic Conditions	38%	44%	18%	0%	0%
DNA Technology for Beef Breeders: Single-Step BREEDPLAN	51%	41%	8%	1%	0%
What Does DNA Technology Mean For You?	46%	42%	11%	1%	0%
AVERAGE	**44%**	**44%**	**11%**	**1%**	**1%**

Figure 1.3. Attendees were asked whether they felt they had a better understanding of BREEDPLAN as a result of attending the BREEDPLAN Fundamentals regional forum.

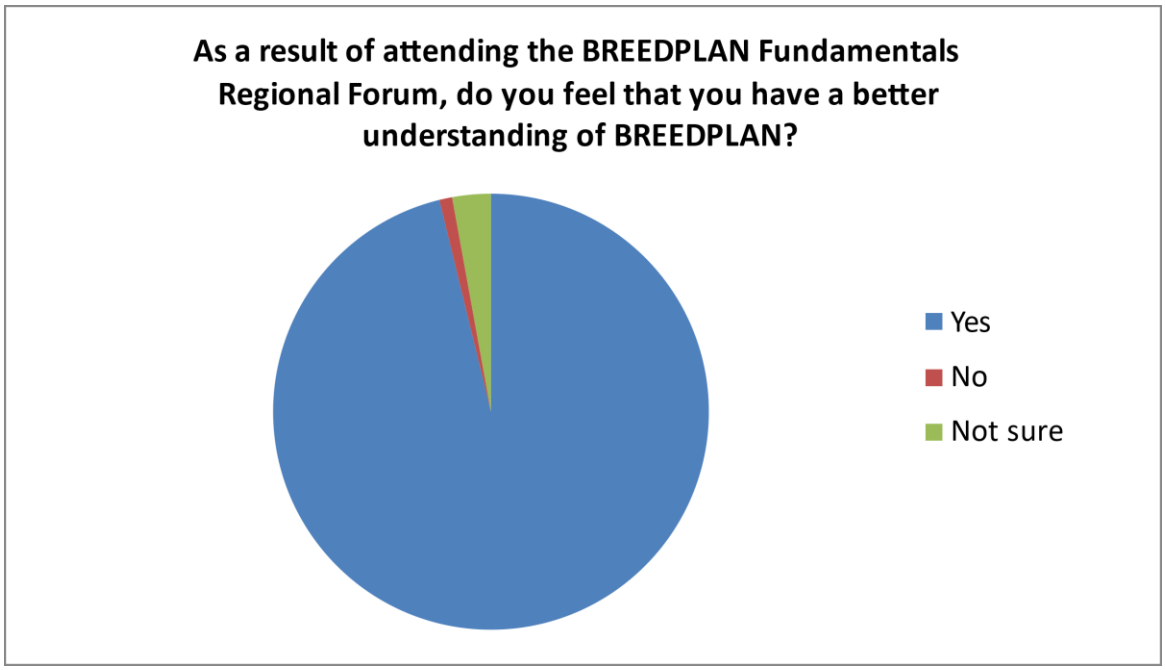


Figure 1.4. Attendees were asked whether they felt they had a better understanding of the use of DNA technologies in cattle breeding as a result of attending the DNA Technologies regional forum.

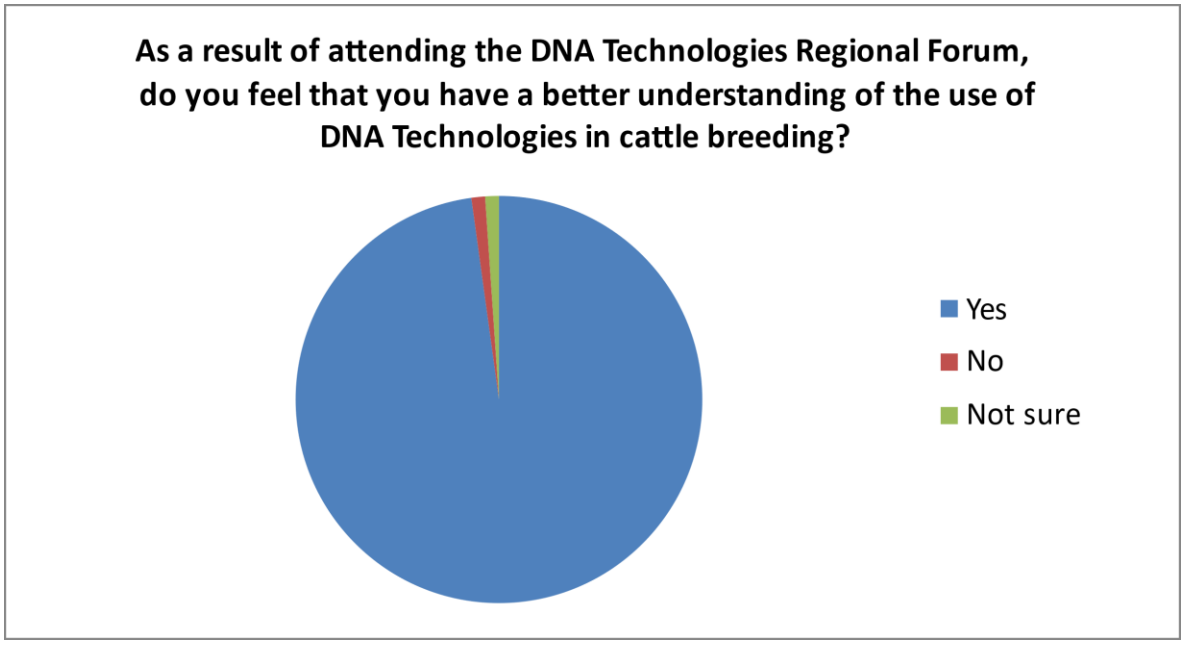


Figure 1.5. Attendees were asked to give an overall rating of the BREEDPLAN Fundamentals regional forum.

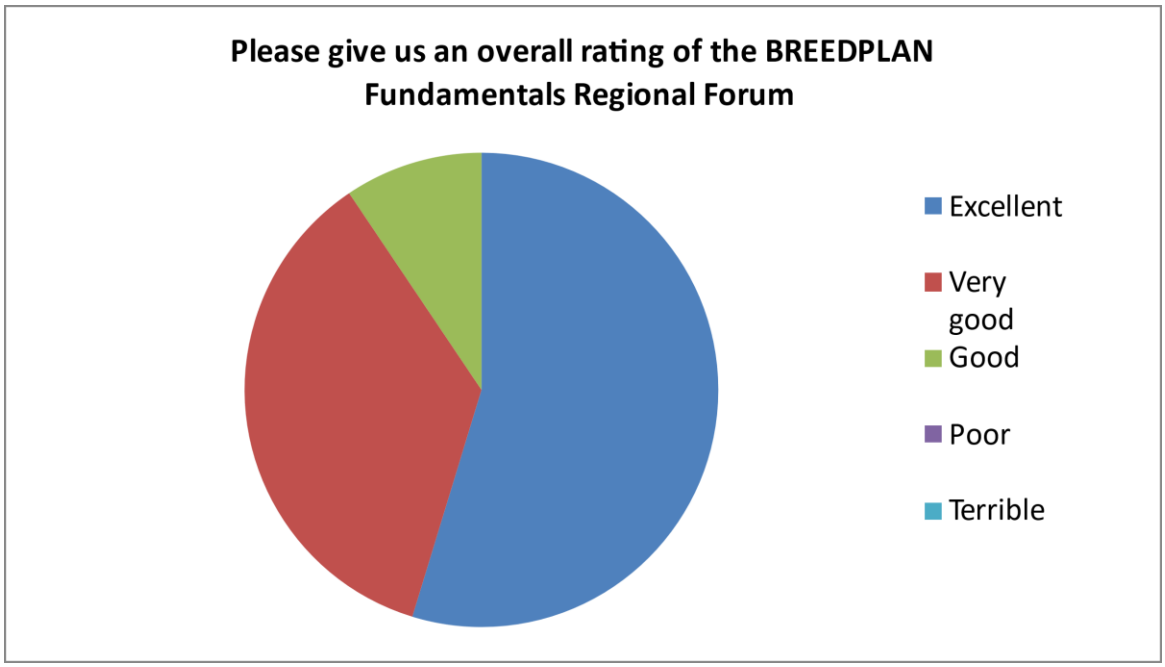
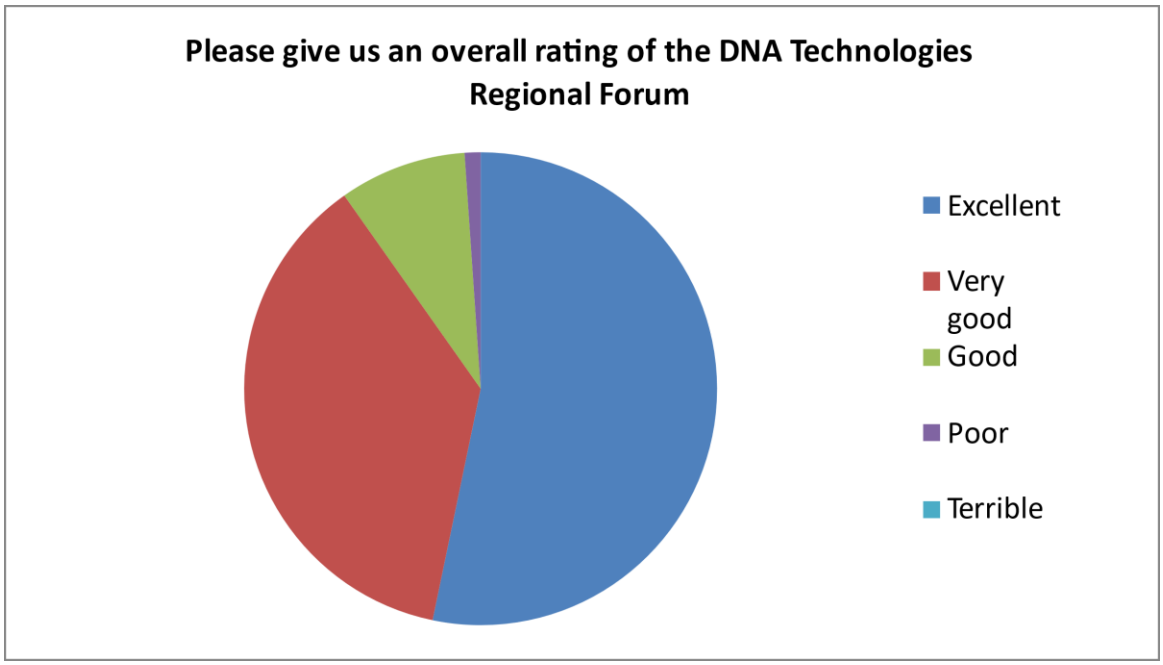


Figure 1.6. Attendees were asked to give an overall rating of the DNA Technologies regional forum.



9.2.3 Learning outcomes

Table 1.7. Attendees were asked a number of questions at the start and end of the BREEDPLAN Fundamentals regional forum, to gauge whether their knowledge of BREEDPLAN improved as a result of their attendance at the BREEDPLAN Fundamentals regional forum.

Question	Percent attendees with correct answer		Improvement
	Pre-Forum	Post-Forum	
What a sire passes on to his progeny is:	42%	67%	26%
Breeder defined management groups:	37%	84%	47%
GROUP BREEDPLAN compares animals across different environments by:	30%	68%	39%
What Happens if an Outlier is Not Verified?	31%	74%	43%
Why Is Selective Recording a Problem?	70%	81%	11%
What Does Your Completeness of Performance Report Tell You?	25%	74%	49%
Select if TRUE - BREEDPLAN EBVs:	94%	97%	3%
AVERAGE	**47%**	**78%**	**31%**

Table 1.8. Attendees were asked a number of questions at the start and end of the DNA Technologies regional forum, to gauge whether their knowledge of DNA technologies improved as a result of their attendance at the DNA Technologies regional forum.

Question	Percent attendees with correct answer		Improvement
	Pre-Forum	Post-Forum	
Which of these will NOT improve accuracy of selection?	51%	75%	24%
Parent Verification Works By:	14%	70%	56%
Which of these options would INCREASE likelihood of genetic conditions appearing?	57%	72%	15%
If a producer wishes to avoid breeding horned animals, they should:	70%	90%	20%
Which of these statements about Single-Step BREEDPLAN is INCORRECT?	28%	64%	36%
Should You Stop Performance Recording once Single-Step BREEDPLAN is Available For Your Breed?	77%	96%	18%
AVERAGE	**50%**	**78%**	**28%**

9.3 Regional forum follow-up survey

Table 1.9. Follow-up survey respondents were asked whether they would be interested in hearing about these topics at a future SBTS & TBTS regional forum.

Potential Topics	Percentage Survey Respondents Interested
BREEDPLAN news and developments	68%
Best practice guide to using BREEDPLAN information in animal selection	82%
Breeding objective – curve bender animals	82%
Breeding objectives – breeding heifer bulls	55%
Breeding objectives – breeding the perfect steer (including MSA compliance)	55%
Breeding objectives – breeding for environmental efficiency	59%
Breeding objectives – breeding maternal cows	68%
Understanding selection indexes	73%
Mate selection – including Mating Predictor, MateSel, inbreeding and genetic diversity	77%
Presenting BREEDPLAN information to your clients	68%

10. Appendix 2

10.1 Registrations and attendance

Table 2.1. Summary of registrations and attendance at each session of the 2016 webinar series. Total views and average view duration of the webinar recordings (via YouTube) are also shown.

2016 Webinar Series Session	No. Registered	No. Attended	YouTube Views[A]	Average View Duration (%)
Choosing Bulls to Suit Your Program	72	33	414	13%
Getting It Right: Management Groups & Contemporary Groups	39	19	187	19%
Making BREEDPLAN Work For You: Performance Recording Problems to Avoid	55	28	153	8%
Fertility Matters: Recording Fertility Information with BREEDPLAN	48	20	203	16%
Collecting Abattoir Carcase Information for BREEDPLAN	42	17	109	13%
Where To With Genomics?	78	35	253	22%
Total (Unique)	**334 (191)**	**152 (99)**	**1,319**	**15%**

[A] As at 30 June 2021.

10.2 Feedback

Table 2.2. Attendees were asked whether they found each of the 2016 webinar series sessions useful.

Did You Find This Webinar Useful?	Strongly Agree	Agree	Neither Agree Nor Disagree	Disagree	Strongly Disagree
Choosing Bulls to Suit Your Program	8%	92%	0%	0%	0%
Getting It Right: Management Groups & Contemporary Groups	14%	79%	0%	7%	0%
Making BREEDPLAN Work For You: Performance Recording Problems to Avoid	15%	70%	15%	0%	0%
Fertility Matters: Recording Fertility Information with BREEDPLAN	17%	61%	22%	0%	0%
Collecting Abattoir Carcase Information for BREEDPLAN	0%	71%	29%	0%	0%
Where To With Genomics?	17%	70%	13%	0%	0%
AVERAGE	**12%**	**74%**	**13%**	**1%**	**0%**

Figure 2.1. Webinar 1 attendees were asked whether they felt better equipped to search online sale and/or semen catalogues as a result of attending the webinar.

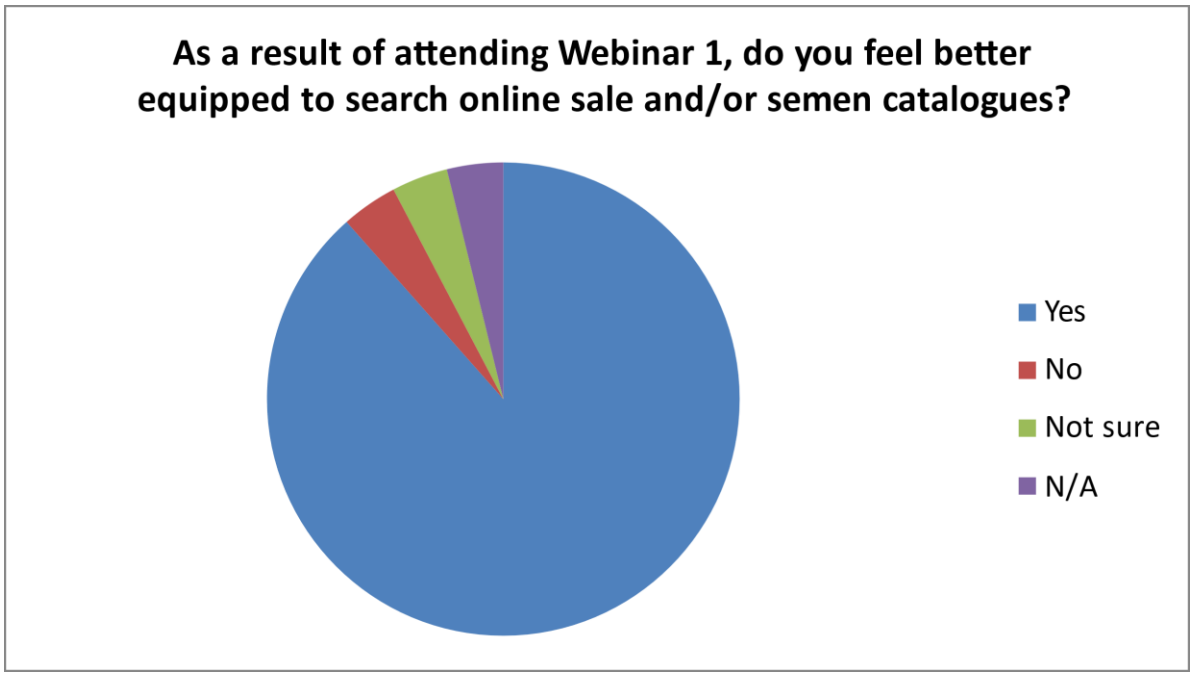


Figure 2.2. Webinar 1 attendees were asked whether they felt better equipped to identify animals with genetics that suit their breeding objectives as a result of attending the webinar.

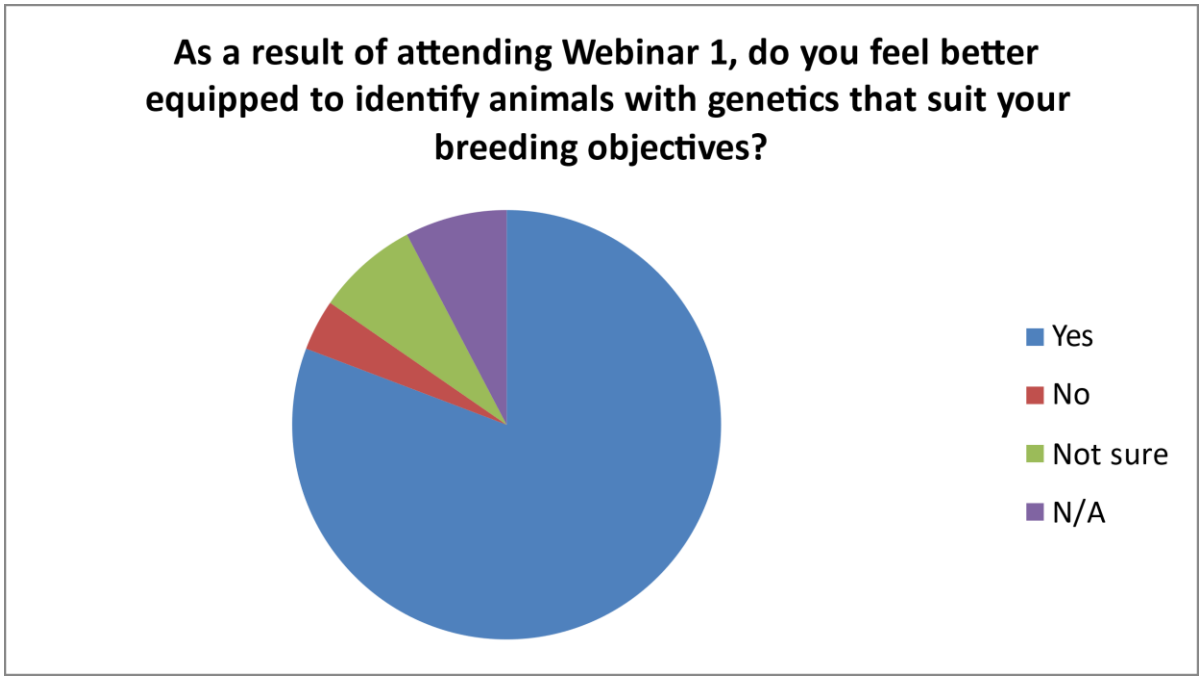


Figure 2.3. Webinar 2 attendees were asked whether they felt they had a greater understanding of BREEDPLAN contemporary group formation as a result of attending the webinar.

Figure 2.4. Webinar 2 attendees were asked whether they felt had a better understanding of how to maximise their contemporary group size for their herd as a result of attending the webinar.

Figure 2.5. Webinar 2 attendees were asked whether they had a greater understanding of when to provide management groups to BREEDPLAN as a result of attending the webinar.

Figure 2.6. Webinar 3 attendees were asked whether they felt they had a greater understanding of common performance problems as a result of attending the webinar.

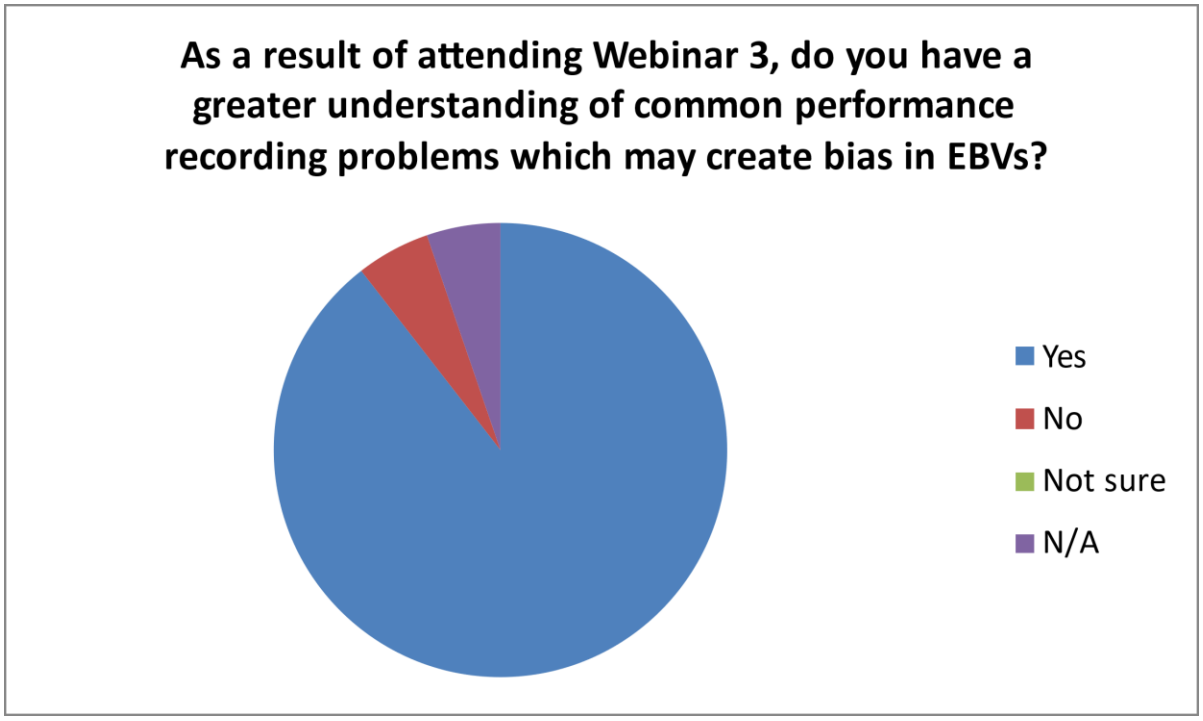


Figure 2.7. Webinar 4 attendees were asked whether they felt they had a better understanding of how to record fertility information for BREEDPLAN as a result of attending the webinar.

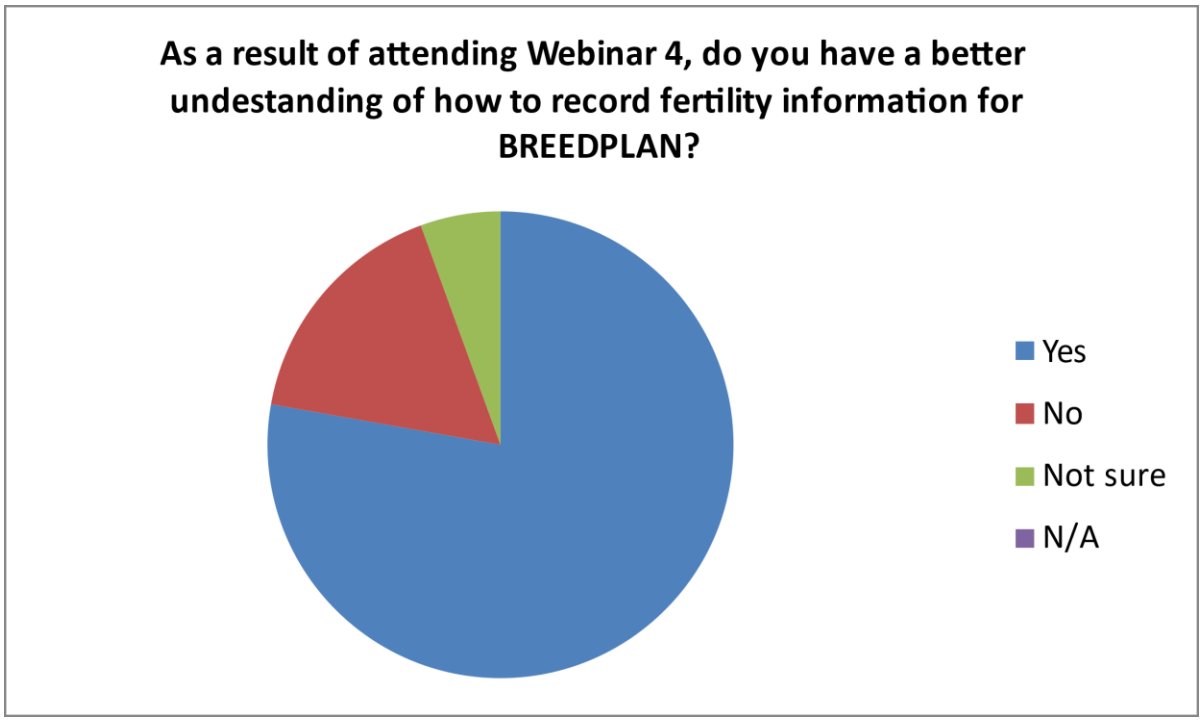


Figure 2.8. Webinar 5 attendees were asked whether they felt they had a greater understanding of how to collect good quality abattoir carcase information as a result of attending the webinar.

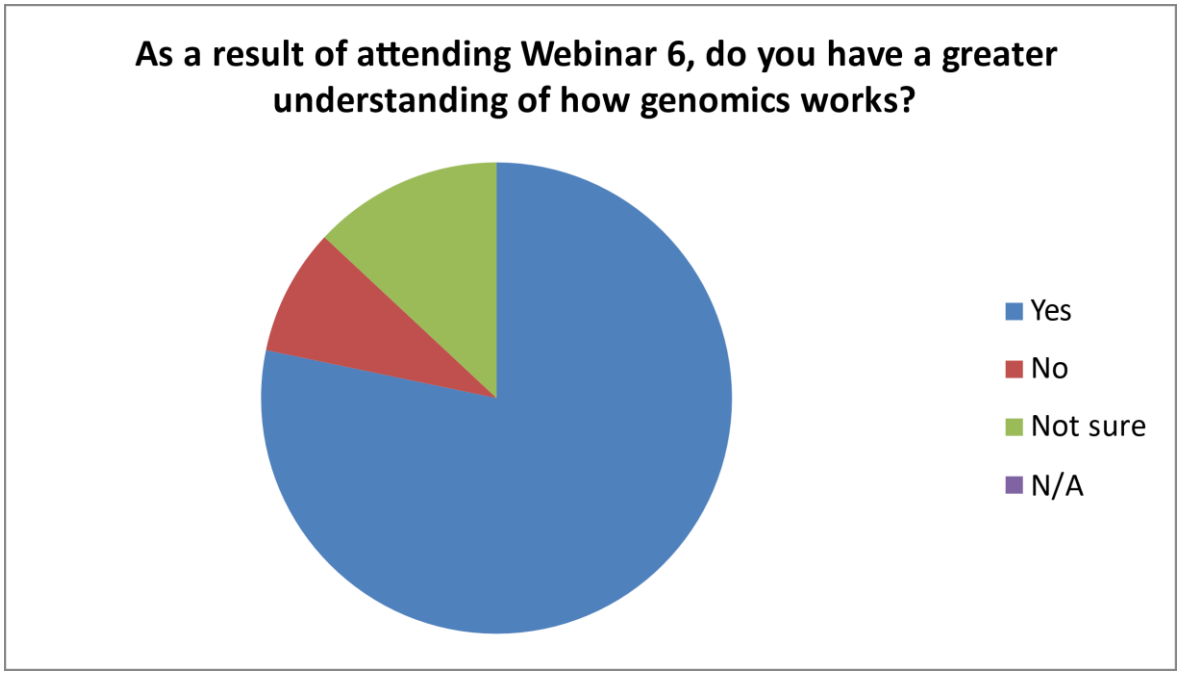


Figure 2.9. Webinar 6 attendees were asked whether they felt they had a greater understanding of how genomics works as a result of attending the webinar.

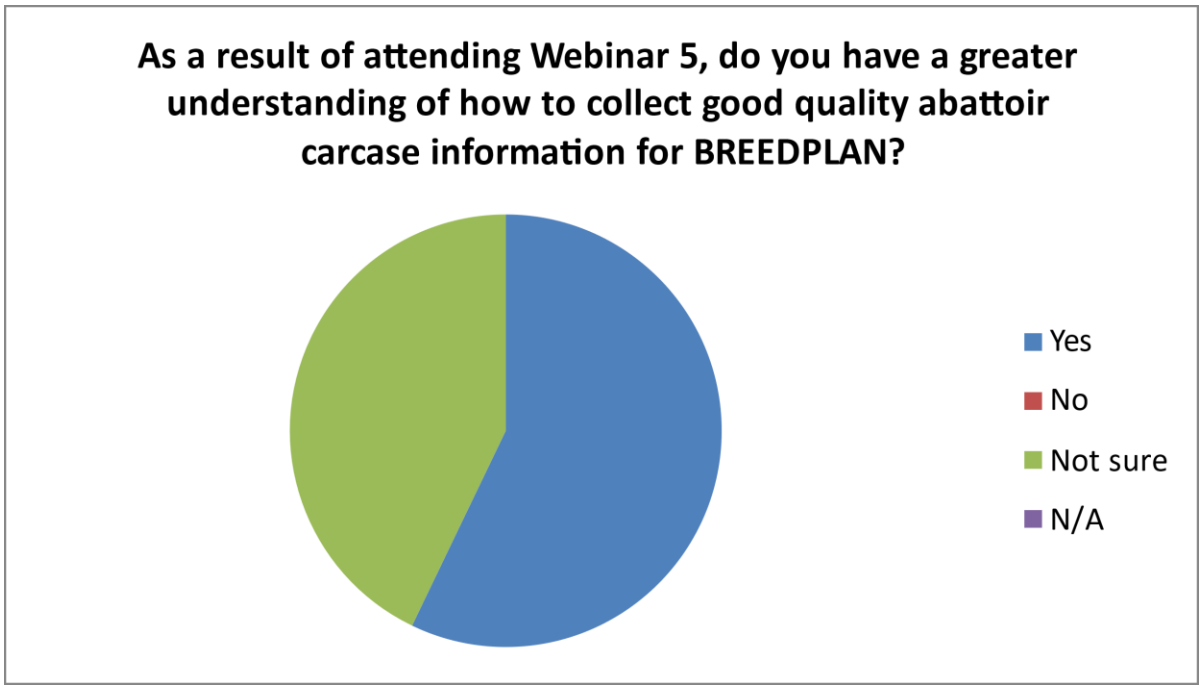


Figure 2.10. Webinar 6 attendees were asked whether they felt they had a greater understanding of the benefits of genomics as a result of attending the webinar.

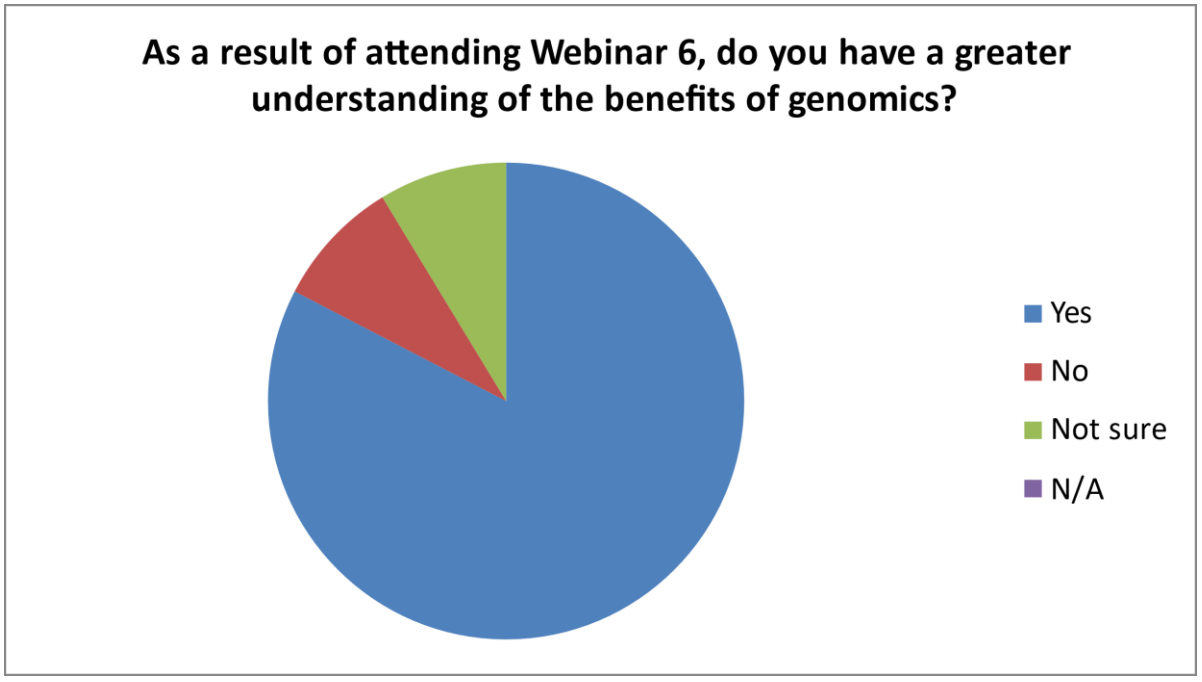
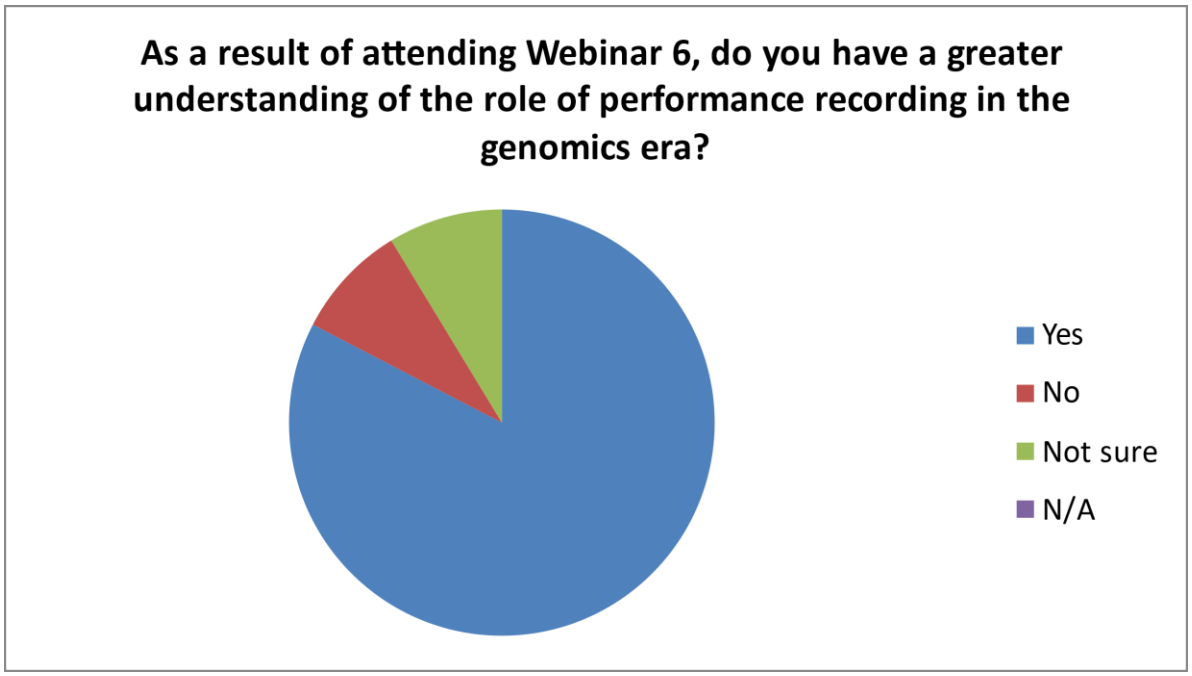


Figure 2.11. Webinar 6 attendees were asked whether they felt they had a greater understanding of the role of performance recording in the genomics era as a result of attending the webinar.



11. Appendix 3

Table 3.1. Face-to-face presentations delivered by Tim throughout the project.

Date	Event	Description	Location	Attendees
Apr-17	Breeding EDGE workshop[A]	Pilot workshop	Clermont	14
19/05/2017	Grazing BMP Workshop	Presented Animal Production Module	Dunkeld	11
16/06/2017	Bull selection day (Traprock Beef Group)	Full day breeding & genetics content	Texas*	14
Jul-17	Breeding EDGE workshop[A]	In-house training	Durham*	9
18/07/2017	TBTS/SBTS Regional Forum	Co-delivered with P.Williams & C.Millen	Toowoomba	15
29/07/2017	Beef challenge weigh day	Breeding & genetics content	Jundah*	11
1/08/2017	OBE Grazing BMP Workshop	Presented Animal Production Module	Blackall	10
17/08/2017	Gyranda Open Day	Selecting the right bull for you	Cracow*	70
15/09/2017	Meat Standards Australia Awards Night[A]	The role genetics plays in achieving the perfect MSA Index	Gympie	82
31/10/2017	Grazing BMP Workshop	Presented Animal Production Module	Mt Surprise*	11
7/11/2017	Grazing BMP Workshop	Presented Animal Production Module	Richmond	9
Nov/Dec 17	Breeding EDGE workshop[A]	Service provider training	Rockhampton	13
6/12/2017	Upskilling agents session	In-house training for mainly new regionally based Qld staff	Roma	15
Feb-18	Tips & Topics Day	Breeding & genetics content	Dirranbandi	40
Mar-18	Breeding EDGE workshop[A]	Co-delivered	Broome	15
Mar-18	Breeding EDGE workshop[A]	Co-delivered	Richmond	9
Mar-18	Grazing BMP Workshop	Presented Animal Production Module	McKinlay	15
Mar-18	Grazing BMP Workshop	Presented Animal Production Module	Cloncurry*	12
Mar-18	Northern Gulf Grazing Forum	Breeding & genetics content	Mt Surprise*	20
Apr-18	Breeding EDGE workshop[A]	Co-delivered	Port Hedland	10
May-18	Beef 2018 Property Tour (Mt Elsa)	Genetic progress in the SC Grazing herd	Rockhampton*	100
Jun-18	GrazingFutures Herd Management Day	Breeding & genetics content	Miles	17
Jun-18	GrazingFutures Herd Management Day	Breeding & genetics content	Surat*	17

Jun-18	Grazing BMP Workshop	Presented Animal Production Module	Injune	5
Jun-18	Brian Pastures Field Day	EBV presentation	Gayndah*	200
Jun-18	Grazing BMP Workshop	Presented Animal Production Module	Roma	6
Jun-18	ABCA Zone 3 Open Day	Are you using tools to make more informed decisions?	Inverell*	50
Jun-18	GrazingFutures Herd Management Day	Breeding & genetics content	Mitchell	8
Jul-18	Tips & Topics Day follow up	Breeding & genetics content	Dirranbandi	16
Jul-18	Belmont Red sale & field day	EBV presentation	Jandowae*	100
July/Aug 18	Breeding EDGE workshop[A]	Co-delivered	Katherine	11
Aug-18	Gyranda Open Day	EBV presentation	Cracow*	70
Aug-18	TBTS/SBTS Regional Forum	Co-delivered with P.Williams	Rockhampton	16
Aug-18	Brian Pastures Field Day follow up	Breeding & genetics content	Gayndah*	70
Sep-18	Spyglass BeefUp Forum[A]	Navigating BREEDPLAN	Charters Towers*	45
Sep-18	Breeding EDGE workshop[A]	Co-delivered	Charters Towers	12
Sep-18	Breeding EDGE workshop[A]	In-house training	Mount Isa	13
Sep-18	AgForce R & D field day	EBVs 101 presentation	Arcadia Valley*	55
Oct-18	MLA BeefUp Forum[A]	Lifting the performance of your breeder herd	Augathella	56
Oct-18	MLA BeefUp Forum[A]	Genetics & genomics update	Mundubbera	69
Nov-18	FBA 'Open the Gate' Forum	How will using genetic tools improve my herd performance & bottom line?	Rockhampton	85
Nov-18	Gyranda hosted bull assessment day	Breeding & genetics content	Charters Towers	16
Nov-18	Gyranda hosted bull assessment day	Breeding & genetics content	Richmond	18
20/01/2019	Droughtmaster South-East Zone meeting	Co-delivered with P.Williams	Gympie	30
Feb-19	Beef Genetics Champions Network Workshop	Navigating BREEDPLAN	Armidale	50
Feb-19	Maranoa Production Group meeting	Breeding & genetics content	Mitchell*	17
25/02/2019	Zoetis ReproActive Day	Making use of genetic technologies to improve the bottom line	Beaudesert*	70

26/02/2019	Zoetis ReproActive Day	Making use of genetic technologies to improve the bottom line	Manumbar*	90
12/03/2019	BredWell FedWell Workshop[A]	Pilot: Co-delivered	Jandowae*	50
13/03/2019	BredWell FedWell Workshop[A]	Pilot: Co-delivered	Banana*	30
4/04/2019	NW Beef Producers Forum	Breeding & genetics content	Moree	40
17/04/2019	BredWell FedWell Workshop[A]	Pilot: Co-delivered	Einasleigh*	25
26/04/2019	Intercollegiate Meat Judging Northern Conference	Using genetic technologies to improve the bottom line and the steak on your plate	Rockhampton	80
28/04/2019	Vetcross information day	Using genetic technologies to improve the bottom line and the steak on your plate	Gin Gin	60
30/04/2019	Farming Innovations Field Day	EBV presentation	Cracow*	30
4/05/2019	BullSELECT workshop	Co-delivered with B.Gudex	Coolatai*	13
9/05/2019	Gympie District Beef Liaison Group Dinner	Improving the bottom line with the right genetics	Gympie	53
15/05/2019	A 'Yarn at the yards' GrazingFutures day	EBV presentation & herd recording yard session	Surat*	25
20/05/2019	TBTS/SBTS Regional Forum	Co-delivered with B.Gudex	Toowoomba	33
29/05/2019	Maranoa Production Group meeting	Breeding & genetics content	Mitchell	10
5/06/2019	TBTS/SBTS Regional Forum	Co-delivered with P.Williams	Rockhampton	13
13/06/2019	Northern Agri Services day	EBV presentation	Kingaroy	50
13/06/2019	South Burnett Ag Network meeting	Breeding & genetics content	Kingaroy	18
17/07/2019	Breeding EDGE workshop[A]	Co-delivered	Fitzroy Crossing	12
27/07/2019	Echo Hills Tech Field Day	Breeding & genetics content	Wallumbilla*	100
31/07/2019	EBV info session	Attended by producers & agri-service providers	Roma	10
15/08/2019	Gyranda Open Day	EBV presentation	Cracow*	40
31/08/2019	Zone 1 Brangus Field Day (Triple B)	BREEDPLAN presentation	Dingo*	70
4/10/2019	Chinchilla Landcare Group presentation	Breeding & genetics content	Chinchilla	20
9/10/2019	Goshen field day	Making use of various tools to help improve the bottom line	Mount Garnet*	20
10/10/2019	Malanda Producer Group presentation	Breeding & genetics content	Malanda	13
11/10/2019	Elders field day	Using genetic technologies to improve the bottom line	Innisfail	20
14/10/2019	Breeding EDGE workshop[A]	Co-delivered	Hughenden	11

22/10/2019	GrazingFutures Project Meeting	Extension approaches - EBV examples	Townsville	35
15/01/2020	Brangus Youth Camp	Practical EBV demonstration (students); Technical session (parents)	Biloela	50
Feb-20	Breeding EDGE workshop[A]	Co-delivered	Rolleston	8
3/03/2020	RCS Continuing Education Conference	Using genetic technologies to improve the bottom line and the steak on your plate	Rockhampton	170
17/03/2020	Breeding EDGE workshop[A]	Co-delivered	Karratha	11
6/08/2020	Tips & Topics Day	Bull buying considerations to help take your herd forward	Mitchell*	70
13/08/2020	Gyranda Open Day	Brief EBV percentile graph presentation	Cracow*	70
17/08/2020	Breeding EDGE workshop[A]	Co-delivered	Taroom	6
20/08/2020	Breeding EDGE workshop[A]	Co-delivered	Augathella	9
Sep-20	Breeding EDGE workshop[A]	In-house training	Burketown*	16
Nov-20	TBTS/SBTS Regional Forum	Co-delivered with P.Williams	Malanda	13
Nov-20	EBV info session for commercial producers	Co-delivered with P.Williams	Malanda	16
8/12/2020	Northern Australia Climate Program workshop	Guest speaker - Collecting data crushside & in the paddock	Mitchell	12
1/02/2021	Breeding EDGE workshop[A]	Co-delivered	Esk	9
26/03/2021	Roma BeefUp Forum[A]	How EBVs can be used as part of the bull buying process	Roma	90
8/05/2021	Intercollegiate Meat Judging Northern Conference	Using BREEDPLAN to assist decision making	Rockhampton	90
17/07/2021	South Burnett Grazing Network day	Bull buying considerations	Kingaroy*	16
28/07/2021	Northern Australia Climate Program workshop	Bull buying considerations	Roma	13
29/07/2021	BredWell FedWell[A]	Co-delivered	Chinchilla*	20

[A] MLA event. * Event held on-farm.

12. Appendix 4

Table 4.1. Enquiries received during the project relating to BREEDPLAN, genetic technologies and breeding.

BREEDPLAN & genetic technologies related enquiries	
DNA testing options for commercial Brahman bulls	Understanding genetic correlations
Hair sampling submission process	Changes in EBVs in recent months - why? (multiple)
Contemporary groups (2)	Genetic conditions (2)
Developing breeding objectives (2)	Genetic Progress Report
Trial work on slick coats and tick resistance in Angus	Completeness of Performance Report
Tropical Composite BREEDPLAN (2)	Genotyping company options (2)
Understanding management groups (3)	Submitting joining records (multiple)
Selection indexes 101 & customized indexes (multiple)	Collecting abattoir carcase data for BREEDPLAN (2)
Process of joining BREEDPLAN (multiple)	Recording in drought (3)
Navigating Internet Solutions (multiple)	Suggested timeframes for inputting various trait information (2)
Understanding Genetic Linkage (2)	Gebv explanation from Northern Genomics Project
Breeding program development (3)	Fee schedules for BREEDPLAN
Qs to ask prospective seedstock producers	IMF scanning in Brahmans
EBVs to target MSA market	Double muscling in Tropical breeds
Ins & Outs of Genomics (2)	Suggested trait cut-offs for yearling heifer joining
Getting started with BREEDPLAN (multiple)	Ways to easily search catalogues that aren't on Internet Solutions
Ins & Outs of Measuring Flight Time (3)	Further explanation of various EBVs - CE direct, CE daughters, Milk, DTC, NFI-F, MCW
Suggested changes/edits to the functionality of Internet Solutions	MCW baseline figure? (3)
EBVs compulsory for all bulls sold?	Risk of Pompes disease
Upcoming scanning accreditation courses (3)	BREEDPLAN information to include in sale catalogues (3)
Parent verification & interpretation of results (2)	Where to buy a flight time machine?
Breeding related enquiries	
Fundamentals of herd recording	Early weaning
Field director details for Brangus	Body condition scoring (2)
Bos indicus options for WA	Reproductive disease concern
Interpretation of morphology results (3)	Structural soundness 101
Use of NLIS equipment and herd recording software (16)	Understanding MSA kill sheets
Fixed time AI program protocol	Understanding BULLCHECK certificates
Herd management template options (2)	JBAS 7+ herds in QLD
Morphology of semen straws	Crossbreeding research (2)
Penile abnormalities	Purchase details for a Reliabull tape
Upcoming pregnancy testing courses (2)	Bull guarantees – possible wording inclusions
Scrotal size in relation to weight diagrams (2)	Umbilical hernia – impact of genetics?

13. Appendix 5

Figure 5.1. Facebook post demonstrating the value of property visits.