



Final report

ParaBoss Phase II and IIa

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Abstract

The ParaBoss project delivers information products to the Australian sheep, goat and cattle industries leading to increased adoption of best-practice parasite management by producers to decrease losses from productivity, market access and animal welfare issues.

The products are based around the creation, maintenance and improvement of eight websites developed through technical committees: ParaBoss, WormBoss for sheep and goats, WormBoss for cattle, FlyBoss for sheep, FlyBoss for cattle, LiceBoss for sheep, LiceBoss for cattle, and TickBoss for cattle. These sites contain industry-endorsed practices recommended for parasite management.

The website content is value-added through communication activities: an e-newsletter, Facebook pages, advisor training (workshop, conference, web forum, certificate course), a worm egg counting quality assurance program, and publication of other presentations and articles.

The sheep resource has been ongoing through the project, the cattle sites were published just prior to the project completion.

Unique users of the websites grew steadily from 5,000 users/month in 2013 to 17,000 in September 2019, but have since declined to 2016 levels (12,500).

Respondents of the 2019 Benchmarking Australian Sheep Parasite Control survey indicated ParaBoss generated substantial value; when extrapolated to industry it is over \$30 million annually and a project benefit to cost of over 80:1.

Executive summary

Background

The ParaBoss project is an extension and communication project, rather than research, funded by Meat and Livestock Australia (MLA), Australian Wool Innovation (AWI), and the University of New England (UNE), and managed and implemented by UNE.

It aims to deliver a national information service for the control of internal and external parasites for sheep, goats and cattle because (i) the effects of parasites and their control result in some of the highest animal health costs in these industries; (ii) the use of chemical treatments is regulated in Australia and their use has a substantial impact on product quality and market access, and (iii) parasites can have negative effects on animal welfare.

The primary target audiences for the ParaBoss products and services are Australian sheep, goat and cattle producers and their private, agribusiness and government-funded consultants/advisors. The secondary audience has been Australian researchers, animal health lecturers/trainers and their students, and pharmaceutical companies.

The products and services are used by the audiences to increase the adoption of best practice parasite management in the Australian sheep, goat and cattle industries.

ParaBoss is owned by Meat & Livestock Australia (MLA), Australian Wool Innovation (AWI) and the University of New England (UNE) with technical and communication activities during Phase IIa being delivered through separate project agreements with the University of New England (UNE) (via a variation to the Phase II ParaBoss Delivery Agreement) and Australian Animal Health Council Limited trading as Animal Health Australia (AHA), respectively.

Background and project intellectual property (IP) are fully described in the ParaBoss Phase II R & D Project Funding Agreement dated 17 March 2017 and the ParaBoss Phase IIa Variation Agreement dated June 30, 2020.

Objectives

The ParaBoss Phase II and IIa project aimed to maintain and deliver the existing ParaBoss material, including the ParaBoss websites and content, and develop new material, tools and training to enable ParaBoss to continue to provide national coordination for sheep and goat parasite management, as well as cattle parasite management when such content was developed.

Other deliverables included:

- ParaBoss News
- ParaBoss Technical Forum
- biennial Technical Workshop
- development of "off-line" tools (agreed change to development of responsive websites)
- a national training process to upskill advisors, service providers and producers
- extension activities
- market research
- a national database of DrenchTest results (agreed change to scoping of national database of DrenchTest results)

Methodology

The ParaBoss project delivers information products to the sheep, goat and cattle industries leading to increased adoption of best-practice parasite management options by producers to reduce or prevent productivity, market access and animal welfare concerns from parasitism.

The products are based around the creation, maintenance and improvement (guided by industry technical committees) of eight websites: ParaBoss, WormBoss for sheep and goats, WormBoss for cattle, FlyBoss for sheep, FlyBoss for cattle, LiceBoss for sheep, LiceBoss for cattle, and TickBoss for cattle. These sites contain industry-endorsed practices recommended for parasite management.

The website content is value-added through communication activities: an e-newsletter (ParaBoss News), Facebook pages, advisor training activities (workshop, conference, web forum, certificate course), a worm egg counting quality assurance program, and publication of other presentations and articles.

Results/key findings

The suite of ParaBoss development, extension, communication and training activities carried out by the University of New England were demonstrated to be successful in achieving an increasing use of the ParaBoss resources and generating a high return on investments to the funders through the value of ParaBoss identified by producers.

Eight websites providing sheep, goat and cattle parasite management information are in operation and the sheep and goat sites are well-used and it is expected that the recently-published cattle sites will receive similar use. The sites provide the repository of information and decision support tools to support a range of parasite management extension, communication and training activities for the sheep, goat and cattle industries.

A range of extension and communication activities to meet the diverse preferred learning styles and mediums of industries users have been demonstrated as successful.

A Certificate in Sheep Parasite Management has been developed, and while not yet open for enrolments, has received very positive feedback from test-users.

Professional training of industry advisors through the 2018 conference and 2020 workshop were both fully subscribed and received excellent reviews.

A Worm Egg Counting Quality Assurance Program was developed with one successful annual round undertaken.

A Drench Resistance Test Database proposal was developed.

Benefits to industry

The ParaBoss products and services allow producers, their advisors, industry service providers, and educators to gain the information required to ultimately enable implementation of best-practice parasite management on Australian livestock properties.

This has and will provide significant value to the red meat and wool industries through improved:

- profitability
- animal welfare
- market compliance

The AWI-commissioned Benchmarking Australian Sheep Parasite Control survey (Colvin *et al*, 2020) of sheep producers showed that the value of ParaBoss to the collective sheep businesses at that time was about \$32.7 million (approximately \$1000 per producer) annually. This represents a very

realistic value of just under 5% of the annual costs of parasites (about \$675 in 2015) to the sheep industry.

This represents an extremely high return on investment to the funders of over 80 to 1.

Future research and recommendations

Due to the cost of parasites, significant investment should be allocated by industry to maintain, improve and deliver the ParaBoss resources to the sheep, goat and cattle industries with a focus on expanding the formats in which current written content could be provided to suit wider audiences.

Upskilling of industry advisors should be funded as they play an important role in extending and communicating best-practice to producers.

Results of the Ball and Curtis Review (2020) should be considered for implementation.

Table of Contents

Executive summary	3
1. Background	8
1.1 Industry problem	8
1.2 Project focus	8
1.3 Audiences	9
1.4 Use of results	9
2. Objectives	9
3. Methodology	19
3.1 ParaBoss Planning Documents Phase II and IIa	19
3.1.1 ParaBoss Business Plan, Steering Committee TOR and IP Register	19
3.1.2 Technical Committee TOR	19
3.1.3 IP Register	20
3.1.4 Commercialisation activities	20
3.2 ParaBoss Delivery Activities II and IIa	20
3.2.1 ParaBoss Websites	20
3.2.2 ParaBoss News and subscriber database	21
3.2.3 ParaBoss Technical Forum	21
3.2.4 ParaBoss Facebook Pages	22
3.2.5 ParaBoss Tools	23
3.2.6 ParaBoss Multimedia	24
3.2.7 ParaBoss feature articles in Beyond the Bale	27
3.2.8 ParaBoss Technical Conference 2018 and Workshop 2020	27
3.2.9 ParaBoss Sheep Parasite Management Certificate	28
3.2.10 ParaBoss Worm Egg Counting Quality Assurance Program	29
3.2.11 Drench Resistance Test Database feasibility and proposal	30
3.3 ParaBoss Evaluation II and IIa	31
3.3.1 ParaBoss Analytics	31
3.3.2 ParaBoss Surveys	32
3.3.2.1 Benchmarking Australian Sheep Parasite control	32
3.3.2.2 ParaBoss review: Recommendations for products and services	32
4. Results	34

4.1	ParaBoss Planning Documents Phase II and IIa.....	34
4.1.1	ParaBoss Business plan, Steering Committee TOR, IP Owners Committee TOR34	
4.1.2	Technical Committee TOR and Project Committee TOR	34
4.1.3	IP Register	35
4.1.4	Commercialisation activities	36
4.2	ParaBoss Delivery Activities Phase II and IIa	37
4.2.1	ParaBoss Websites.....	37
4.2.2	ParaBoss News and subscriber database	49
4.2.3	ParaBoss Technical Forum	51
4.2.4	ParaBoss Facebook Pages	51
4.2.5	ParaBoss Tools.....	54
4.2.6	ParaBoss Multimedia.....	57
4.2.7	ParaBoss feature articles in Beyond the Bale	62
4.2.8	ParaBoss Technical Conference 2018 and Workshop 2020	62
4.2.9	ParaBoss Sheep Parasite Management Certificate	64
4.2.10	ParaBoss Worm Egg Counting Quality Assurance Program	65
4.2.11	Drench Resistance Test Database feasibility and proposal	66
4.3	ParaBoss Evaluation Phase II and IIa.....	66
4.3.1	ParaBoss Analytics	66
4.3.2	ParaBoss Surveys	67
4.3.2.1	Benchmarking Australian Sheep Parasite Control.....	67
4.3.2.2	ParaBoss Review: Recommendations for products and services.....	69
5.	Conclusion	70
5.1	Key findings	71
5.2	Benefits to industry.....	72
6.	Future research and recommendations	72
7.	References	73
8.	Appendices	73

1. Background

1.1 Industry problem

Gastrointestinal worms, liver fluke, blowflies, buffalo flies, ticks and lice cost the sheep, goat and cattle industries over one billion dollars annually according to the MLA report: Priority list of endemic diseases for the red meat industries (Lane *et al*, 2015).

They are the key parasites affecting sheep, goats and cattle in Australia and incur some of the biggest costs of all endemic diseases to these industries.

The report showed that in the sheep industry, parasite costs amounted to approximately \$675 million dollars annually, with the cost of internal parasites about \$430 million, second only to perinatal mortalities. The fifth biggest endemic disease cost for sheep was from flystrike, about \$170 million, then at seventh position was lice with costs of about \$75 million.

In the goat industry, internal parasite costs that were over 2.5 million dollars annually for this small industry, dwarfed the cost of all other endemic diseases by more than 5 times.

The highest costing endemic disease for cattle was ticks with an annual cost of \$160 million; third was buffalo fly at nearly \$100 million, and fifth were internal parasites at about \$90 million. Collectively for cattle, the reported annual cost of parasites was about \$350 million dollars.

In addition, parasites can cause discomfort, illness and death: undesirable animal welfare outcomes that threaten consumer and community support for the industries and their products.

Parasite control relies heavily on the use of chemical treatments. These, with their potential residue levels in the meat, milk and wool or fibre products, are heavily regulated in Australia and many countries to which Australia exports, so their use must be managed, in large part by developing producer knowledge, to maintain market access and reduce consumer rejection.

In past years, most state departments of agriculture/primary industries provided free extension services to these industries, but with the gradual withdrawal of much of these services over the past two decades, and often with market failure of private consultants to operate in extensive livestock industries, there was a growing need to provide current, effective information resources for parasite management.

The first Sheep Industry Cooperative Centre started to tackle this problem with the launch of WormBoss for sheep in 2005. Since this time LiceBoss and FlyBoss for sheep were launched and WormBoss underwent a significant upgrade of content in 2012 by the University of New England staff in Sheep CRC II.

All the sites were brought together under the ParaBoss umbrella in 2014 in ParaBoss Phase I, with more improvements made in that project, including the addition of goat content to WormBoss.

With a demonstrated continuing need and value to the sheep industry, this project—ParaBoss Phase II—was created.

1.2 Project focus

ParaBoss Phase II is not a research project, but an extension and communications project, so there are no research questions answered in this project.

The project focused on further improvements in content, as well as improvements to tools, and the website platform, the creation of a worm egg counting quality assurance program for laboratories and development of a Sheep Parasite Management Certificate course.

Concurrently, the Queensland Department of Primary Industries and Fisheries led the development of new parasite management content for cattle, and the ParaBoss staff and web developer created four new websites specifically for cattle: TickBoss, WormBoss, LiceBoss and FlyBoss, onto which the content has been added and published.

1.3 Audiences

The ultimate audiences for ParaBoss content are sheep, cattle and goat producers, who are responsible for implementing recommended practices. Therefore, the web materials are written with producers as the priority audience. However, many other people in industry provide advice, training and services to producers, and the ParaBoss information is also pitched at them, and in some circumstances (particularly for professional development training) has also been developed in formats to specifically suit these other audiences, which include veterinarians and industry animal health consultants; government extension staff; rural merchandise store staff and stock agents; technical and sales staff from pharmaceutical companies; university animal or veterinary science lecturers and their students; researchers and companies that will be developing improved products and practices to manage or treat parasites; and worm egg counting laboratories.

1.4 Use of results

The products and services developed by the project are used by producers to gain knowledge allowing them to implement recommended parasite management practices, and by industry advisors and service providers to provide improved advice and services to industry that relate to parasite management.

2. Objectives

All objectives of the project have been met, with Tables 1 and 2, below, listing the objectives and a summary of the achievements of those objectives for each project phase.

Note that some documents referred to as appendices are commercial-in-confidence and are denoted with a † symbol. These documents will not be publicly available.

Table 1. Summary of achievements against objectives for ParaBoss Phase II

Description	Achievement
Review and prepare an updated ParaBoss Business Plan in consultation with MLA, AWI and the Steering Committee. The draft plan must be finalised during the first year of this agreement. The draft Business Plan must outline strategies and activities, including those to develop independent revenue streams and provide on-going financial support for ParaBoss. The final draft Business Plan must be submitted to the ParaBoss Phase II Steering Committee for review and the Steering Committee's recommendations incorporated. The updated draft	Completed. The ParaBoss Business plan frames the ParaBoss mission, vision and goals and objectives for ParaBoss Phase II. It outlines the key strengths, weaknesses, opportunities and threats for ParaBoss and details strategic options and strategies, commercialisation opportunities and communication and extension approaches. It also outlines the ParaBoss budget and evaluation methods. <i>Appendix A[†]: ParaBoss Phase II Business Plan 20170705</i>

<p>Business Plan must then be submitted to MLA and AWI for approval.</p>	
<p>a. The Business Plan must include the current Terms of Reference for the ParaBoss Phase II Steering Committee (a copy of which is attached as Annexure A) and the final Terms of Reference for the ParaBoss Phase II Technical Committees which will be prepared under this agreement.</p>	<p>Completed. The governance of ParaBoss II is overseen by the Steering Committee and Technical Committee. The Terms of Reference outline the role and function of the committees. <i>Appendix B[†]: ParaBoss Steering Committee TOR 201803406</i> <i>Appendix C[†]: ParaBoss Technical Committee TOR 20170425</i></p>
<p>b. As part of the Business Plan, UNE (in consultation with MLA and AWI) must maintain a detailed IP Register (in the form set out in Annexure B) which provides sufficient detail on all new ParaBoss Project IP developed under this Project with sufficient detail to enable the parties to clearly identify their ownership Interest in that Project IP developed under this project versus any other ParaBoss IP developed under other projects.</p>	<p>Completed. The IP register for Phase II details party ownership interest in Project IP developed under ParaBoss Phase II and any other ParaBoss IP developed under other projects. <i>Appendix D[†]: ParaBoss IP register 20210429</i></p>
<p>Review and prepare the Terms of Reference for the ParaBoss Phase II Technical Committee in consultation with MLA, AWI and the ParaBoss Phase II Steering Committee. The Terms of Reference must be finalised during the first year of this agreement. The draft Terms of Reference must ensure the scientific and technical basis of recommendations and actions are sound and nationally relevant. The Technical Committee membership must have high level expertise in management of internal and external parasites of sheep and internal parasites of goats to oversee the technical development of the website, to identify research and extension needs and to provide feedback to the Steering Committee on technical issues. The Technical Committee(s) will review and ensure scientific rigour of the information prior to entry into the</p>	<p>Completed. The Terms of Reference for the Phase II Technical committee outline the role and function of the Technical Committee and its members. <i>Appendix C[†]: ParaBoss Technical Committee TOR 20170425</i></p>

<p>ParaBoss web sites. The final draft Terms of Reference for the ParaBoss Phase II Technical Committee must be submitted to the ParaBoss Phase II Steering Committee for review and the Steering Committee’s recommendations incorporated. The updated draft ParaBoss Phase II Technical Committee Terms of Reference must be submitted to UNE, MLA and AWI for approval.</p>	
<p>a. Identify up to six new members of the Technical Committee (to replace existing members) for approval by existing members at a time indicated in the Technical Committee Terms of Reference.</p>	<p>Completed. Six new Technical Committee members were identified for approval representing the different production regions of Australia, the breadth of technical industry roles and both sheep and goat expertise.</p>
<p>UNE must:</p>	
<p>a. Ensure the four main ParaBoss websites (ParaBoss; WormBoss; FlyBoss; and LiceBoss) are updated as required so that they are technically current. The currency of the websites and the relevance to industry needs are delivered through the Technical Committee, the ParaBoss Technical Forum and the ParaBoss Technical Workshop.</p>	<p>Completed. The following link displays new information available on the Boss sites: https://www.paraboss.com.au/news/whats-new-in-paraboss.php Changes and improvements that have been carried out have been detailed in IP register. <i>Appendix D[‡]: ParaBoss IP register 20210429</i></p>
<p>b. Produce monthly outlooks and feature articles to cover worms, flies and lice in the form of two editions of the ParaBoss News e-newsletter. State outlooks and feature articles must include contributions by the industry. Organise media releases around the calendar of animal health events throughout the year and draw from ParaBoss News.</p>	<p>Completed. https://www.paraboss.com.au/news/archives.php</p>
<p>c. Create and host an on-line ParaBoss Technical Forum for industry advisors and service providers to debate contentious topics, develop new best practice recommendations, identify</p>	<p>Completed. http://parabossforum.com.au/ (this site is password protected, members only)</p>

<p>issues worthy of research and identify extension/communication needs and request advice or ideas from colleagues.</p>	
<p>d. Maintain and schedule regular updates (postings) for the ParaBoss Facebook page.</p>	<p>Completed. Generally 4 posts per week. https://www.Facebook.com/paraboss.com.au https://www.Facebook.com/ParaBoss.Goats AHA contracted to do Facebook posts from August 2019.</p>
<p>e. Host a biennial workshop (2018 & 2020) for industry advisors and service providers to provide opportunity for debate and discussion leading to consensus on key principles, which are captured in ParaBoss material, and identification of issues that require further R&D.</p>	<p>Completed. <i>Appendix E: ParaBoss Technical Conference 2018 Evaluation Sheet Results</i> Presentations from the ParaBoss Conference 2018 can be found here: https://www.paraboss.com.au/multimedia/videos.php <i>Appendix F: ParaBoss Technical Workshop 2020 Evaluation Report</i></p>
<p>f. Make the following improvements that will encourage greater adoption of best practice sheep parasite control:</p>	<p>Completed.</p>
<p>g. Provide the following tools in an “off-line” format, such as an App, to enable use in the absence of internet connectivity (FlyBoss Optimise Treatment Tool, FlyBoss and LiceBoss Products Tool, LiceBoss Long Wool Tool, LiceBoss Treatment Guide, WormBoss Drench Decision Guide, WormBoss Drenches database).</p>	<p>Completed. Agreed change to development of responsive websites.</p>
<p>ii. Develop a national training process to improve adoption of regionally differentiated best practice parasite control by livestock producers. The process will address the needs of professional trainers, industry advisors, service providers and producers. The level of parasite management knowledge required at applied and advanced levels</p>	<p>Completed. Advisors who are graduates of the ParaBoss Sheep Parasite Management Certificate can help producers to confidently manage parasites in an effective and economical way while limiting development of chemical resistance. They have a comprehensive, in-depth knowledge of prevention, management and treatment of worms, flystrike and lice in sheep and can advise about:</p> <ul style="list-style-type: none"> • Parasites and how they are affected by regional climate, week-to-week weather differences, management practices, breeding, and chemical prevention or treatment products.

<p>will be established by the ParaBoss Technical Committee and UNE must ensure there will be broad consultation with industry trainers and advisors to establish the training materials, formats and delivery modes that will best meet training requirements. UNE must ensure an independent assessment of technical knowledge and skills will be completed on-line through ParaBoss prior to industry recognition of training skills. In this way the quality of both trainers and trainees is independently assessed through ParaBoss. It is envisaged that a fee will accompany the</p>	<ul style="list-style-type: none"> • The practices used in an annual program and how these can be applied on individual farms • The tests to monitor both the parasites and the effectiveness of the chemical treatments • The chemical groups and actives used to prevent or treat parasites and in what situations they can be used. • how the chemicals can be used to optimise their effectiveness while limiting the development of chemical resistance.
<p>iii. provision of training materials to trainers and the assessment process.</p>	<p>Completed. The certificate platform is both a training and assessment tool. The decision was made to not conduct “train the trainer” activities, but simply to provide one training/assessment instrument. The primary existing trainers in this space are pharmaceutical companies. Copies of the online learning questions (which are the basis of the certificate questions) are available for any trainers to ensure their training complements and prepares their students to undertake the ParaBoss certificate.</p>
<p>iv. Boost engagement with a wider cross-section of Boss Users through creation of audio (interview/conversation) files that convey procedural details of written information. Also provide links to procedural video files</p>	<p>Completed.</p> <ul style="list-style-type: none"> • ParaBoss videos include short instructional presentations (focussed on how to do a particular practice) as well as longer technical presentations from a range of experts at the 2018 ParaBoss Technical Conference. • ParaBoss webinars have in-depth information on selected topics and the ability to ask questions if you join the live webinar. • Wormcasts are podcasts produced by ParaBoss covering parasite management topics—worms, flies, lice, ticks and fluke—for sheep, cattle and goats

	<ul style="list-style-type: none"> • Snapshots are short audio presentations about a specific topic in a few-minute lecture presentation style • https://www.paraboss.com.au/multimedia.php
<p>v. Develop a national database to store DrenchTest results with on-line accessibility —for industry advisors and service providers— as determined by producers. Effective drenches are identified from a DrenchTest which is a key WormBoss practice. However, DrenchTest results are infrequently used (nor available) in retail stores to staff to help producers make better drench purchasing decisions. The national database will seek to collate</p>	<p>Completed. Agreed by steering committee to undertake a feasibility study and develop a project proposal for a national drench resistance database. <i>Appendix G[‡]: Project Proposal ParaBoss National Drench Resistance Database</i></p>
<p>Monitor the user audience (analytical data such as user numbers, sessions and page views) as part of a continual process of improvement and report this to the ParaBoss Phase II Steering Committee.</p>	<p>Completed. Progressive reports provided at each Steering Committee meeting. <i>Appendix H: Website analytics 20210525</i></p>
<p>Evaluate awareness and usefulness of Boss materials among producers, industry advisors and service providers on a biennial basis (a monitoring and evaluation plan will be provided as part of Milestone 2).</p>	<p>Completed. A Survey was undertaken for AWI (Collins, 2016) (<i>Appendix I[‡]: Dave Collins 2016 Parasites and Diseases Survey Results</i>) detailing the awareness and impact of WormBoss and FlyBoss. The above survey provided the basis for the questions about ParaBoss in the Benchmarking Australian Sheep Parasite Control by Colvin <i>et al</i>, 2020. A further survey was conducted by Ball and Curtis, 2020, to Report progress/success of ParaBoss Phase II by identifying the following about ParaBoss products, services, and activities with the aim to inform the future priority products and services of ParaBoss Phase III</p> <ul style="list-style-type: none"> • Use, usefulness, and impact • Priority gaps • Improvements required <p><i>Appendix J[‡]: Ball and Curtis 2020 Recommendations for products and Services</i> <i>Appendix K[‡]: ParaBoss M&E Plan Phase IIa completed for 10 March 2021</i></p>

<p>Increase adoption through on-ground activity delivered through endorsed PB advisors.</p>	<p>ParaBoss endorsed WEC QA providers are promoted to producers via the Boss websites and ParaBoss News to encourage adoption of WEC testing and to ensure accurate services are provided.</p> <p>As a result of the 2020 ParaBoss Technical Workshop, which had 60 advisor attendees, all responders of a follow-up survey indicated that they were using their parasite management knowledge, including that gained at the workshop. 85% indicated they used it in their work, including to directly assist and prepare parasite management programs for customers.</p> <p>Attendees at the 2016 (ParaBoss Phase I) and 2018 Technical workshops were almost all in an advisory role. While evaluation indicated a very high level of satisfaction with the workshops, no follow up surveys were undertaken to quantify actual use of new knowledge. However, it can safely be assumed that during the course of ParaBoss Phase II, that new knowledge acquired from these workshops was built into advisor recommendations, leading to increased adoption of ParaBoss recommendations.</p> <p><i>Appendix E: ParaBoss Technical Conference 2018 Evaluation Sheet Results</i></p> <p><i>Appendix F: ParaBoss Technical Workshop 2020 Evaluation Report</i></p> <p>Once enrolments in the Parasite Management Certificate course commence, monitoring and evaluation of on-ground adoption of best practice parasite control will be conducted through surveys of certificate holders.</p>
<p>Conduct market research survey to better understand demand drivers for ParaBoss activities</p>	<p>Completed.</p> <p>The survey: ParaBoss review: Recommendations for products and Services (Ball and Curtis, 2020), reported on the progress/success of ParaBoss Phase II. It identified the following about ParaBoss products, services, and activities with the aim to inform the future priority products and services of ParaBoss Phase III</p> <ul style="list-style-type: none"> • Use, usefulness, and impact • Priority gaps • Improvements required <p><i>Appendix J[†]: Ball and Curtis 2020 Recommendations for products and Services</i></p>

Table 2. Summary of achievements against objectives for ParaBoss Phase IIa

Description	Achievement
<p>Undertake ongoing website maintenance and updating of all the Boss websites, including:</p> <ul style="list-style-type: none"> • Hosting and maintenance, domains and all URLs. • Functionality. • Completion and ongoing maintenance of the Mobile Responsive platforms. 	<p>Completed.</p> <p>All Boss sites maintained and updated to continue working on contemporary web browsers. All additions to the Boss sites for the duration of the project are recorded in the ParaBoss IP Register. All 8 websites are mobile responsive.</p> <p>https://www.paraboss.com.au/ http://www.wormboss.com.au/sheep-goats/ http://www.wormboss.com.au/cattle/ http://www.flyboss.com.au/sheep-goats/ http://www.flyboss.com.au/cattle/ http://www.liceboss.com.au/sheep-goats/ http://www.liceboss.com.au/cattle/ http://www.tickboss.com.au/cattle/</p> <p><i>Appendix D[†]: ParaBoss IP register 20210429</i></p>
<p>Maintain, administer and monitor the Technical web forum.</p>	<p>Completed.</p> <p>The forum platform has advantages of being archivable and searchable on topics, but has the disadvantage of being less user friendly than either a Facebook discussion group or a listserv email discussion group. In Phase III the forum concept and platform used will be reviewed as part of ParaBoss Phase III, component 3. Due to the relatively small membership base (there are approx. 277 registered members who have started 175 threads (topics) and contributed 702 posts) the ongoing discussions are limited, but this is similar to the sheep veterinary discussion list which also has limited membership. In future, graduates of the certificate will be added to the membership.</p> <p>http://parabossforum.com.au/ (this site is password protected, members only)</p>
<p>Maintain the ParaBoss IP register.</p>	<p>Completed.</p> <p><i>Appendix D[†]: ParaBoss IP register 20210429.</i></p> <p>This includes all additions to the Boss sites for the duration of the project.</p>
<p>Complete technical website content updates, including:</p>	<p>Completed.</p>
<p>1. Products database and search tools incorporating all sheep and cattle treatment products;</p>	<p>Completed.</p> <p>The ParaBoss Products Search has been created to house all the current available commercial products (as provided by the manufacturers) relating to parasite type and animal type. It is available on each of the Boss sites and on each website the search tool allows a search of any host by parasite.</p> <p>The following criteria can also be used to limit searches:</p> <ul style="list-style-type: none"> • specific parasites • chemical actives and groups • application method

	<ul style="list-style-type: none"> length of protection withholding periods product name <p>As the tools are the same on each site, only one link has been provided here: http://www.wormboss.com.au/cattle/treatment/products/search.php</p>
2. Development and release of the Flystrike Risk Tool on FlyBoss website;	<p>Completed.</p> <p>The Flystrike Risk Simulator is a comprehensive program that allows the comparison of two different management systems. It is downloaded with local flystrike data risk files from within 5 kms of a chosen location.</p> <p>This program estimates the risk of flystrike then makes adjustments for:</p> <ul style="list-style-type: none"> management options such as: shearing; crutching; breach modification; chemical preventive treatments; including optimising the timing of treatments; effect of breeding for reduced breach strike. <p>http://www.flyboss.com.au/sheep-goats/tools/flystrike-risk-simulator-downloadable.php</p>
3. Ad-hoc technical content updates to address unforeseen technical issues as required by ParaBoss funding partners and as agreed by UNE.	<p>Completed.</p> <p>Technical updates are documented in the IP register <i>Appendix D[†]: ParaBoss IP register 20210429.</i></p>
Contribute to the Communication activities of ParaBoss Phase IIa that are to be carried out by a third party communications provider engaged by MLA and AWI (i.e. AHA). By providing:	
1. Draft content and key messages for the first one (1) month's editions of ParaBoss News and ParaBoss Facebook pages, and the June edition of ParaBoss BTB articles.	<p>Completed.</p> <p>September 2020 features and outlooks published</p> <ul style="list-style-type: none"> https://www.paraboss.com.au/news/archives/september-2020-2.php https://www.paraboss.com.au/news/archives/september-2020.php June BTB published with ParaBoss contribution https://www.wool.com/globalassets/wool/about-awi/media-resources/publications/beyond-the-bale/btb_June2020.pdf September Facebook posts published.
2. A Technical Review Service: Telephone or web meeting	Completed.

<p>consultations with AHA up to a total of 4 hours per month, for the first three months, reverting to 2 (two) hours per month following this initial period to provide comment (not editing) on the technical accuracy and appropriateness of materials that have been prepared by AHA for the ParaBoss News e-newsletters, the ParaBoss Facebook pages and the Beyond the Bale and Feedback articles.</p>	<p>Technical review web meetings and consultation achieved: Meeting dates: 24/8/2020; 17/9/2020; 29/9/2020; 24/11/2020 Review of technical accuracy and appropriateness of each ParaBoss news feature article and State Outlooks edition that have been prepared by AHA for the ParaBoss News e-newsletters, and the Beyond the Bale and Feedback articles ongoing with communication via email.</p>
<p>3. Briefings to AHA on new or updated ParaBoss materials and information.</p>	<p>Completed. AHA briefed and supplied with new or updated ParaBoss materials and information when developed including FlyBoss Flystrike Risk Simulator, WEC QA; certificate content and cattle website</p>
<p>4. The ParaBoss News subscriber database (to be used for the sole purpose of sending ParaBoss News e-newsletters in accordance with AHA’s obligations under the AHA Agreement, as specified by Privacy laws).</p>	<p>Completed. The ParaBoss News subscriber database supplied within campaign monitor. Access given to AHA September 2020 .</p>
<p>5. Access to the ParaBoss News administration for publishing the newsletter.</p>	<p>Completed. Access given to AHA September 2020.</p>
<p>6. Access to the ParaBoss Facebook pages’ administration for publishing Facebook posts.</p>	<p>Completed. Access give to Communications Coordinator in September 2019. Access given to other requested AHA staff in September 2020.</p>
<p>7. Contact list and introduction to the contributors of the ParaBoss News State Outlooks.</p>	<p>Completed. Contact list provided 20/8/2020 and introduction to the contributors of the ParaBoss News State Outlooks made 10/9/2020.</p>
<p>Develop and, as specified, deliver training and technical services:</p>	
<p>1. Manage and operate the WEC QA program including:</p> <ul style="list-style-type: none"> • Development of automation. • Delivery of 2020 WEC QA round. • Monitor and report usage. 	<p>Completed. 2020 WEC QA cancelled due to freight delays caused by Covid-19. Intent to run 2021 WEC QA round in October 2021 There are now 36 accredited providers and they are promoted through the WormBoss website on the professional service providers pages.</p>

	http://www.wormboss.com.au/sheep-goats/tests-tools/professional-service-providers.php
2. Completion of the accreditation certificate content (service provider online training) to delivery-ready stage for delivery in Phase III.	Completed. Achieved completion of the accreditation certificate content including user feedback. Delivery ready for July 2021.
Develop and implement a Monitoring & Evaluation (M&E) Plan for UNE-run ParaBoss activities.	Completed. M&E plan includes M&E activities and quarterly milestone achievements. <i>Appendix K[†]: ParaBoss M&E Plan Phase IIa completed for 10 March 2021</i>
Contribute to the development of the ParaBoss Phase III Strategic Plan.	Completed. A successful tender was completed by UNE for Component 3 of Phase III. Collaboration with the successful tenderers of Components 1 and 2 will continue.
Effectively manage agreed ParaBoss projects, activities, and budget including any subcontractors.	Completed. Progress reports supplied.
UNE will comply with all applicable privacy laws in an appropriate manner to enable AHA to meet its obligations under the AHA Agreement.	Completed. Databases and other access provided to AHA.

3. Methodology

3.1 ParaBoss Planning Documents Phase II and IIa

3.1.1 ParaBoss Business Plan, Steering Committee TOR and IP Register

The ParaBoss Executive Officer and Operations Manager updated the original ParaBoss Business Plan in consultation with MLA, AWI and the Steering Committee. This included the Terms of Reference for the ParaBoss Phase II Steering Committee and IP register detailing party ownership interest in Project IP developed under ParaBoss Phase II and any other ParaBoss IP developed under other projects. The IP register includes: IP register tables detailing improvements to the ParaBoss websites; a list of Domain names and ownership; and a list of Trademarks and ownership.

3.1.2 Technical Committee TOR

The ParaBoss Executive Officer and Operations Manager prepared the Terms of Reference for the ParaBoss Phase II Technical Committee (*Appendix C[†]: ParaBoss Technical Committee TOR 20170425*) in consultation with MLA, AWI and the ParaBoss Phase II Steering Committee. Six new Technical Committee members were identified for approval.

The Terms of reference required members to represent the different production regions of Australia, the breadth of technical industry roles and both sheep and goat expertise.

3.1.3 IP Register

The IP register for Phase IIa (*Appendix D[†]: ParaBoss IP register 20210429*) details party ownership interest in Project IP developed under ParaBoss Phase IIa and any other ParaBoss IP developed under other projects. The IP register includes: IP register tables detailing improvements to the ParaBoss websites; a list of Domain names and ownership; and a list of Trademarks and ownership.

3.1.4 Commercialisation activities

ParaBoss Review of Funding and Commercialisation Opportunities

A review was conducted by Russell Barnett (Australian Venture Consultants P/L, 2018) to identify possible avenues for commercialising ParaBoss content to generate income stream. This review looked at a three types of revenue models: a) user-oriented, b) third party revenue, and c) other.

Appendix N[†]: ParaBoss Review of Funding and Commercialisation Opportunities March 2018.

Advertising

Advertising positions were set up on WormBoss, FlyBoss and LiceBoss websites (and are also included on the newly released cattle websites. These include a leaderboard position (on all pages), three MRECs (medium rectangles) on each home page, and an MREC on each internal page.

Additionally, a position was made available in each ParaBoss News e-newsletter, using an MREC image to advertise, and advertorials could also be included in the Feature Article edition of ParaBoss News.

Various companies with an agricultural focus were contacted and provided with information on pricing, advertising and advertorial requirements, and web use statistics. Follow up contacts were made each few months to canvass advertising.

Licensing of ParaBoss content

Enquiry was received from the national wool organisation of another country with interest to licence WormBoss content.

Visits and discussion were held with their representatives and a proposed licence agreement was presented to the organisation.

3.2 ParaBoss Delivery Activities II and IIa

3.2.1 ParaBoss Websites

The ParaBoss sheep/goat websites, including ParaBoss.com.au; WormBoss.com.au, FlyBoss.com.au; LiceBoss.com.au and TickBoss.com.au, have been developed and maintained by Graeme Wright of Wrightway Design and have been developed based on the LAMP (Linux Apache PHP MySQL) website platform and are all mobile responsive. The sheep websites were quite mature in content at the start of Phase II, however, new content was added in consultation with the Technical Committee. A record of new and changed content is in the ParaBoss IP register (*Appendix D[†]: ParaBoss IP register 20210429*). The sheep/goat ParaBoss websites feature the available information and tools for producers to apply best practice management of sheep and goat parasites.

During Phase II and IIa, the content for the cattle websites was developed in the project MLA B.AHE.0314 ParaBoss for Cattle Parasites, managed by the Queensland Department of Agriculture and Fisheries (DAF), while UNE, through Wrightway Design, created the new cattle site platforms, which are mobile responsive based on the sheep/goat sites. In the latter part of Phase II and during Phase IIa, the content was provided to ParaBoss and the sites were populated. The Cattle Technical

Committee and reviewers checked the sites before they were published in April 2021 and were launched at the Beef Australia 2021 field days (first week of May, 2021).

3.2.2 ParaBoss News and subscriber database

ParaBoss News is a twice-monthly email newsletter with an end-of-month regional updates edition known as State Outlooks (primarily on worm activity, but also flies and lice) plus a mid-monthly Feature Article edition on each parasite group. The newsletters are sent to the ParaBoss subscriber base, currently approximately 3200 (includes a wide range of people with an industry interest in parasite management, not just producers).

The newsletter is also published directly on the ParaBoss website and archived there, and is used by some of the AWI extension networks who include them wholly, or in part, in their communication to producers.

The newsletter contains a large amount of technical detail and recommendations and creates a twice monthly reminder for subscribers about parasite management and provides numerous links to the ParaBoss websites. In keeping with the technical nature, technically-experienced staff were used to prepare the newsletter during Phase II. Maxine Murphy, (an experienced parasitologist) prepared the initial drafts of ParaBoss News, including collating and editing of monthly reports from state and regional contributors and loading the content onto the platform for publishing. The feature articles were prepared initially either by Maxine, or by one of the current or previous ParaBoss technical staff (Deborah Maxwell, Lillian Mukandiwa, Susan Swaney, Liz Baiocchi), but for approximately one year Dr Paul Nilon (a highly experienced sheep industry consultant and past Technical Committee member) was commissioned to prepare the feature article introductions. Final technical editing was carried out by Executive Officer, Deborah Maxwell and renowned parasitologist, past Technical Committee member and the ParaBoss “independent parasitologist”, Dr Brown Besier.

In early 2020, due to a reduction in funding, the Executive Officer and Technical Manager took over all of these roles that had previously been outsourced to other technical experts. Approximately three months into Phase IIa, Animal Health Australia communications staff took over the preparation and publishing of the ParaBoss News, with the ParaBoss Executive Officer providing a technical checking service.

During Phase II, the newsletter was hosted from within the ParaBoss website. It was changed to an external platform—Campaign Monitor—in September 2020, to allow a greater level of user interrogation.

The subscriber database was also integrated into the ParaBoss website platform. Users can link to the subscription page from any of the other Boss websites to subscribe to ParaBoss News. With the change to Campaign Monitor, the database is still on the ParaBoss site, but is integrated with Campaign Monitor.

Since 2021, each of the websites also hosts a user category survey, aimed at identifying the industry categories and roles that users belong to. This was requested by the ParaBoss Steering Committee as a result of the review by Russell Barnett (Australian Venture Consultants, 2018) to enable ParaBoss to better understand their web audience.

3.2.3 ParaBoss Technical Forum

The ParaBoss Technical Forum (<http://parabossforum.com.au/>) was developed to:

- debate contentious topics
- gain input to develop new best practice recommendations
- identify issues worthy of research

- identify extension/communication needs
- request advice or ideas from colleagues

It is moderated by ParaBoss staff and previously had scheduled, regular contributions from the ParaBoss Technical Committee (Phase II) to raise and discuss issues relating to the control of worms, flies and lice in sheep, and also to maintain momentum of the forum. The Technical Committee was disbanded for Phase IIa, although past members still occasionally contribute, but posts are no longer scheduled.

The platform used is a MyBB web forum, which is a free and open-source forum software developed by the MyBB Group. It is written in PHP, supports MySQL, PostgreSQL and SQLite as database systems and, in addition, has database failover support. The forum is self-administered by ParaBoss staff.

The forum has a number of sub-forums, including:

- Worm management
 - Sheep worm control
 - Goat worm control
 - Camelid worm control
 - Cattle worm control
- Flystrike management
- Tick management
 - Cattle ticks and their control
 - Other ticks and their control
- Buffalo fly management
- Nuisance fly management
- Lice management
 - Sheep lice control
 - Goat lice control
 - Camelid lice management
 - Cattle lice and their control

3.2.4 ParaBoss Facebook Pages

There are two separate Facebook pages, one for sheep and one for goats.

- ParaBoss for sheep: <https://www.Facebook.com/paraboss.com.au>
- ParaBoss for goats: <https://www.Facebook.com/ParaBoss.Goats>

Generally, four Facebook posts are sent each week, one for goats and three for sheep. Posts are organised around the calendar of animal management events throughout the year and also drawn from ParaBoss News. UNE staff prepared the posts until August 2019, after which AHA has produced posts.

The choice was made to create pages, rather than groups, as a platform for ParaBoss to promote its web content, rather than as a discussion forum.

3.2.5 ParaBoss Tools

An original project aim was to convert the existing online ParaBoss tools into offline tools so that advisors could use these on farm visits where there was no internet reception. However, MLA no longer supported development of offline apps due to the requirement for ongoing maintenance.

Concurrently, feedback showed a rapid increase in use of websites on mobile devices, which resulted in a more urgent need to make the websites mobile responsive for an improved user experience. The project Steering Committee agreed to substitute development of mobile responsiveness for offline apps.

The exception to this was the FlyBoss Flystrike Risk Simulator tool, which is downloadable. This tool strongly supports producers modelling scenarios of breeding for flystrike resistance (as well as chemical and management action), which is very useful to determine readiness and a path towards ceasing mulesing. The tool already existed as a Windows (offline) tool not currently being used, but is very complex and would have required development for the web at an expense not covered in the budget. Modest updating was carried out independently at no cost to the ParaBoss project to update it to latest operating systems and make it downloadable from the FlyBoss website and utilise current flystrike risk data (much more accurate than similar data in the online quick tools) from the University of New England.

The online FlyBoss and LiceBoss tools created by Brian Horton were written in Delphi program, and were originally hosted on a separate site, but embedded into the FlyBoss and LiceBoss sites. For ease of maintenance most of the lice tools were rewritten in PHP by our web developer, Graeme Wright.

The ParaBoss websites are mobile responsive allowing most ParaBoss Tools to be used readily on mobile devices. The tools are:

- WormBoss Drench Decision Guides
- FlyBoss Flystrike Risk Simulator (Phase IIa)*
- FlyBoss QuickTools Online
 - Optimise Treatment tool**
 - Compare Management tool**
- LiceBoss Tools:
 - Lice Treatment Guide (Its purpose is to provide a roadmap to the other treatment information and tools on the LiceBoss site)
 - Long Wool Lice Tool
 - Rubbing Tool
 - Short Wool Lice Tool
 - Ewe/Lamb Treatments Tool
 - Treatment Factors Tool
 - Wool Residue Tool**

*Downloadable tool

**Not on a mobile responsive page

ParaBoss Products Search

This is a new tool created in ParaBoss Phase II and IIa. The Drenches Database tool on WormBoss, and the Products Tool on LiceBoss and FlyBoss have been replaced by the new single ParaBoss Products Search as new products tools were needed for the new cattle sites.

The ParaBoss Technical Committee (during Phase II) reviewed the previous tools and identified the best features of the existing tools to be retained, the less useful or not-used features for removal, and added a greater indication of the likely resistance issues of the products. A single tool replicated across each Boss site was created allowing users to search on any host/parasite relationship regardless of the site they were visiting. The search modes from any site are:

- cattle x worms
- cattle x flies
- cattle x lice
- cattle x ticks
- sheep x worms
- sheep x flies
- sheep x lice
- goat x worms

Pharmaceutical companies were invited to provide a list and details about their parasite management products, which were then added into the central products database.

Due to the large number of products and associated data, it was decided to rely on the manufacturers to provide current and correct information. The information required was not able to be simply downloaded from the APVMA PubCRIS site, instead, to do the task ourselves, every single label would have had to be reviewed, hence why this was left to the manufacturers, who become responsible for checking and accuracy of their own products, and, in effect, also get free advertising by providing their data.

3.2.6 ParaBoss Multimedia

ParaBoss multimedia includes videos, podcasts, audio and webinars.

Videos

- Short (1–5 minute) instructional presentations focussed on how to do a particular practice are listed in Table 3. These were developed by ParaBoss staff in consultation with the Technical Committee to ensure technical accuracy.
- Longer technical presentations are listed in Table 4. These were delivered by a range of experts at the 2018 ParaBoss Technical Conference.

Table 3. Instructional videos on the ParaBoss Multimedia Page.

Instructional Videos
Collecting Sheep Dung Samples in the Paddock for a Worm Egg Count
Sample Size for Bulk Worm Egg Counts
Checking Sheep for Lice
Hand jetting with the Dutjet wand.

Plunge dipping
Shower dipping

Table 4. Technical presentation videos on the ParaBoss Multimedia Page.

Presentation Videos
Workshop Introduction
Workshop Introduction video: Deb Maxwell (ParaBoss Executive Officer)
Virbac Animal Health sponsor presentation
Virbac Introduction video: Susan Swaney
Sometimes it's all in the formulation
Presentation video: Chhaya Mahashabde and Susan Swaney
Scouring: causes, diagnosis, management and treatment
Presentation video: John Webb Ware, Caroline Jacobson
Discussion video: Lewis Kahn, Paul Nilon, Brown Besier
Effective worm control while managing drench resistance
Presentation video: Brown Besier, Lewis Kahn, John Webb Ware
Discussion video: Matt Playford, Bruce Watt
Boehringer Ingelheim sponsor presentation
Presentation Video: Gareth Kelly
Goat and Camelid drenches
Presentation video—Goats: Sandra Baxendell
Presentation video—Alpacas: Abdul Jabbar
Discussion video: Bruce Watt, Harun Rashid, Berwyn Squire
Flystrike management: breeding, interactive decision tools, management after stopping mulesing
Presentation video—Risk Tools: Brian Horton
Presentation video—Breeding, breech strike: Geoff Lindon
Discussion video: Paul Nilon, Peter James
Workshop Summary
Presentation video: Deb Maxwell, ParaBoss Executive Officer

Webinars

Webinars provide in-depth information on selected topics covering sheep parasite management. The webinars, listed in Table 5, were developed by ParaBoss staff under the New England WormBoss PDS project or commissioned by SheepConnect. They were promoted, facilitated and recorded by ParaBoss staff in conjunction with MLA and AWI and made available on the ParaBoss multimedia webpage. The webinars are approximately 1 hour long (40 minutes presentation followed by a question and answer session).

Table 5. ParaBoss Webinars

Webinar
Low Worm—Risk Paddocks for Summer Rainfall Regions
Bulk WormTests Increase Accuracy
WormTests—what's stopping you?
Sheep Connect—Sheep Blowfly Resistance Update
Sustainable flystrike control
Drench Resistance Testing

Podcasts

“Wormcasts” are podcasts produced by ParaBoss covering parasite management topics—worms, flies, lice, ticks and fluke—for sheep, cattle and goats. They feature former Technical Manager Susan Swaney and guest experts covering the topics listed in Table 6.

These are longer presentations of engaging stories or scenarios, and covered some related topics across the ParaBoss websites, integrating key ParaBoss messages. Wormcasts are available on the ParaBoss multimedia page and from Podcasts channels, hosted by Buzzsprout.

Table 6. ParaBoss Podcasts on the ParaBoss Multimedia Page.

Podcasts
Introducing Wormcasts and its hosts
Code-breaking the jargon
What happens when you take your finger off the pulse
What about the parasites on the pasture
Visiting our friends at the APVMA
Fly control as you move away from mulesing with John Webb Ware
The history of drenches
What’s important about a parasite’s life cycle
Better control of parasites and extending the life of your drenches through Integrated Parasite Management (IPM)
Has organics got anything to teach the non-organic farmer?
Sheep Blowfly Resistance update with Deborah Maxwell

Short audio

Conversely, “Snapshots” are short audio presentations focused on a narrow topic (generally related to information on a specific web page) presented in a lecture style by former ParaBoss Technical Manager Susan Swaney. They cover the topics listed in Table 7.

Table 7. ParaBoss Short Audio listed on the ParaBoss Multimedia Page.

Short Audio
Grazing management in southern Australia
Smart grazing in southern Australia
Breeding worm resistant sheep

WormBoss Control programs in high winter rainfall regions
When to worm egg count and when to drench
Quarantine drenching
Choosing drenches

3.2.7 ParaBoss feature articles in Beyond the Bale

Each quarter, AWI publishes the Beyond the Bale magazine. ParaBoss has prepared technical feature articles for each edition. These provide detailed information on parasite management topics, as well as some summaries about tools or seasonal reminders.

3.2.8 ParaBoss Technical Conference 2018 and Workshop 2020

The 2018 ParaBoss Technical Conference

This was a day-long conference that covered Sheep, Goat and Camelid Parasite Management.

The conference was held in Melbourne on Friday 17th August 2018, as an adjunct to the Australian Veterinary Association Sheep Goat and Camelid Veterinarians Special Interest Group Annual Conference on the preceding three days, and was held at the Parkroyal Hotel, Melbourne airport to allow the most flexibility in timing for attendees who needed to catch planes at the end of the event on a late Friday afternoon.

Invitations were sent to professional advisors, researchers and educators in the Australian and New Zealand sheep industry, including researchers, extension staff, veterinarians, university lecturers, private consultants, and pharmaceutical company staff, but not to rural merchandise store staff.

- The event was fully booked with 125 attendees.
- The registration fee was \$150 for early registration (\$180 later).
- A pre-conference dinner was held on the night before with a technical presentation by the major sponsor.
- Veterinary Education points (6 structured) were arranged through the Australian Veterinary Association.
- Sponsorship was gained for the event from pharmaceutical companies.

Technical experts presented in the following four sessions:

- Scouring: causes, diagnosis, management and treatment
- Effective worm control while managing drench resistance
- Goat and Camelid worm control
- Flystrike: Interactive Decision Tools and Managing Breech Strike

For the conference program see *Appendix L[‡]: ParaBoss Technical Conference 2018 Program*.

The conference presentations were recorded and made available on the ParaBoss multimedia web page: <https://www.paraboss.com.au/multimedia/videos.php>

The 2020 ParaBoss Technical workshop

This workshop aimed to improve the knowledge and skills of advisors to the sheep industry, particularly targeting rural merchandise staff, as well as veterinarians. The aim of this workshop was

to enable participants to prepare parasite management plans (worms, flies and lice) for sheep producer clients.

The workshop was held on Tuesday 10th March 2020, the day before the Australian Veterinary Association Cattle Veterinarians Special Interest Group Annual Conference in Adelaide, and was held at ‘The Function’, Glenelg, Adelaide.

Invitations were sent to rural merchandise staff in South Australia, western Victoria and south west NSW, as well as national pharmaceutical company staff, veterinarians, professional advisors, and educators in the Australian sheep industry. The workshop also involved 10 farmers and 10 technical advisors.

Process:

- Short technical presentations by ParaBoss staff and other invited technical experts.
- Small group sessions for each of the topics: lice, flies and worms.
- There were ten small groups with each consisting of six participants (who acted as advisors to a farmer client), plus one facilitator/technical expert and one real farmer.
- Facilitators were technical experts: either pharmaceutical company technical managers, university academics with real farm experience; farm consultants and/or sheep veterinarians; and the ParaBoss Executive Officer and ParaBoss Technical Manager.
- Each group of six participants worked as a team to act as an “advisor” to the farmer “client”, and the group was facilitated and supported by the expert. Real farmers were identified through the facilitators; the farmers’ own situations were used for the development of their plans.
- The participants were provided with a standard set of questions to follow as well as a calendar onto which they noted key farm activities and parasite management practices relevant to the particular farmer. At each question in the process the facilitator discussed key points related to the question.

For the conference program see *Appendix M: ParaBoss Technical Workshop 2020 Program*.

- The event was fully booked with 60 “advisor” attendees.
- The registration fee was \$120 per “advisor” participant.
- Sponsorship was gained for the event from pharmaceutical companies.

3.2.9 ParaBoss Sheep Parasite Management Certificate

The ParaBoss Sheep Parasite Management Certificate was developed based on the online learning (developed in ParaBoss Phase I) on the WormBoss, FlyBoss and LiceBoss Websites. It will inform and assess participants on their knowledge of sheep parasites and their management and treatment.

A contemporary online training/assessment model is used (similar to that used for Chemical User accreditation, or Livestock Production Assurance accreditation), where both the information and the assessment are contained within the one online instrument.

The platform used is Moodle, hosted by University of New England Partnerships (UNEP).

The certificate was designed with the primary target audience being rural merchandise staff, as well as other industry advisors.

There are three modules: Worms, Flies, Lice, and each module contains quizzes to assess the student’s knowledge (and skills using ParaBoss tools). Each assessment quiz is stand alone and most

can generally be completed in 15 to 30 minutes, but can be saved during completion. This formula was chosen to suit small amounts of time available to rural merchandise staff between customer interactions, and where they might be interrupted partway through a quiz.

- For LiceBoss and FlyBoss, ten scenarios have been created.
- LiceBoss quizzes have about 10 questions each
- FlyBoss quizzes have about 20 questions each.
- WormBoss has 7 topic areas with variable numbers of questions, plus a region-specific section. Users can do one or more of these region-specific sections.
- For each question there are approximately three to six question variants, with one of these variants randomly allocated into its respective quiz. This results in tens of thousands of possible combinations of questions that can be generated for each quiz, so removing the ability of “cheat sheets” being developed.
- Each question is generally multiple-choice or true-false questions, though there are some other types. ParaBoss realises the limitations of these, but they allow the course to be marked immediately online at low cost.
- The training/learning component is facilitated by providing a small section of information at the beginning of each question, from which the answer can be drawn.
- The learning component uses the “question and answer” sections from the online learning for WormBoss, FlyBoss and LiceBoss. These components are considered by the past ParaBoss Technical Committee to comprise **all** “core knowledge” on Parasite management of sheep.
- The quizzes are a comprehensive training tool by virtue of them holding all the “core knowledge” and students must complete questions on every single topic, not a subset; and they must gain a 100% pass mark.

User testing has been conducted. Initial interest was gained from 48 people to conduct user-testing on the basis that they were able to complete the course at no charge, but they were required to provide feedback on whether they disagreed with answers, saw ambiguous questions or typographical or formatting mistakes.

The user-testing process also collected user feedback on the value of the course, which will be used in promotion of the course.

Continuing Professional Development points (for veterinarians) will be linked to the course as further incentive for veterinarians to enrol.

The certificate is not yet publicly available, but will be opened in the second half of 2021 by the University of New England (UNE) with a view to a similar course for cattle in the future.

3.2.10 ParaBoss Worm Egg Counting Quality Assurance Program

The ParaBoss WEC QA program responds to the need to ensure that producers are gaining accurate worm egg counting services to enable the appropriate worm management decisions to be made. A previous program was administered by the Department of Agriculture and Food (DAF) WA (now DPIRD) for some years, but was discontinued as it was costly to the department and not considered core business. That previous program identified that laboratories and individuals do not all provide accurate services, and there is no other means to assess this.

ParaBoss opened a tender for skilled laboratories to prepare and send the samples for a new program and the tender was won by Department of Primary Industries and Regional Development

WA (DPIRD WA, previously DAF WA), with the staff who had carried out the previous WA program. This brought considerable experience to the process.

The first round was run in 2019 and involved laboratories paying a fee to participate (previously in the WA program there had been no charge to participate).

The technical process was managed by Dr Brown Besier, previously with DPIRD and part of the original WA team. The promotion, registration, collation of results, and reporting was managed by ParaBoss staff. Details of the original process and data analysis are published in van Burgel *et al*, 2014.

After the first round, because nearly one third of participating laboratories failed to meet the required standards, a supplementary round was carried out to allow these the opportunity to meet the standards.

The 2019 rounds were carried out with all collation of data and reporting done manually. Once the process was known, Wrightway Design was asked to prepare an automated online system to manage most of the registration, data collection, analysis, and reporting, to greatly reduce the labour costs and allow the program to recover all operational costs through fees. This was to be used in the 2020 round.

In 2020, the COVID 19 pandemic severely disrupted national freight services and the program was cancelled as there was a high chance that many of the perishable samples sent around Australia to participating laboratories would take too long in transit and the samples would be compromised.

At the time of this report, the intent is to run the next round in October 2021.

3.2.11 Drench Resistance Test Database feasibility and proposal

Originally, this activity was to create a database, but it became evident that this was a much larger and complex task than would be possible within the time and budget of the project. As such, the Steering Committee agreed to change this activity to conducting a feasibility study and preparing a project proposal.

The project aims to collate drench resistance data for immediate use in sheep worm control programs, and to investigate the most efficient approach to monitoring resistance trends in the future.

The study to develop the project proposal was conducted by independent parasitologist, Dr Brown Besier, with input from Dr Matthew Playford and ParaBoss Executive Officer, Deborah Maxwell.

Information from a national drench resistance database would provide both immediate and longer term benefits to the sheep industries:

- Informed drench choice decisions will enable producers to avoid likely ineffective products, and hence minimise losses due to resistant worms.
- Extension campaigns highlighting drench resistance figures focus attention on the value of drench testing and need for resistance management.
- The impact of resistance management recommendations and communication effectiveness can be evaluated by monitoring resistance trends over time in relation to industry practice.
- Identifying environment-specific resistance factors provides an objective basis for R, D&E responses.

The study involved liaison with stakeholders, including pharmaceutical companies (many of whom already conduct tests) as well as some key worm egg count testing houses.

For the proposal document see *Appendix G[†]: Project Proposal ParaBoss National Drench Resistance Database*.

3.3 ParaBoss Evaluation II and IIa

3.3.1 ParaBoss Analytics

ParaBoss Analytics reports are prepared quarterly and presented to the Steering Committee and Technical Committee (Phase II) and Project Committee (Phase IIa). These include analytic data on the ParaBoss websites, most frequently visited webpages; ParaBoss Tool usage; ParaBoss multimedia and ParaBoss social media.

Google Analytics was used to assess the usage over the suite of ParaBoss websites. This included reporting on the number per month of users, pageviews and sessions over each of the Boss sites from July 2013 (inception) to the present. From this data, comparisons were made between the sites individually and as a collective.

The website analytics were also used to determine the most frequently visited pages over time for each of the websites and to assess the usage trends in page visits at different times.

Google Analytics is also used to give an indication of ParaBoss Tool usage including the:

- WormBoss Drench Decision Guides
- FlyBoss Flystrike Risk Simulator (Phase IIa)
- FlyBoss QuickTools Online
 - Optimise Treatment tool
 - Compare Management tool
- LiceBoss Tools:
 - Lice Treatment Guide
 - Long Wool Lice Tool
 - Rubbing Tool
 - Short Wool Lice Tool
 - Ewe/Lamb Treatments Tool
 - Treatment Factors Tool
 - Wool Residue Tool
- Products Search (launched with the Cattle sites, so only a month of data).

Facebook Insights and Google Analytics are used to view the value of the ParaBoss social media including the use of the ParaBoss sheep Facebook page and the ParaBoss Goat Facebook page. Number of total followers, daily reach of posts, number of daily engaged users and average engagement per post for each page is recorded, as well as the number of website sessions as a result of Facebook referrals.

The majority of ParaBoss videos and webinars are hosted through the ParaBoss YouTube channel, however some can be downloaded directly through the ParaBoss website, and duplicated on the WormBoss, FlyBoss or LiceBoss websites, so openings from the websites are not recorded in YouTube analytics. YouTube analytics are used to show the number of views of ParaBoss videos/webinars and the number of views by traffic source hosted through the ParaBoss YouTube channel.

Google Analytics is used to determine the number of pageviews to the Boss websites multimedia pages, which gives an indication of total video downloads.

ParaBoss Wormcasts are podcasts produced by ParaBoss covering parasite management topics—worms, flies, lice, ticks and fluke—for sheep, cattle and goats. Wormcasts launched on 1 December 2019. Wormcasts are hosted by the podcast hosting service Buzzsprout, which records statistics on the number of downloads over time for each episode. ParaBoss Wormcasts are also available for download directly from the ParaBoss website. These downloads are not tracked through Buzzsprout, but are followed through Google Analytics and indicated by visits to the ParaBoss multimedia page. There is currently no capability to record data for individual episode downloads.

ParaBoss Snapshots are short audio presentations about a specific topic in a few-minute lecture presentation style. ParaBoss Snapshots are available for download directly from the ParaBoss website, and are tracked through Google Analytics and indicated by visits to the ParaBoss multimedia page.

3.3.2 ParaBoss Surveys

3.3.2.1 Benchmarking Australian Sheep Parasite Control

Australian Wool Innovation (AWI) commissioned the Benchmarking Australian Sheep Parasite Control survey (independently of ParaBoss) to benchmark the sheep parasite control practices of Australian wool producers. This survey was carried out by Dr Alison Colvin, Prof. Stephen Walkden-Brown and Dr Ian Reeve from the University of New England (Colvin *et al* 2020).

ParaBoss was consulted on what questions to include that could demonstrate awareness and use of the ParaBoss resources. As there was already a small survey conducted for AWI by Collins in 2016 (Appendix I[‡]: Dave Collins 2016 Parasites and Diseases Survey Results) to assess awareness, use and value of WormBoss and FlyBoss, it was decided to use the questions from that survey (or similar ones) in the Benchmarking Australian Sheep Parasite Control survey to provide some longitudinal results. Questions regarding LiceBoss were also included.

The questions of this survey relating directly to the Boss sites included:

- How useful for parasite control are these websites to you?
- If you have used WormBoss, FlyBoss or LiceBoss information to make changes to your parasite management, please estimate the annual dollar (\$) value of these changes across your property from changes in labour costs, chemical costs, other costs or differences in production.
- Preferred method of delivery of information

The Benchmarking Australian Sheep Parasite Control report (Colvin *et al*, 2020) can be found on the AWI web site at the following URL:

<https://www.wool.com/globalassets/wool/sheep/research-publications/welfare/surveys/2018-benchmarking-australian-sheep-parasite-control-survey.pdf>

3.3.2.2 ParaBoss review: Recommendations for products and services

Dr Alex Ball (Rural Analytics) and Kimbal Curtis (Livestock Dynamics) were commissioned to survey users of ParaBoss products and services in early 2020 (Appendix J[‡]: Ball and Curtis 2020 *Recommendations for products and Services*).

The review was to achieve two purposes:

1. Provide information to

- Report progress/success of ParaBoss Phase II
- Identify the following about ParaBoss products, services, and activities
 - Use, usefulness, and impact
 - Priority gaps
 - Improvements required
- Inform the future priority products and services of ParaBoss Phase III

2. Identify the value of the ParaBoss Technical Committee and to inform how a future committee might best be structured and operate.

In total, thirty-one industry stakeholders were interviewed, including sheep or goat producers, sheep industry consultants, veterinary consultants, reseller or agency representatives, chemical company representatives or technical consultants, commercial worm egg count providers, and steering committee members.

The interview format was structured to extract opinions on each of the products, services, and activities listed below:

- ParaBoss—as an integration program
- WormBoss—the product, tools, and information
- LiceBoss—the product, tools, and information
- FlyBoss—the product tools and information
- ParaBoss Newsletter
- Facebook pages (2 pages)
- Videos
- Podcasts
- Webinars
- Conference/Workshop
- ParaBoss articles—specifically those that appear in “Beyond the Bale”
- ParaBoss Web Technical Forum (where appropriate)
- WEC QA program

Interviewees were asked to provide responses to the following questions for all of the products, services, and activities in ParaBoss with which they were familiar:

- what the interviewees like/use/favourites/value and their impacts
- what they do not like/use and why
- how they see that it could be improved

All interviews were conducted by telephone and ranged in length from 35 to 90 minutes.

The Technical Committee review asked:

- What is the value of the Technical Committee to its members?
- What is the value of the Technical Committee to ParaBoss?

- Does it operate in the way you expected it to?
- What is the ideal number of members for the Technical Committee?
- Is the Technical Committee too operational or not operational enough?
- Is there a better way to run the Technical Committee other than large face to face meetings?
- What functional improvements could be made to the Technical Committee?

The review, including details of methodology can be found in *Appendix J[‡]: Ball and Curtis 2020 Recommendations for products and Services*.

The review generated fourteen recommendations, shown in the Results section below.

4. Results

4.1 ParaBoss Planning Documents Phase II and IIa

4.1.1 ParaBoss Business plan, Steering Committee TOR, IP Owners Committee TOR

The ParaBoss Business plan framed the ParaBoss mission, vision and goals and objectives for ParaBoss Phase II. The purpose of the business plan was to inform the direction of ParaBoss Phase II and focus the Phase II objectives so that there is maximum adoption of industry best practice in ParaBoss delivery activities. The Business Plan outlined the key strengths, weaknesses, opportunities and threats for ParaBoss. The report also included strategic options and strategies; commercialisation opportunities and communication and extension approaches and evaluation methods, all which guided the development of ParaBoss Phase II activities.

The Steering Committee TOR (Phase II) was developed in conjunction with the ParaBoss Business Plan, and the IP Owners Committee TOR (Phase IIa) were developed as part of the research variation agreement for Phase IIa. These Terms of reference outline the role of the committees to ensure that ParaBoss continues to improve its role as Australia’s national authority for the control of internal and external parasites of grazing ruminant livestock; and to provide oversight of the performance of ParaBoss Phase II and IIa Delivery Agreements.

The Business Plan and TOR’s were reviewed and accepted by all concerned parties.

For the approved business plan see *Appendix A[‡]: ParaBoss Phase II Business Plan 20170705*.

4.1.2 Technical Committee TOR and Project Committee TOR

Technical Committee (Phase II)

The function of the Technical Committee (Phase II) was to ensure the technical basis of ParaBoss information, programs and tools are evidence-based, current and nationally relevant. The Technical Committee was responsible for overseeing the technical content of the ParaBoss website, identifying improvements, providing recommendations on research and extension needs and feedback to the Steering Committee on technical issues.

The Role of the ParaBoss Technical Committee was to:

- Provide national leadership (in grazing livestock parasitology) by developing or endorsing national best practice principles and identifying issues that need resolution.
 - Make recommendations on research/communication/extension needs and where appropriate, on research/communication/extension programs and activities for

parasite management in grazing livestock to the ParaBoss Steering Committee and Research Development Corporations.

- Recommend improvements to ParaBoss that reflect industry need.
- Provide sign-off on all ParaBoss substantive technical material and tools.
- Identify other industry professionals for contribution to ParaBoss communication activities.
- Contribute to the ParaBoss Technical Forum and ParaBoss communication content including ParaBoss News.

The ParaBoss Technical Committee met or teleconferenced three or four times each year during Phase II.

Project Committee (Phase IIa)

The functions of the Project Committee (Phase IIa) were to provide strategic and operational guidance for the ParaBoss Phase IIa project and to provide updates, advice and recommendations to an Intellectual Property (IP) Owners Committee of MLA, AWI and UNE. These updates to the IP Owners Committee were intended to inform the progress of project activities towards ensuring ParaBoss' remit as Australia's national authority for the control of internal and external parasites for grazing ruminant livestock. The role of the Project Committee was to:

- review progress against the ParaBoss and AHA Phase IIa Delivery Agreements, Monitoring and Evaluation plans and Annual Operating plans (or equivalent);
- monitor improvements to ParaBoss and ParaBoss IP rights and, through the Project Committee Chair, note these for the attention of the IP Owners Committee of MLA, AWI and UNE;
- assist in identifying additional resources and opportunities for ParaBoss; and
- provide updates, advice and recommendations on project activities, and recommendations for development of the ParaBoss Phase III Strategic Plan, through the Project Committee Chair, to the IP Owners Committee.

The Project Committee (Phase IIa) met by web meeting three times.

The Technical Committee TOR (Phase II) and Project Committee TOR (Phase IIa) were reviewed and accepted by all concerned parties.

Appendix C[‡]: ParaBoss Technical Committee TOR 20170425.

4.1.3 IP Register

The purpose of ParaBoss IP register is to record the ownership of improvements to the intellectual property of the ParaBoss suite of products and services. The approach that has been taken is restricted to the identification of substantive changes and developments, rather than a few words here and there on pages (such as correcting misspellings or improving the readability of a statement).

Any content associated with ParaBoss, WormBoss, FlyBoss, LiceBoss or TickBoss not described in the ParaBoss IP register is deemed to have existed prior to the commencement of the ParaBoss Licence Agreement (dated 21 November 2013) or is a contributed article from another party (where published, these are shown with the author's name).

The ParaBoss IP Register details a list of domain names and ownership (at 30 May 2021). It can be found in *Appendix D[‡]: ParaBoss IP register 20210429*. Domain names, expiry date and renewal

period of each Domain name is listed. The IP register also details a list of Trademarks and ownership. The renewal date of each Trademark is listed.

The ParaBoss IP register was maintained for ParaBoss Phase II and IIa. Improvements to the website include:

- New or major additions to web pages
- Feature articles for ParaBoss News
- Webinars
- Case studies
- Web platform functionality
- Web-based tools
- Presentations and associated materials
- Magazine and other contributed articles
- Other

Details of these additions can be found in *Appendix D[‡]: ParaBoss IP register 20210429* tables according to the website and the Phase.

The continual improvement of the ParaBoss suite of websites as shown in the IP Register, continues to ensure ParaBoss retains its role as Australia’s national authority for the control of internal and external parasites of grazing ruminant livestock.

4.1.4 Commercialisation activities

ParaBoss Review of Funding and Commercialisation Opportunities

The review conducted by Australian Venture Consultants (2018) identified that options for ParaBoss to generate income to replace industry funding were extremely limited, but did provide recommendations for improvements that may enable ParaBoss to later identify external income generating opportunities.

Appendix N[‡]: ParaBoss Review of Funding and Commercialisation Opportunities March 2018.

Advertising

Some success was achieved in gaining advertising on the web sites generating an average income of about \$25,000 annually, with net income re-invested into the project (after set up costs to house advertising on the sites, and staff costs to solicit and administer advertising).

Despite contacting a range of rural companies, only those that sold parasite treatment products took up advertising.

The websites are set up with simple-to use functionality to include advertisements and these are fast and easy to use. However, some dedicated part-time staff are required to maintain a register of the advertising, contact companies and “sell” advertising. This may suit a communications operation, better than technical staff.

Advertising positions were never entirely filled, but provided very good opportunities when companies were releasing new products.

Advertising income dropped during the drought of 2018–2019, especially as it became very severe in 2019, with companies providing feedback that they were doing very little advertising anywhere

because parasite issues became minor to farmers under these circumstances. In late 2019 and since, due to reduced funding, limited staff time was available to seek advertising.

Overall, income generated did cover the costs of the work involved, and with the facility to continue this already in place on the websites, it is recommended that advertising be continued.

Financial Year	Gross income from advertising (GST exclusive)
2017–2018	\$43,776
2018–2019	\$12,407
2019–2020	\$38,320
2020–2021	\$8,036
Total	\$102,539

Licencing of ParaBoss content

The single enquiry for licencing of content from another wool producing country resulted in a proposed licence agreement discussed with the organisation. Unfortunately, their available funds were limited and did not meet the expectations of MLA, therefore this opportunity did not progress any further.

4.2 ParaBoss Delivery Activities Phase II and Ila

4.2.1 ParaBoss Websites

The following websites (collectively referred to as the “Boss websites”) are tracked by Google Analytics:

<https://www.paraboss.com.au/>

<http://www.wormboss.com.au/sheep-goats/>

<http://www.wormboss.com.au/cattle/>

<http://www.flyboss.com.au/sheep-goats/>

<http://www.flyboss.com.au/cattle/>

<http://www.liceboss.com.au/sheep-goats/>

<http://www.liceboss.com.au/cattle/>

<http://www.tickboss.com.au/cattle/>

However, the cattle sites were only published at the end of April 2021 (i.e. one month before this report was submitted), so limited Google Analytics data is presented here for them.

Fig. 1, 2 and 3 show the numbers per month of users, pageviews and sessions respectively over each of the Boss sites from 01 July 2013 to 25 May 2021. Fig. 4 shows total users across all sites from 01 July 2013 to 28 February 2021. Fig. 5 shows the comparison of average users, sessions and pageviews across all sites from 01 April 2017–25 May 2021.

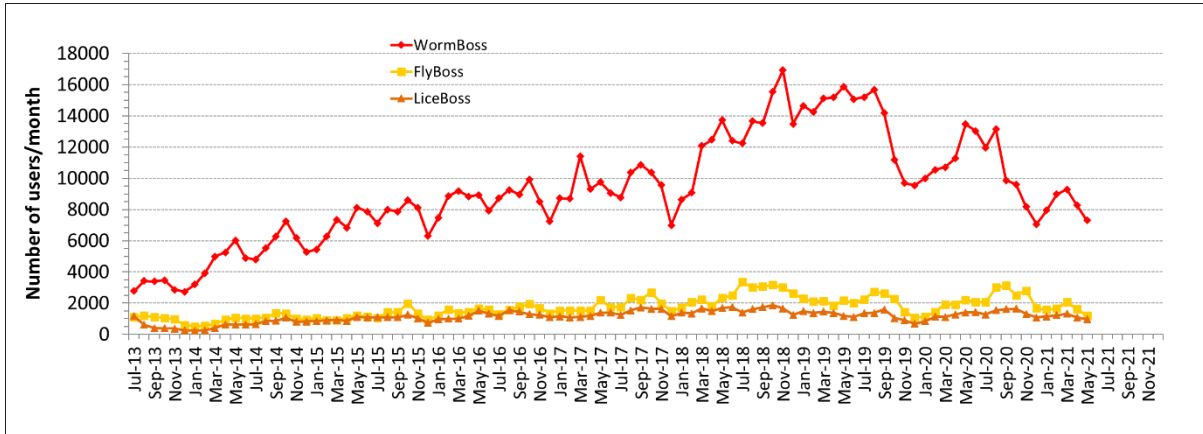


Figure 1. Users per month for WormBoss, FlyBoss and LiceBoss from 01 July 2013–25 May 2021

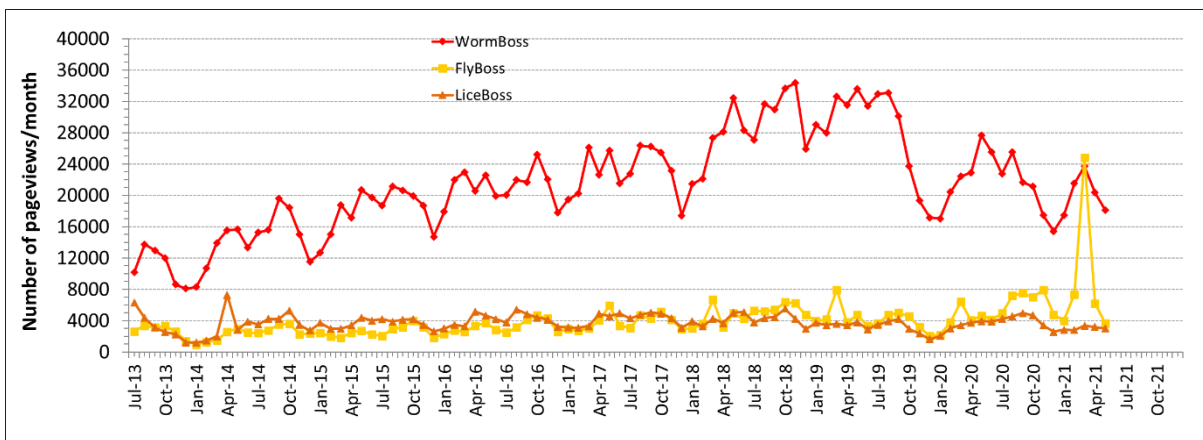


Figure 2. Pageviews per month for WormBoss, FlyBoss and LiceBoss from 01 July 2013–25 May 2021

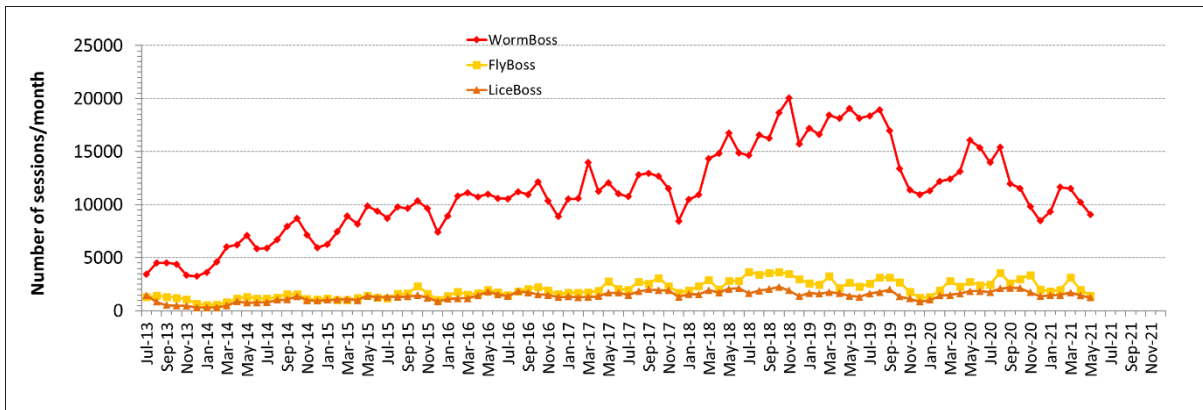


Figure 3. Sessions per month for WormBoss, FlyBoss and LiceBoss from 01 July 2013–25 May 2021

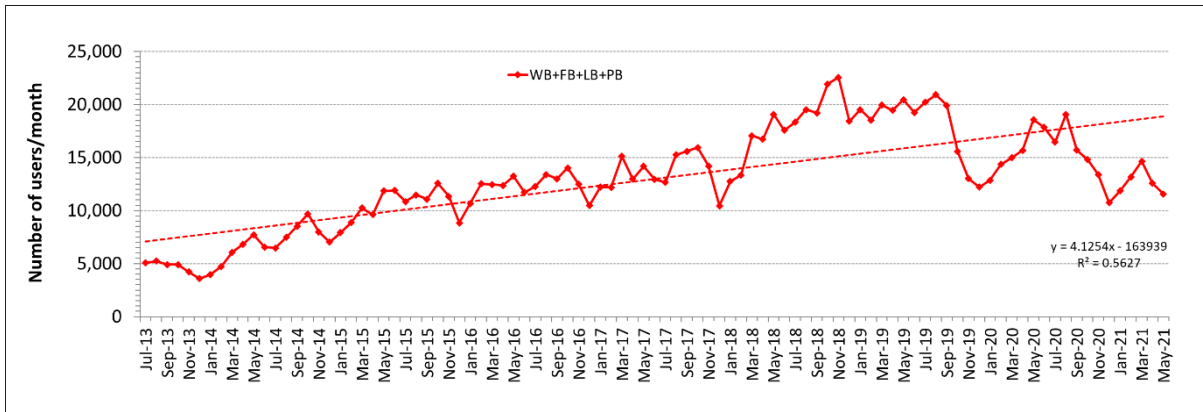


Figure 4. Total Users across all sites from 01 July 2013–25 May 2021

The web usage had grown at a steady rate until about September 2019, during this time there were clear annual cycles with usage dipping during the December/January period each year and with peaks in each spring time.

It is not understood why there is a significant drop in usage since September 2019, with a general flattening or slight downward trend. It was initially postulated (especially when some recovery was seen in mid 2020) that the drought may have caused producers to not need to look for parasite advice, however the drought was ongoing from 2018 through to the end of 2020 (and longer for some regions) and usage figures were still climbing in 2018 and much of 2019 despite this; also the continued decline in usage statistics in 2020 and 2021, (with resulting very high worm and flystrike problems) is the opposite to what would be expected in these high rainfall years. And while there might be fewer livestock, there are still many producers.

The reduction in referrals to the websites from the ParaBoss Facebook pages (see results section 4.2.4 further on for commentary on the Facebook pages), and a year later (September 2020) reductions in referrals from the ParaBoss News e-newsletter has certainly reduced the web usage, but to what extent and what other factors there are, are difficult to determine. The drop has corresponded with a change in the team producing these two communication products from UNE to AHA.

It is recommended that a review of the Facebook and Newsletter performance is conducted, and also a detailed assessment of Google Analytics data to better understand where the shortfalls in web usage are stemming from.

WormBoss has always been the most popular website, as shown below in Fig. 5. This reflects the considerable complexity involved in worm management compared to flystrike and lice management, with a resulting larger demand from producers for worm management information.

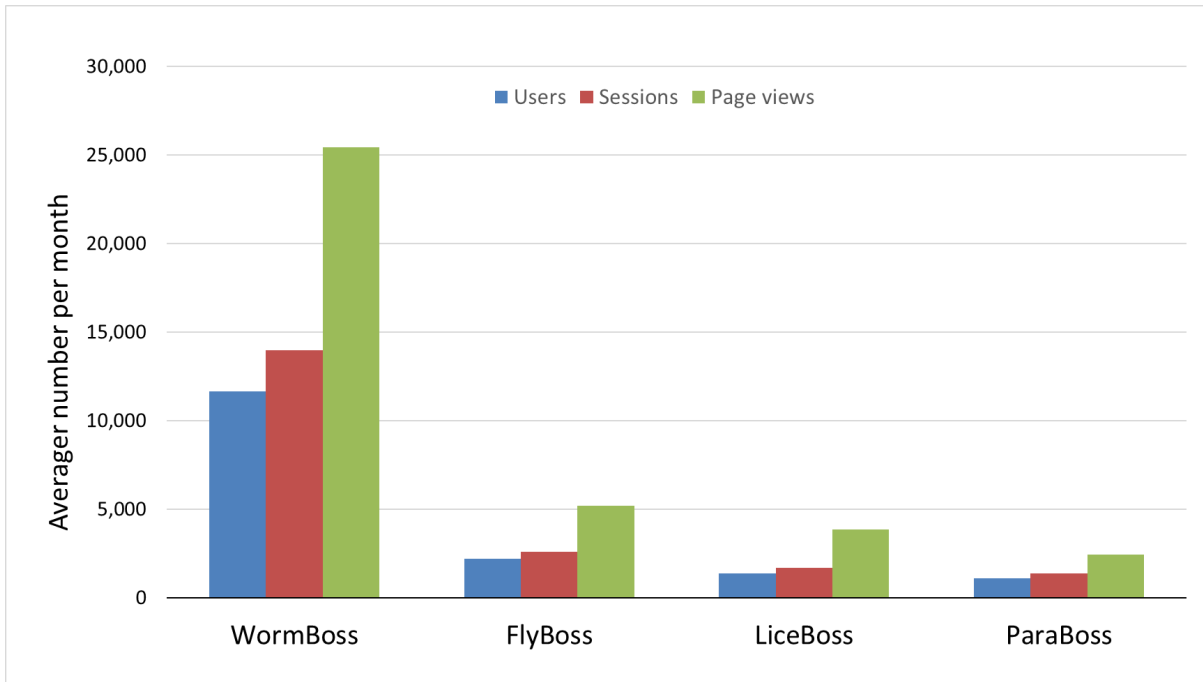


Figure 5. Comparison of Users, Sessions and Pageviews across all sites from 01 Apr 2017–25 May 2021

Most frequently visited pages—ParaBoss and the sheep websites

Tables 8, 9, 10 and 11 show the Page Name and URL and number of Pageviews of the 15 Most Frequently Visited pages from 01 April 2017–25 May 2021 from WormBoss, FlyBoss, LiceBoss sheep sites and ParaBoss respectively.

Table 8. Page Name and URL of the 15 most frequently visited pages from 01 April 2017–25 May 2021 for <http://www.wormboss.com.au/sheep-goats/>

Rank	Page Name	URL for http://www.wormboss.com.au/sheep-goats/	Number of Pageviews
1	Signs of worms	/sheep-goats/worms/roundworms/signs-of-worms.php	72906
2	Home Page	http://www.wormboss.com.au/sheep-goats/	68373
3	Drenches	/sheep-goats/tests-tools/management-tools/drenches.php	56019
4	Liver fluke	/sheep-goats/drenches.php	55194
5	Roundworm life cycle	/sheep-goats/worms/roundworms/roundworm-life-cycle.php	48306
6	Barber's pole worm	/sheep-goats/worms/roundworms/barbers-pole-worm.php	45920
7	Drench Decision Guides	/sheep-goats/tests-tools/drench-decision-guide.php	42445
8	Sheep	/sheep-goats/programs/sheep.php	31409
9	Worm egg counting	/sheep-goats/tests-tools/tests/worm-egg-counting.php	27076
10	Lungworm	/sheep-goats/worms/roundworms/lungworm.php	23620
11	Drenches for goats: using products correctly and legally	/sheep-goats/tests-tools/management-tools/drenches/drenches-for-goats-using-products-correctly-and-legally.php	22731
12	Brown stomach worm	/sheep-goats/worms/roundworms/brown-stomach-worm.php	18383
13	Liver fluke control	/sheep-goats/programs/sheep/nsw/appendices/liver-fluke-control.php	17464
14	Grazing management	/sheep-goats/tests-tools/management-tools/grazing-management.php	16811
15	Hydatids	/sheep-goats/worms/tapeworms/hydatids.php	16293

Table 9. Page Name and URL of the 15 most frequently visited pages from 01 April 2017–25 May 2021 for <http://www.flyboss.com.au/sheep-goats/>

Rank	Page Name	URL for http://www.flyboss.com.au/sheep-goats/	Number of Pageviews
1	Home Page	http://www.flyboss.com.au/sheep-goats/	22371
2	FlyBoss: Optimise Management	http://www.flybosstools.com.au/tools/FBOptimise.aspx	18200
3	Blowfly Biology	/sheep-goats/susceptibility/blowfly-biology.php	15902
4	Flystrike Decision Support Tools	http://www.flybosstools.com.au/	13881
5	FlyBoss Region Selection	http://www.flybosstools.com.au/tools/Map.aspx	11804
6	Choosing The Right Chemical for FlyStrike	/sheep-goats/treatment/choosing-the-right-chemical.php	11748
7	FlyBoss Tools - Products	/sheep-goats/treatment/products.php	8234
8	Online Planning Tools for Flystrike Prevention	/sheep-goats/tools.php	7339
9	Tail Length in Sheep	/sheep-goats/management/tail-length.php	6021
10	FlyBoss: Compare Management	http://www.flybosstools.com.au/tools/FBCompare.aspx	5429
11	Treatment	/sheep-goats/treatment.php	5158
12	Pain relief FAQs	/sheep-goats/management/breech-modification/pain-relief-faqs.php	5095
13	Annual flystrike management plans	/sheep-goats/management/annual-flystrike-management-plans.php	4355
14	Shearing And Crutching	/sheep-goats/management/shearing-and-crutching.php	3924
15	New CLiK™ Extra ideal for strategic fly control	/sheep-goats/news/articles/flyboss-featured-articles/new-клик-extra-ideal-for-strategic-fly-control.php	3812

Table 10. Page Name and URL of the 15 most frequently visited pages from 01 April 2017–25 May 2021 for <http://www.liceboss.com.au/sheep-goats/>

Rank	Page Name	URL for http://www.liceboss.com.au/sheep-goats/	Number of Pageviews
1	LiceBoss Tools	/sheep-goats/tools.php	36009
2	Treating Lice	/sheep-goats/treating.php	19673
3	Home Page	http://www.liceboss.com.au/sheep-goats/	14577
4	Lice and Flystrike Products	/sheep-goats/treating/products.php	14006
5	Backlining	/sheep-goats/treating/application-methods/backlining.php	6660
6	Long Wool Lice Tool	/sheep-goats/tools/long-wool.php	5995
7	Plunge and cage dipping	/sheep-goats/treating/application-methods/plunge-and-cage-dipping.php	4747
8	Sheep lice control for ewes and lambs	/sheep-goats/treating/sheep-lice-control-for-ewes-and-lambs.php	4399
9	LiceBoss Treatment Decision Guide	/sheep-goats/tools/treatment-guide.php	3925
10	Lice treatment products	/sheep-goats/treating/lice-treatment-products.php	3747
11	Itch mite in sheep	/sheep-goats/monitoring/itch-mite-in-sheep.php	3664
12	Biology of Lice	/sheep-goats/about-lice/biology-of-lice.php	3493
13	Solve Your Current Lice Issue	/sheep-goats/tools/solve-your-current-lice-issue.php	3122
14	Sheep lice	/sheep-goats/about-lice/liceboss-online-learning/sheep-lice.php	3020
15	Control of body lice (<i>Bovicola ovis</i>) on shedding and hair breeds of sheep	/sheep-goats/treating/control-of-body-lice-bovicola-ovis-on-shedding-and-hair-breeds-of-sheep.php	2777

Table 11. Page Name and URL of the 15 most frequently visited pages from 01 April 2017–25 May 2021 for <https://www.paraboss.com.au/>

Rank	Page Name	URL for http://www.paraboss.com.au/	Number of Pageviews
1	Home page	https://www.paraboss.com.au/	29237
2	New South Wales Updates	/news/outlooks/nsw.php	7632
3	News	/news.php	4964
4	Quick Quiz	/news/quick-quiz.php	4736
5	Victoria Updates	/news/outlooks/vic.php	4315
6	Subscribe To ParaBoss	/subscriptions.php	4168
7	Western Australia Updates	/news/outlooks/wa.php	3190
8	Tasmania Updates	/news/outlooks/tas.php	3151
9	South Australia Updates	/news/outlooks/sa.php	2983
10	ParaBoss State Outlooks	/news/outlooks.php	2180
11	ParaBoss Workshops / Events Calendar	/events.php	2160
12	Queensland Updates	/news/outlooks/qld.php	2097
13	ParaBoss Conference 2018	/paraboss-conference-2018.php	1966
14	Wormcasts - ParaBoss podcasts	/multimedia/podcasts.php	1375
15	WormBoss Articles	/news/articles/wormboss-articles.php	1344

Most frequently visited pages—cattle websites

Tables 12, 13, 14 and 15 show the Page Name and URL and number of Pageviews of the 15 Most Frequently Visited pages from 01 April 2017–25 May 2021 from WormBoss, FlyBoss, LiceBoss and TickBoss cattle sites respectively.

Table 12. Page Name and URL of the 15 most frequently visited pages from 23 April 2021–30 May 2021 for <http://www.wormboss.com.au/cattle/>

Rank	Page Name	URL for http://www.wormboss.com.au/cattle/	Number of Pageviews
1	WormBoss.com.au	http://www.wormboss.com.au/cattle/	271
2	ParaBoss Products Search	/cattle/treatment/products/search.php	144
3	Which animals are susceptible to worms	/cattle/treatment/how-decide-which-animals-to-treat/which-animals-are-susceptible-to-worms.php	55
4	Worm egg counts	/cattle/management/assess-worm-burdens/worm-egg-counts.php	45
5	Assess worm burdens	/cattle/management/assess-worm-burdens.php	43
6	Barber's pole worm: <i>Haemonchus placei</i> , <i>Haemonchus contortus</i>	/cattle/worms/roundworms/barbers-pole-worm.php	43
7	Drench resistance	/cattle/treatment/drench-resistance.php	32
8	Manage drench resistance	/cattle/treatment/drench-resistance/manage-drench-resistance.php	30
9	Treatment	/cattle/treatment.php	28
10	Annual Program	/cattle/programs.php	25
11	How to decide which animals to treat	/cattle/treatment/how-decide-which-animals-to-treat.php	20
12	Brown stomach worm: <i>Ostertagia ostertagi</i>	/cattle/worms/roundworms/brown-stomach-worm.php	19
13	Monitoring WECs of cattle	/cattle/treatment/how-decide-which-animals-to-treat/monitoring-wecs-of-cattle.php	19
14	Plan an annual control strategy	/cattle/treatment/how-decide-which-animals-to-treat/plan-an-annual-control-strategy.php	19
15	Monitor worm control effectiveness	/cattle/management/assess-worm-burdens/monitor-worm-control-effectiveness.php	13

Table 13. Page Name and URL of the 15 most frequently visited pages from 23 April 2021–30 May 2021 for <http://www.flyboss.com.au/cattle/>

Rank	Page Name	URL for http://www.flyboss.com.au/cattle/	Number of Pageviews
1	FlyBoss Tools - Products	http://www.flyboss.com.au/cattle/treatment/Products-tool.php	282
2	FlyBoss.com.au	http://www.flyboss.com.au/cattle/	190
3	ParaBoss Products Search	http://www.flyboss.com.au/cattle/treatment/products/search.php	139
4	Buffalo Fly	http://www.flyboss.com.au/cattle/treatment/treat-cattle/buffalo-fly.php	53
5	Back-Rubber	http://www.flyboss.com.au/cattle/treatment/products/application-methods/backrubber.php	20
6	Treatment	http://www.flyboss.com.au/cattle/treatment.php	20
7	Manage Buffalo Fly	http://www.flyboss.com.au/cattle/management/buffalo-fly.php	17
8	Signs, Impact and Biology	http://www.flyboss.com.au/cattle/flies-diseases/buffalo-fly-and-other-flies-grazing-cattle/mosquitoes-and-midges/signs-impact-biology.php	9
9	Keep Flies Out	http://www.flyboss.com.au/cattle/management/feedlot-flies/keep-flies-out.php	8
10	Manage Cattle Surrounds	http://www.flyboss.com.au/cattle/management/feedlot-flies.php	8
11	Other Flies	http://www.flyboss.com.au/cattle/treatment/treat-cattle/other-flies.php	8
12	Risk Management Steps To Protect Against Flystrike	http://www.flyboss.com.au/cattle/management.php	8
13	Chemical Groups and Actives	http://www.flyboss.com.au/cattle/treatment/products/chemical-groups-and-actives.php	7
14	Ear Tags	http://www.flyboss.com.au/cattle/treatment/products/application-methods/ear-tags.php	7
15	What is Pesticide Resistance	http://www.flyboss.com.au/cattle/treatment/pesticide-resistance/what-is-pesticide-resistance.php	7

Table 14. Page Name and URL of the 15 most frequently visited pages from 23 April 2021–30 May 2021 for <http://www.liceboss.com.au/cattle/>

Rank	Page Name	URL for http://www.liceboss.com.au/cattle/	Number of Pageviews
1	Home page	http://www.liceboss.com.au/cattle/	76
2	ParaBoss Products Search	/cattle/treatment/products/search.php	41
3	Treating lice	/cattle/treatment/treating-lice.php	26
4	Application methods	http://www.liceboss.com.au/cattle/treatment/products/application-methods.php	11
5	Macrocyclic lactones	http://www.liceboss.com.au/cattle/treatment/products/chemical-groups-and-actives/macrocyclic-lactones.php	11
6	Synthetic pyrethroids	http://www.liceboss.com.au/cattle/treatment/products/chemical-groups-and-actives/synthetic-pyrethroids.php	10
7	Types of lice	http://www.liceboss.com.au/cattle/lice-mites/about-lice/types-of-lice.php	10
8	Chemical mixtures and combinations	http://www.liceboss.com.au/cattle/treatment/products/chemical-groups-and-actives/chemical-mixtures-and-combinations.php	9
9	Organophosphates	http://www.liceboss.com.au/cattle/treatment/products/chemical-groups-and-actives/organophosphates.php	8
10	Treatment	http://www.liceboss.com.au/cattle/treatment.php	8
11	Chemical groups and actives	http://www.liceboss.com.au/cattle/treatment/products/chemical-groups-and-actives.php	7
12	Species of lice	http://www.liceboss.com.au/cattle/lice-mites/species-of-lice.php	7
13	Dip	http://www.liceboss.com.au/cattle/treatment/products/application-methods/dip.php	6
14	Consider other parasites when treating	http://www.liceboss.com.au/cattle/treatment/consider-other-parasites-when-treating.php	5
15	Ear tags	http://www.liceboss.com.au/cattle/treatment/products/application-methods/ear-tags.php	4

Table 15. Page Name and URL of the 15 most frequently visited pages from 23 April 2021– 30 May 2021 for <http://www.tickboss.com.au/cattle/>

Rank	Page Name	URL for http://www.tickboss.com.au/cattle/	Number of Pageviews
1	TickBoss.com.au	http://www.tickboss.com.au/cattle/	290
2	ParaBoss Products Search	/cattle/treatment/products/search.php	191
3	Treatment	/cattle/treatment.php	47
4	Tick identification	/cattle/ticks-and-diseases/species-of-ticks/tick-id.php	39
5	Treating Cattle Tick	/cattle/treatment/treating-cattle-tick.php	35
6	Risk Management Steps To Protect Against Ticks	/cattle/management.php	23
7	Ticks & Tick-Borne Diseases	/cattle/ticks-and-diseases.php	16
8	Annual Program	/cattle/programs.php	14
9	Professional service providers	/cattle/management/professional-service-providers.php	14
10	Tickboss.com.au Acknowledgements	/cattle/about.php	12
11	TickBoss cattle products search guide	/cattle/treatment/products/search.php	11
12	Tick life cycles and life stages	/cattle/ticks-and-diseases/about-ticks/tick-life-cycles.php	10
13	Organophosphates	/cattle/treatment/products/chemical-groups-and-actives/organophosphates.php	9
14	Synthetic pyrethroids	/cattle/treatment/products/chemical-groups-and-actives/synthetic-pyrethroids.php	9
15	Tropical Coast QLD	/cattle/programs/region-6-tropical-coast-qld.php	9

Cattle ParaBoss web content deficits

During the development of the cattle websites, the University of New England was tasked with a review of current cattle worm management recommendations. This highlighted a number of research suggestions that, if answered, could improve the cattle ParaBoss resource.

1. More data is needed on worm burdens in northern pastoral regions, their production impact on different classes of stock and the relevance of compensatory gain post treatment. A review of

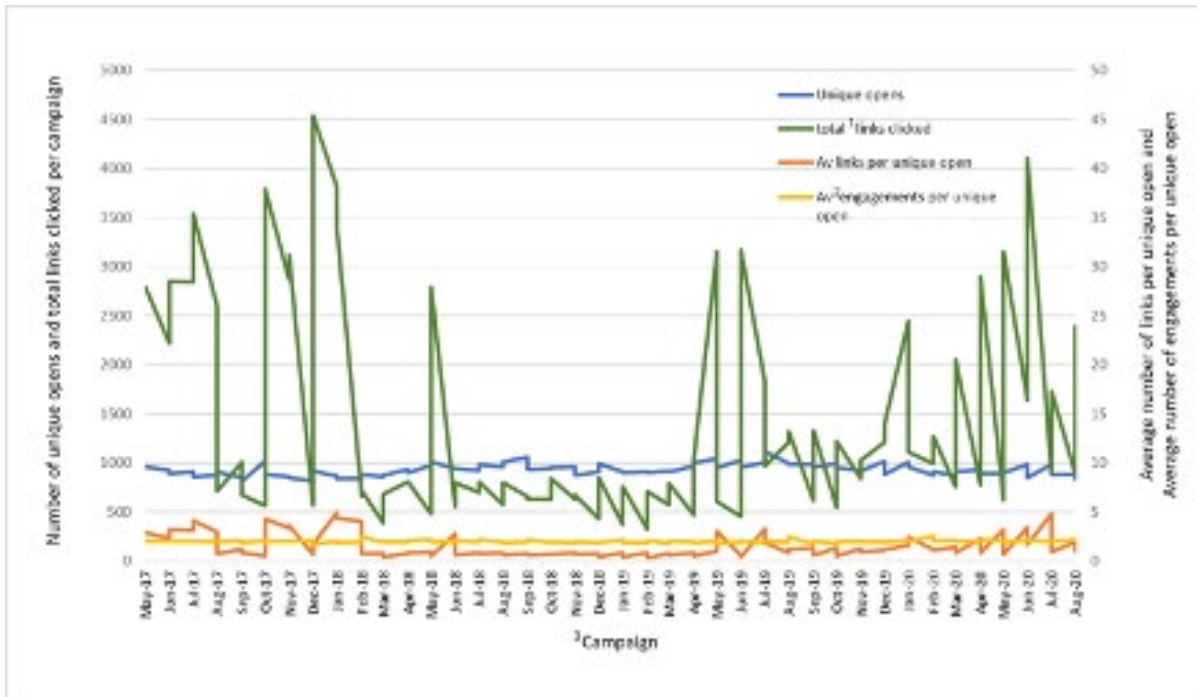
published data would be valuable and perhaps reaching out to regional researchers to determine if much unpublished data exists.

2. A better understanding of whether routine drenching of adult cattle is ever indicated, and if so under what conditions.
3. A better understanding of whether routine pre-calving drenching of first and second calvers is indicated.
4. A better understanding of whether routine pre-joining drenching of cattle (cows and bulls) is indicated.
5. An understanding of whether pre-weaning drenching is indicated when weaning is delayed (or later than a certain age e.g. 6 months).
6. A better understanding of the impact of *Cooperia* spp. on productivity.
7. A better understanding of the distribution of *Cooperia oncophora* versus *C. punctata* and *C. pectinata*.
8. Data on the production impact of *Haemonchus* spp. in cattle.
9. The use of combination treatment products in cattle–i.e. is it different to sheep, and if not, is a modelling study needed to support it because very few people talk about it.
10. What is the value of WECs in different classes of animals and in different regions?
11. The efficacy of pour on versus oral versus injectable treatment formulations in the presence and absence of resistance (an area with lots of opinions, but minimal data).
12. Data on the production effects of post-weaning treatment programs is lacking in QLD, WA, TAS and SA.

4.2.2 ParaBoss News and subscriber database

ParaBoss News has been published twice monthly throughout ParaBoss Phase II and IIa.

The following data covers the time when University of New England published ParaBoss News from the commencement of Phase II in May 2017 until August 2020. After this, Animal Health Australia published the newsletter.



¹Links clicked refer to the linked URLs in the campaign

²Number of engagements refers to the number of times a user engages in a campaign including opening or viewing the campaign or clicking on a link.

³Campaign refers to Both ParaBoss News–State Outlooks and ParaBoss News–Feature Articles.

Figure 6. Number of Unique Opens, Total Number of Links Clicked, Average Number of Links Clicked per Unique Open and Average Number of Engagements per Unique Open for Each Campaign from May 2017 to August 2020.

There were 100 newsletter campaign sent during this period, including one State Outlooks and one Feature Article edition each month. The average number of unique opens per newsletter in this period is 928, ranging between 813 to 1117. The average total number of links followed for each newsletter is 1436, with a large range between 324 and 4539. This large range can be attributed to the varying number of links included in any one campaign.

The variation between average links clicked per unique open and average engagement per unique open is quite low, however analysis of the time stamp data shows that some users open a newsletter up to 5 times, returning to it hours, days or even weeks later, with or without clicking on newsletter links.

These link statistics only include those from the email newsletter received by subscribers. It does not include the many links followed from the state outlook reports themselves, which are on ParaBoss web pages. The State Outlook edition of the newsletter contains an overview for a state outlook (links to these are included in these statistics), however once a user follows the link from the email to the monthly report provided by our contributors there are a number of further links through there report to information in the ParaBoss sites. These links are not included in these statistics, but are an important referral source to the ParaBoss website as shown in the results section: 4.2.1 ParaBoss Websites.

Animal Health Australia (AHA) took over ParaBoss News in September 2020, so data since this has not been reported.

The number of successful deliveries to subscribers of ParaBoss News are approximately 3,000 per edition, ranging from 3,200 in April 2017 to 2965 in September 2020. This subscription rate has remained steady during this period, and the expectation is that the subscription rate will increase

with the involvement of AHA, and their potential to cross promote ParaBoss News and refer a new audience through their established network.

ParaBoss News is a critical communication device to keep parasite management in front of subscribers and to refer traffic to the websites. It is strongly recommended that further analysis of the newsletter and its preparation is conducted to ensure that it fulfills this role effectively.

4.2.3 ParaBoss Technical Forum

The ParaBoss Technical Forum has 277 members. The forum activity to 30 May 2021 is 175 threads and 1087 posts.

The relatively low membership is a result of all members being by invitation or approved request only, and importantly, the number reflects the low number of people nationally with the knowledge and interest to be involved in such a technical forum. This results in a small critical mass and relatively little forum activity.

Web forums as a platform have generally lost some following since the availability and popularity of Facebook groups has risen. The sheep and cattle veterinarians special interest groups use a Listserv email discussion list platform which appears popular, and there is a Sheep Veterinarians Facebook group. However, web forums provide vastly superior archiving and searchability compared to either Facebook pages or Listserv discussions.

The future of this forum will be reviewed in Phase III and any continuing platform will need to meet the preferences of contemporary users.

4.2.4 ParaBoss Facebook Pages

ParaBoss Facebook pages assist to bring user traffic to the Boss websites. The total number of posts for ParaBoss Phase II and IIa for the ParaBoss Facebook pages (broken down in Table 16) was 653. This generally included a worm, fly and lice post for the ParaBoss Sheep page and a worm post for the ParaBoss goat page each week.

The average reach and average engagement per post is slightly higher for the ParaBoss Goat posts than sheep, despite their being many more commercial sheep producers than goat producers in Australia. This is likely due to a number of factors: There are more non-commercial smallholder goat owners than similar sheep owners and they likely make up a significant number of the viewers of the goat Facebook posts. Commercial sheep producers have a generally superior knowledge and experience of parasite management than smallholder goat owners. There are already numerous goat-related Facebook pages and groups in Australia, but there are relatively few pages dedicated to sheep husbandry matters.

These factors are likely to result in goat owners having a higher desire to find parasite management information and likelihood to use Facebook as a means to do so.

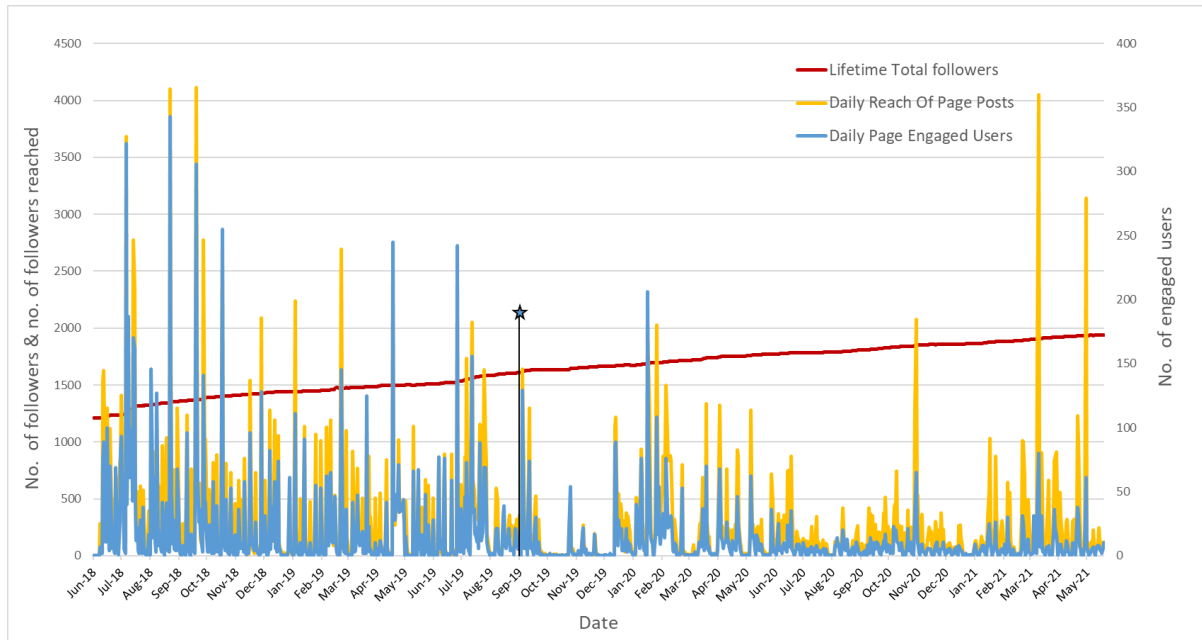
Table 16. Number of posts from 01 May 2017–25 May 2021, average reach per post and average engagement per post from 01 July 2018–25 May 2021 for ParaBoss Sheep and Goats Facebook pages.

Facebook Page	Number of posts	¹ Average reach per post	² Average Engagement per post
ParaBoss Sheep	440	715	33
ParaBoss Goats	213	869	55

¹ The average number of people who had your Page's post enter their screen. Posts include statuses, photos, links, videos and more. (Unique Users).

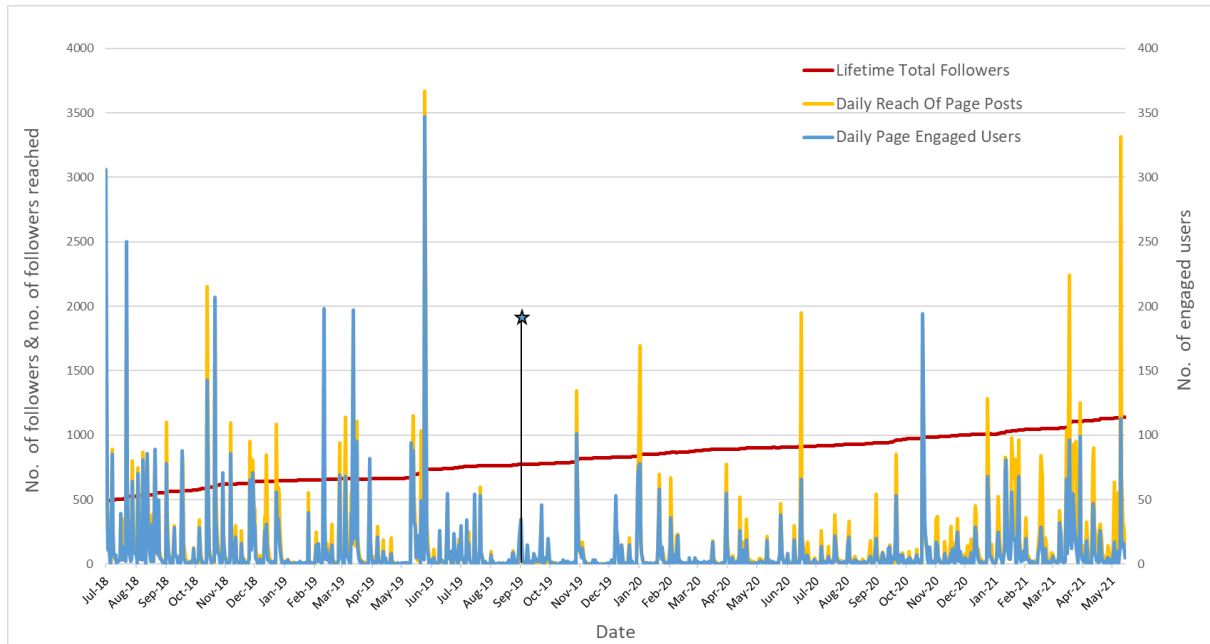
² The average number of unique people who engaged in certain ways with your Page post, for example by commenting on, liking, sharing, or clicking upon particular elements of the post. (Unique Users).

Fig. 7 and Fig. 8, below, show the number of total followers, daily reach of posts and number of daily engaged users from June 2018 to 30 November 2020 for the ParaBoss Facebook pages. Both pages show a steady increase in the lifetime of total followers. It was (and continues to be) expected that there would continue to be a steady increase in followers for little effort as the Facebook demographic is as yet largely untapped.



★Facebook posts were prepared and published by University of New England staff to this date, and Animal Health Australia thereafter.

Figure 7. Number of total followers, daily reach of posts and number of daily engaged users from June 2018 to 30 November 2020 for the ParaBoss Sheep Page—ParaBoss Facebook.



★Facebook posts were prepared and published by University of New England staff to this date, and Animal Health Australia thereafter.

Figure 8. Number of total followers, daily reach of posts and number of daily engaged users from July 2018 to 30 November 2020 for the ParaBoss Goats Page—ParaBoss Facebook.

However, the hoped-for acceleration in Facebook results (followers, reach, engagements) with Animal Health Australia taking over the majority of Facebook posting was not realised. On review, there were few referrals, cross promotion or shared posts through AHA’s existing networks* and social media platforms, but possibly, AHA’s Facebook following may not have been as substantial as ParaBoss’s and so, may not have offered a significant benefit. There is also an unexpected downward trend since AHA commencement (ignore a small gap in posting during October 2019 to January 2020).

(* this would not involve breach of the use of the respective databases, but instead promotions included in each to cross-promote the other and sharing of Facebook posts).

It is difficult to determine reasons for popularity of specific posts, but potentially, this could be a result of external factors (such as drought), although post statistics were good despite many months of drought already occurring, and then, with many drought-stricken areas receiving substantial rain in 2020 and the parasite threat returning, this should have signalled a rise in the need for parasite information, which was not reflected in the Facebook statistics. Another possibility may be in a change to the writing, style and appeal of posts that occurred with the change from technical UNE authors to AHA communications staff authors. Additionally, a period in early 2020 saw a number of repeated posts and use of the same images, which may have affected engagements, although low reach and engagement continued.

Fig. 9, 10, 11 and 12, below, show the total number of sessions and pageviews referred from Facebook from the 01 April 2017 to 25 May 2021. Over 30,000 sessions and 40,000 pageviews were referred by Facebook to the WormBoss website, averaging 20 sessions and 30 pageview referrals per day. The FlyBoss, LiceBoss and ParaBoss websites have significantly lower referrals than WormBoss, however, they still average between 1 to 3 referrals per day to the websites. This demonstrates the importance the ParaBoss Facebook pages play in contributing to the awareness of the ParaBoss websites. Fewer referrals occurred with the changeover of ParaBoss post authors from late 2019, suggesting the posts were less compelling.

Figure 9. Total number of sessions referred by Facebook to the WormBoss website from 01 April 2017 to 25 May 2021.

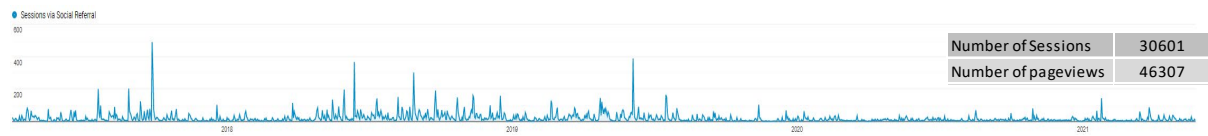


Figure 10. Total number of sessions referred by Facebook to the FlyBoss website from 01 April 2017 to 25 May 2021.

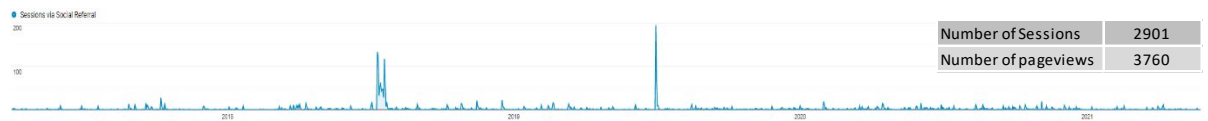


Figure 11. Total number of sessions referred by Facebook to the LiceBoss website from 01 April 2017 to 25 May 2021.

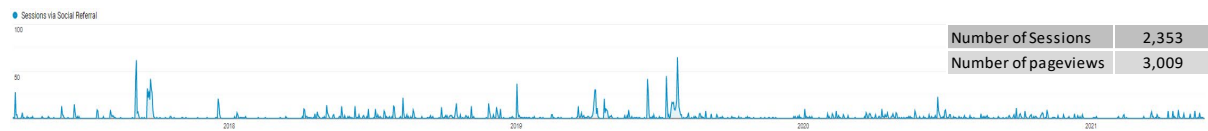
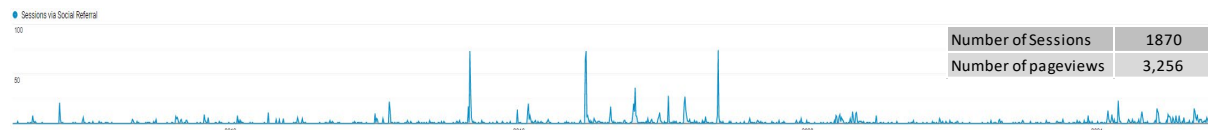


Figure 12. Total number of sessions referred by Facebook to the ParaBoss website from 01 April 2017 to 25 May 2021.



It is recommended that the Facebook analytics and individual posts are critically analysed to identify what makes successful ParaBoss posts. Additionally, cross-promotion across the ParaBoss and AHA communications may see an increase in reach if AHA subscribers and Facebook following is of a substantial size.

4.2.5 ParaBoss Tools

The ParaBoss tools are well-used by industry; Tables 17, 18, and 19 show the tool usage across the Boss sites for the duration of the Phase II and Ila projects.

Table 17 shows the number of pageviews for each of the WormBoss Drench Decision Guides for both sheep and goats. Table 18 shows the number of pageviews for each of the FlyBoss Tools, and Table 19 shows the number of pageviews for each of the LiceBoss Tools from 01 April 2017–25 May 2021. The number of pageviews is an indication of tool usage.

There is significant tool usage across WormBoss, FlyBoss and LiceBoss. This is reflected in the feedback received from advisors participating in the user testing of the Sheep Parasite Management Certificate. Although the use of the downloadable Flystrike Risk Simulator appears to be low, it is a recently published tool and the number of pageviews in this case is not indicative of real-life usage.

Once the Simulator has been downloaded, it is available for use at any time by the user on their own computer and does not need to be downloaded again. This means that repeated use of the simulator by any one user is not recorded by Google Analytics.

Table 17. Number of pageviews of the WormBoss Drench Decision Guides for Sheep and Goats from 01 April 2017–25 May 2021. <http://www.wormboss.com.au/sheep-goats/tests-tools/drench-decision-guide.php>

Drench Decision Guide	Number of Pageviews	
	Sheep	Goats
Western Australia	4046	554
South Australia	4030	449
Victoria	7368	1409
Tasmania	1579	523
NSW central, southern and southwest	6878	1159
Qld south and NSW northwest	2956	-
Qld central and south and NSW northwest	-	1161
NSW northeast and Qld Granite Belt	3467	556
Rangelands (pastoral)	986	189
East coast	-	1433
Australian smallholders	-	906

NB: Number of pageviews is an indication of online drench decision guide usage.

Table 18. Number of pageviews for each of the FlyBoss Tools from 01 April 2017–25 May 2021. <http://www.wormboss.com.au/sheep-goats/tests-tools/drench-decision-guide.php> (<http://www.flyboss.com.au/sheep-goats/tools.php>)

Tool	URL for http://www.flyboss.com.au/sheep-goats/	Number of Pageviews
Optimise Treatment Tool	www.flybosstools.org.au/tools/FBOptimise.aspx	16505
Flystrike Decision Support Location	www.flybosstools.org.au/tools/Map.aspx	9951
Compare Management Tool	www.flybosstools.org.au/tools/FBCompare.aspx	5583
WoolRes Tool	www.flyboss.com.au/sheep-goats/tools/woolres-tool.php	879
Lice and Flystrike Products	/sheep-goats/tools/products.php	7991
Flystrike Risk Simulator (Downloadable)	/tools/flystrike-risk-simulator-downloadable/FlyBoss-Tools-Setup-Win.zip	164
Flystrike Risk Simulator (Downloadable)	tools/flystrike-risk-simulator-downloadable/FlyBoss-Tools-Setup-Mac.zip	29

NB: Number of pageviews is an indication of online drench decision guide usage.

Table 19. Number of pageviews for each of the LiceBoss Tools from 01 April 2017–25 May 2021. (<http://www.liceboss.com.au/sheep-goats/tools.php>)

Tool	URL for http://www.liceboss.com.au/sheep-goats/	Number of Pageviews
LiceBoss Treatment Decision Guide	/sheep-goats/tools/treatment-guide.php	4883
Long Wool Lice Tool	/sheep-goats/tools/long-wool.php	6262
Lice Treatment for Breeding Ewes and their Lambs	/sheep-goats/tools/ewe-lamb.php	2401
Rubbing Tool	/sheep-goats/tools/rubbing.php	2522
Treatment Factors Tool	/sheep-goats/tools/treatment.php	849
Short Wool Lice Tool	/sheep-goats/tools/short-wool.php	1390
Lice and Flystrike Products	/sheep-goats/treating/products.php	5844
WoolRes Tool	/licebosstools.org.au/LBWR.aspx?pest=lice	2498

NB: Number of pageviews is an indication of online drench decision guide usage.

The new Products Search Tool is currently the top or second ranked page viewed on each of the cattle websites.

Table 20 shows the use of the new Products Search Tool on each of the Cattle Boss websites from the 23 April 2021 to 30 May 2021. Although there is limited data, there has already been significant usage of the tool on all the Cattle Boss sites, particularly TickBoss. It is possible to search for any combination of host and parasite on any of the websites, but unfortunately, the analytics data is not able to break down to a host or parasite search level to provide further information on the specific usage of the Products Search Tool.

At the time of this report, the new tool was just being placed onto the sheep sites so there is no data for it on those sites, but the old tools have strong usage figures and appear in the top most frequently visited pages of their respective sites.

As such it is imperative that the Products Search is maintained with current chemical information and is available for continued use.

Table 20. Number of pageviews for the Products Search Tools on the Cattle Boss websites from 23 April 2021– 30 May 2021.

Website	Tool	Number of Pageviews
http://www.wormboss.com.au/cattle/	Product Search Tool	144
http://www.tickboss.com.au/cattle/	Product Search Tool	191
http://www.flyboss.com.au/cattle/	Product Search Tool	139
http://www.liceboss.com.au/cattle/	Product Search Tool	41

NB: Number of pageviews is an indication of Product Search Tool usage.

4.2.6 ParaBoss Multimedia

Videos

The majority of ParaBoss videos and webinars are hosted through the ParaBoss YouTube channel, however, some can be downloaded directly through the ParaBoss website, and are duplicated on the WormBoss, FlyBoss or LiceBoss websites. As such, views from these pages are not recorded in YouTube analytics. Table 21 shows the number of views of ParaBoss videos and webinars hosted through the ParaBoss YouTube channel. The most popular videos are a mix of short instructional videos and technical presentations and webinars. As this table does not include videos that can be downloaded directly from the Boss websites, the data is likely an underestimate of actual video views.

Table 22 shows the number of views by traffic source of ParaBoss videos and webinars hosted on the ParaBoss YouTube Channel for the period 14 November 2018–25 May 2021.

Table 23 shows the number of pageviews of the multimedia pages found on the Boss websites. The number of video downloads cannot be directly determined by Google Analytics, however the number of pageviews gives an indication as to total downloads. The results show the most popular videos watched through the webpages are short, instructional videos.

The videos are more recent additions to the sites and would benefit from ongoing promotion, as well as the development of more videos to suit users who prefer visual and audio information to reading.

Table 21. Number of views of the top 15 ParaBoss videos and webinars hosted through the ParaBoss YouTube channel for the period 14 November 2018–25 May 2021 in order of most viewed.

Rank	Video Title	Number of Views	Date Published
	Total	1058	-
1	Checking Sheep for Lice	201	Mar 26, 2020
2	ParaBoss WormTests What's Stopping You	153	Jun 6, 2019
3	ParaBoss Conference 2018 extract Baxendell goat drench doses	139	May 14, 2019
4	ParaBoss Bulk WormTests Increase Accuracy	79	Jul 10, 2019
5	ParaBoss: Low Worm-Risk Paddocks for Summer rainfall Regions	68	Aug 1, 2019
6	ParaBoss: Drench Resistance Testing	67	Aug 15, 2019
7	ParaBoss Conference 2018 extract Webb Ware Cost of scouring	59	May 14, 2019
8	ParaBoss Conference 2018 extract Jacobson & Webb Ware Development of immunity to worms	59	May 14, 2019
9	Collecting Sheep Dung Samples in the Paddock for a Worm Egg Count	44	Mar 27, 2020
10	Sample size for Bulk Worm Egg Count	24	Mar 26, 2020
11	Sheep Connect - Sheep Blowfly Resistance Update	21	Nov 17, 2020
12	1 Introduction Deb Maxwell	14	Nov 15, 2018
13	ParaBoss Conference 2018 extract Lindon Breeding for flystrike resistance	12	May 14, 2019
14	7 Worm Mgt Besier & Kahn & Webb Ware	10	Nov 15, 2018
15	4 Scouring Jacobson & Webb Ware	8	Nov 15, 2018

Table 22. Number of views by traffic source of ParaBoss videos and webinars hosted on the ParaBoss YouTube Channel for the period 14 November 2018–25 May 2021

Traffic source	Number of Views
Total	1058
¹ External	612
² Direct or unknown	168
³ Other YouTube features	84
⁴ YouTube search	63
⁵ Playlists	57
⁶ Playlist page	39
⁷ Channel pages	14
⁸ Suggested videos	14
⁹ Browse features	7

¹ Traffic from websites and apps that embed your videos or link to your videos on YouTube.

² Traffic from direct URL entry, bookmarks and unidentified apps.

³ Traffic from within YouTube that doesn't fall into any other category, such as views from Partner promotions, or the dashboard.

⁴ Search terms used by viewers on YouTube to find your content.

⁵ Traffic from any playlist that included your video (this can be your own playlist or another user's playlist).

⁶ ParaBoss YouTube playlist page

⁷ Traffic from your YouTube channel page, other YouTube channel pages, or topic channel pages.

⁸ Views from suggestions appearing alongside or after other videos.

⁹ Traffic from the homepage/home screen, the subscription feed, and other browsing features

Table 23. Number of pageviews on the Boss Websites for the period 01 April 2017–25 May 2021

Website	Multimedia Page	Number of pageviews
ParaBoss	/multimedia/videos.php	344
ParaBoss	/multimedia/webinars/recorded-webinars.php	177
WormBoss	/sheep-goats/news/webinars/recorded-webinars.php	207
LiceBoss	sheep-goats/treating/application-methods/hand-jetting.php	1927
LiceBoss	/sheep-goats/treating/application-methods/shower-dipping.php	2032
FlyBoss	sheep-goats/files/pages/treatment/treatment-of-struck-sheep/E93_Treating_flystruck_sheep_Web_video_small_WMV_4x3.wmv	1353
FlyBoss	sheep-goats/files/pages/treatment/choosing-the-right-application-method/sprayons/E90_Sprayon_Web_video_small_WMV_4x3.wmv	170
FlyBoss	sheep-goats/files/pages/treatment/choosing-the-right-application-method/jetting/automatic-jetting-races/E88_Jetting_race_Web_video_small_WMV_4x3.wmv.crdownload	131
FlyBoss	www.flyboss.com.au/http://www.flyboss.com.au/sheep-goats/files/pages/treatment/choosing-the-right-application-method/jetting/hand-jetting/E89_Dutjet_Web_video_small_WMV_4x3.wmv.crdownload	112

NB: Number of pageviews is an indication of podcast downloads.

Podcasts and Short Audio

ParaBoss “Wormcasts” are podcasts produced by ParaBoss covering parasite management topics—worms, flies, lice, ticks and fluke—for sheep, cattle and goats. Wormcasts launched on 01 December 2019. Wormcasts are hosted by the podcast hosting service Buzzsprout, which records statistics on the number of downloads overtime for each episode. It also tracks the apps and devices our audience is using to listen to our podcast and has the capability to track listener location. ParaBoss Wormcasts are also available for download directly from the ParaBoss website. These downloads are not tracked through Buzzsprout, but are followed through Google Analytics and indicated by visits to the ParaBoss multimedia page. There is currently no capability to record data for individual episode downloads. Table 24 shows the Buzzsprout statistics for the number of downloads for the period 01 December 2020–28 February 2021 for each wormcast. Table 25 shows the number of pageviews for the ParaBoss multimedia podcast page.

ParaBoss “Snapshots” are short audio presentations about a specific topic in a few-minute lecture presentation style. ParaBoss Snapshots are available for download directly from the ParaBoss website, and are tracked through Google Analytics and indicated by visits to the ParaBoss multimedia page. There is currently no capability to record data for individual episode downloads. Table 26 shows the number of pageviews for the ParaBoss multimedia short audio page for the period 01 December 2020–28 February 2021.

Table 24. Number of downloads for the period 01 December 2020–28 February 2021 for each wormcast from Buzzsprout analytics.

Episode Title	Number of downloads
Total	1930
Episode 1 Introducing Wormcasts and its hosts	235
Episode 2 Code-breaking the jargon	197
Episode 3 What happens when you take your finger off the pulse	188
Episode 4 What about the parasites on the pasture?	168
Episode 5 Visiting our friends at the APVMA	107
Episode 6 Fly control as you move away from mulesing with John Webb Ware	136
Episode 7 The History of drenches	202
Episode 8 What's important about a parasite's life cycles	141
Episode 9 Better control of parasites and extending the life of your drenches through Integrated Parasite Management (IPM)	348
Episode 10 Has organics got anything to teach the non-organic farmer	208

Table 25. Number of pageviews for the multimedia podcasts for the period 01 April 2017–25 May 2021

Website	Multimedia Page	Number of pageviews
ParaBoss	/multimedia/podcasts.php	1369

*NB: Number of pageviews is an indication of podcast downloads.
Total podcast from hosting site and website 3299 downloads.*

Table 26. Number of pageviews for the multimedia short audio for the period 01 April 2017–25 May 2021

Website	Multimedia Page	Number of pageviews
ParaBoss	/multimedia/short-audio.php	240

NB: Number of pageviews is an indication of short audio downloads.

When targeting a broad audience with different experiences and learning preferences, a range of mediums, styles and channels of extension and communication will always be required.

The multimedia described above has been successful despite relatively little promotion. The websites have very large volumes of written information that may not appeal to those who prefer more audio and visual materials. It is recommended that more of the written web content is presented in alternative forms to suit these audiences. Additionally, greater promotion may achieve increased use of the existing and new materials.

4.2.7 ParaBoss feature articles in Beyond the Bale

ParaBoss has provided one or more technical feature articles for every quarterly edition of AWI Beyond the Bale since June 2014. This was provided by UNE staff until and including September 2020, after which they have been provided by AHA. Articles are listed in Table 27.

Table 27. ParaBoss articles from UNE published in AWI Beyond the Bale magazine between June 2017 and September 2020.

Year	Month	Article title
2017	June	Treating Lice on Pregnant and Lambing Ewes
2017	September	Drenches for Spring Lambs
2017	December	Worm Egg Counts: Individual versus Bulk Samples
2018	March	Ewes: How they can Sabotage your Worm Control
2018	June	Putting WormBoss into Practice
2018	June	Lambing Ewes: Is a Pre-Lambing Drench Warranted
2018	September	Making the Transition to a Ceased Mulesing Flock
2018	December	Drought: What happens to worms?
2019	March	Flystrike Treatments during Drought
2019	June	Insecticide Resistance Strategy – to maximise flystrike control
2019	September	‘Just in Case’ Lice Treatments: Take the Plunge, and Stop
2019	December	A fly in the Ointment
2020	March	Putting WormBoss into Practice
2020	March	Parasite management plans, write it down, to get it right
2020	March	Worm Egg Counts – is your provider up to scratch?
2020	June	ParaBoss Regional Reminders
2020	June	Lice treatment products—What drives their choice?
2020	June	Lice Biosecurity—The return of the strays
2020	June	LiceBoss Treatment Tool
2020	September	The importance of Quarantine when restocking
2020	September	ParaBoss Regional Reminders
2020	September	A step closer to ceased mulesing
2020	September	September –FlyBoss Flystrike Risk Simulator
2020	September	LiceBoss Treatment Factors Tool

4.2.8 ParaBoss Technical Conference 2018 and Workshop 2020

Event planning

When the first ParaBoss conference/workshop was conducted in 2016 (Phase I) we considered how to attract people for a one day event, when the targeted audience came from across Australia, and would be put off by travel costs for a short event.

We decided to hold it immediately following another event targeted at a key portion of our audience: the NSW District Veterinary Officer’s Annual Conference.

This was highly successful, resulting in the event being fully booked, but predominantly by those already attending as NSW District Vets. It still did not attract a great deal of others vets who were not invited to the District Vets event.

As such, the same reasoning was applied when planning the 2018 and 2020 events. The 2018 conference was held alongside the Sheep Vets conference, and was also fully subscribed at 125 attendees (conference style). Likewise, the 2020 workshop, held alongside the cattle vets conference was fully booked at 60 attendees (workshop style, so limited places).

While face-to-face training is generally preferred by attendees, national, state- and even regionally-based technical conferences/workshops are very expensive for both deliverers and attendees, primarily due to associated travel and accommodation costs and extra time spent in travel.

Although each of our conference/workshops were fully subscribed, they still only attracted a small portion of the potential audience due in part to these cost and time restraints.

ParaBoss aims to extend this advanced information to a broader group than those who can afford the travel and accommodation costs and the additional time involved in face-to-face attendance of this training. Therefore, other methods that deliver the training to more of the target audiences at a lower financial and time cost to the registrants must be investigated.

The University of New England staff are also very experienced at delivering technical and highly successful, well-received workshops/seminars directly to mixed audiences of producers, rural merchandise staff and pharmaceutical company staff at low cost, but to achieve this they were also done very close to the location of the presenter.

The COVID pandemic has introduced considerable uncertainty and risk with travel (particularly air and interstate travel) for at least 2021 and possibly longer. But the positive outcome has been the great increase in skills and experience of our “advisor” target audiences in using web meetings and webinars.

While webinars and web meetings are not generally as desirable as face-to-face meetings, as they do not provide the networking and social advantages, they provide the benefits of convenience, reduced time, and reduced costs for both the presenters and the attendees, so making the training affordable and accessible to a much greater proportion of our target audiences.

As such, UNE plans to deliver technical presentations as webinars or web meetings or using an alternative remote delivery method considered appropriate to the material and target audience unless there is a clear user demand for face-to-face formats.

2018 Conference evaluation

This conference was considered a great success based on being fully booked and receiving very positive feedback.

The feedback highlights are:

- Presentation scores for each presenter ranged from 7.1 to 8.9 out of 10, with the average score being a very pleasing 8.1 out of 10.
- The event was considered interesting, with scores of 6 to 10 out of 10, averaging 8.8 out of 10 for interest level.
- The event was considered useful, with scores of 5 to 10 out of 10, averaging 8.6 out of 10 for usefulness level.
- The event was considered worth attending, with 98.7 responses indicating it was worth attending.
- The feedback generated a list of desired topics for future events.

Evaluation results of the conference are found in *Appendix E: ParaBoss Technical Conference 2018 Evaluation Sheet Results*.

Presentations from the ParaBoss Conference 2018 can be found here:

<https://www.paraboss.com.au/multimedia/videos.php>

2020 Workshop evaluation

The aim of the 2020 workshop was to provide advisors, predominantly rural merchandise staff and veterinarians, with skills to prepare parasite management calendars for their farmer clients or customers. Based on the change in the participants' confidence in preparing calendars from before until after the workshop, this aim was achieved.

The feedback highlights are:

- The average of the 'before' scores was 4.6, with 39 of the 60 participants scoring 5 or below.
- After the workshop, the average score was 7.8—an increase of 3.2/10—now with only 5 people scoring 5 or below, and the rest 6 or above.
- The workshop also provided positive perceptions to most participants as judged by the high average scores out of 10 for enjoyment (8.5), interest (8.8) and usefulness (8.8).

The evaluation also generated 13 detailed operational recommendations as a result of the feedback, as well as recommendations on pricing, attendance and promotion, which can be viewed in the full evaluation report *Appendix F: ParaBoss Technical Workshop 2020 Evaluation Report*.

The overall recommendation for future events was that where possible, an aim of self-funding should be attempted, through higher registration fees and advertising/sponsorship fees, however, particularly for the rural merchandise audience that is a key target for ParaBoss advisor training, this may not be feasible.

Further research raised at professional training events

The following recommendations for further research or development continue to be raised at conferences and workshops.

- Easier, cheaper, faster methodology to conduct worm egg counts and particularly, drench resistance tests.
- Practical, cost effective methods to assess the worm larval contamination on paddocks.

4.2.9 ParaBoss Sheep Parasite Management Certificate

The Certificate course has been developed, but will not open for enrolment until the second half of 2021.

Course statistics:

- 1,994 individual question variants housed in the quizzes
- 406 questions presented to each student (each question randomly presents one of its variants)
- 43 separate quizzes (covering all ParaBoss core content)
- 3 content modules: WormBoss, FlyBoss and LiceBoss

A test-user process has been operating with about 10 users completing all quizzes in the course, and about 20 completing some quizzes.

This process has been extremely valuable to identify ambiguous questions, incorrect answers, unclear instructions, and typographical and formatting errors, which are inevitable in a set of nearly 2,000 technically complex questions.

We understand the limitation of multiple choice and true false answers to determine whether the student has in depth understanding. However, it is believed that the basic knowledge of facts is a primary shortfall in the majority of the targeted audience, therefore simply achieving a much greater level of the facts will go a very long way to improving the quality of their advice to industry. These question types have the great advantage of allowing the certificate to be marked online, immediately and at no extra cost.

The test-users have shown that most quizzes can be completed in 15–30 minute sessions, which suits the target audience. Because they can also save their progress part way through a quiz, this has allowed them to be interrupted by customers and resume doing a quiz later.

The quiz set up enhances the reading and learning component because it effectively stops users from guessing answers until they get them all correct. While it is possible for them to guess, if they do, there is a severe penalty applied; any wrong answers results in them having to redo an entire quiz again (not just incorrect answers), and with another random presentation of question variants. Feedback from test-users indicated that having to redo one quiz caused them to read the provided information (with the answers) carefully for each question for all future quizzes, to avoid incorrect answers. Nevertheless, sometimes they still got an incorrect answer, and this was either because there was an error in the question/answer or because—in the words of most of them—they were careless, or hurrying and not paying enough attention. This feature will maximise the “learning” component of the Certificate course.

While 49 test-users signed up, only about half started, and of those that did, initial enthusiasm dwindled, and progress was slow until they were given reminders. It is foreseen that this will be a problem with genuine enrolments as well, and therefore, a form of a reminder system will be implemented.

If the model is successful, a similar certificate could be development for Cattle parasite Management.

4.2.10 ParaBoss Worm Egg Counting Quality Assurance Program

The 2019 program saw 128 individuals from 49 businesses participate.

Unfortunately, about 30% of the individuals failed to meet the accuracy and variability standards set by the program. This shows the high value of this program in identifying these providers and giving them the opportunity to improve their service. A supplementary round was held where some of these were able to demonstrate proficiency. However, some participants were unable to complete this round as about half of the samples were held for too long at Perth airport by the courier, out of the control of ParaBoss, rendering the perishable samples unsuitable.

Ultimately, 36 of the 49 participating WEC provider businesses were endorsed by ParaBoss in the 2019 round.

Those that were unsuccessful were provided with advice to assist them to improve their procedures.

In 2020, the COVID 19 pandemic caused significant freight delays nationally. Prior to the planned program the DPIRD laboratory and Dr Brown Besier conducted two informal trials to determine whether samples could be treated to endure a 2-week transit period. These trials involved formalin treatment and air exclusion from sample bags. While both methods have anecdotally been considered useful for field samples of faeces, neither was successful at prolonging the sample life in this case. The samples used have a few millilitres of purified worm egg solution added into a

container, but not incorporated with 2 grams of worm-free faeces. In contrast, the worm eggs in field samples are naturally incorporated through the faeces and are therefore not so exposed.

As there was a high likelihood that samples would deteriorate during the expected 2-week transit times, the 2020 program was cancelled.

The 2019 program recovered all operational costs (sample preparation, freight, analysis of results and technical consultation), but not all costs of the ParaBoss staff. All ParaBoss work: promotion, registration, data management, and reporting was done manually.

An automated online system has since been created, which also does the analysis. This system will markedly reduce the costs associated with the initial round and cost-recovery from fees charged is anticipated for future rounds.

Considering there was a higher than expected failure rate in 2019, it is vital that the program should continue (at user expense) so that WEC providers meeting expected standards can demonstrate their proficiency, and so industry users of WEC services can find ParaBoss-endorsed providers and achieve accurate worm monitoring, drench testing and individual animal WEC test services, which underpin treatment time and drench choice decisions, as well as genetic analysis of worm resistance.

4.2.11 Drench Resistance Test Database feasibility and proposal

The Drench Resistance Test Database project proposal outlines the project and design methods; preliminary budget; and the outputs, outcomes and impacts of the project. It was determined that the ParaBoss program has the necessary expertise, impartiality and communication channels to develop and maintain a drench resistance test database, and provide an authoritative basis for drench choices.

The project was considered feasible, but would require ongoing funding. The developed project proposal was provided to the Steering Committee and later to Animal Health Australia for further action.

For the proposal document see *Appendix G[†]: Project Proposal ParaBoss National Drench Resistance Database*.

4.3 ParaBoss Evaluation Phase II and IIa

4.3.1 ParaBoss Analytics

The insights established from Google Analytics about the use of the ParaBoss suite of websites highlighted in this report supports the recommendation that Google Analytics continue to be used as a monitoring and evaluation tool. Google Analytics has been used by ParaBoss to assess the use of the ParaBoss websites since their inception in 2013. It effectively evaluates the breakdown of popular pages and ParaBoss Tools and their use at different times according to key time in the parasite management calendar. It is also used to estimate the multimedia engagement for the videos, podcasts and short audios available for download directly from the websites, which adds to the analytic results from the ParaBoss YouTube Channel and the Podcast hosting service, Buzzsprout. Google Analytics is also able to show social network referrals to the website and highlights the importance of Facebook as a platform to increase awareness of ParaBoss.

Continued use of insights directly from Facebook is also recommended as evaluation of the page and post information is valuable in determining audience interest and informing the direction of further extension activities.

Continued use of YouTube Analytics is also recommended to gain insight into the popularity of individual videos, where they are being viewed, and future video development. Similarly, analytics for the Podcasts and Short-audios audios should be continued to monitor and evaluate topic interest and inform the development of further podcasts. .

4.3.2 ParaBoss Surveys

4.3.2.1 Benchmarking Australian Sheep Parasite Control

This survey, while not conducted by ParaBoss, included questions relating to the awareness, use and value of ParaBoss. ParaBoss staff and the Steering Committee provided wording for the ParaBoss-related questions so that they were similar to those asked in a previous AWI survey in 2016, as well as providing a longitudinal comparison to the 2011 Benchmarking survey.

Extract from AWI Beyond the Bale, March 2020, p 40 (Colvin, 2020).

USE OF PARABOSS HAS INCREASED

The ParaBoss suite of websites was popular amongst respondents. The WormBoss website was a confirmed favourite with 63% of respondents visiting the website; 28% also used the site to make changes to their worm control practices. WormBoss was ranked an important source of information on worm control, second only to ‘other farmer or staff member’. The drench decision guide on the WormBoss website is also popular, ranking second only to ‘self’ as the most important source of information for specific worm control decisions.

	FLYBOSS		WORMBOSS		LICEBOSS	
	Total who visited site	Used site to make changes	Total who visited site	Used site to make changes	Total who visited site	Used site to make changes
2011	13%	2%	21%	5%	15%	3%
2018	59%	18%	63%	28%	57%	20%

Figure 13. The increase in sheep producer use of the ParaBoss suite of webpages from 2011 to 2018, from Beyond the Bale, March 2020, page 40 (Colvin, 2020).

This shows between a 3- and 4.5-fold increase in use of the sites over 7 years, and 5.6 to 9 times the amount of use of the site to make changes.

Extract from the Final Report of the Benchmarking Australian Sheep Parasite Control (page 6) (Colvin *et al*, 2020):

57. When asked about the usefulness of the WormBoss website, 27.6% used the site to make changes, 35.6% respondents actually visited the site (equating to 63.2% of respondents visiting WormBoss), 23.6% have only heard of it and 13.3% have never heard of it. Meat x Meat producers were significantly more likely to use WormBoss website to make changes (42.9%) whilst many Wool x Other producers had never heard of it (38.5%) or only heard of it (26.9%).

58. For FlyBoss, 17.7% of respondents had used the site to make changes, 40.9% had actually visited the FlyBoss website, 25.9% had only heard of it, and 15.5% had never heard of it. A total of 58.6% had visited the FlyBoss website.

59. LiceBoss website had 19.7% used site to make changes, 37.6% actually visit the site, 26.1% only heard of it, and 16.5% have never heard of it. A total of 57.3% having visited the LiceBoss website.

60. Only 11.6% used the AWI site to make changes, respondents mostly visited the AWI website (59.3%).

61. Respondents mostly estimated the [annual] dollar value of the changes they had made using the ParaBoss websites to be between \$1000-5000 (43.3%), 29.9% estimated between \$0-1000, 17.9% between \$5000-10,000 and 9.0% more than \$10,000. There was a significantly higher than expected estimation of the dollar value of changes in Northern NSW/Qld with 28.6% selecting more than \$10,000.

62. The respondent's preferred method of delivery of information on parasite control was Face to Face workshops (53.3%) followed by websites (23.4%). The area for further information or research that was most popular was Breeding resistant animals, a quicker way to do worm monitoring, accountability for producers not controlling lice, race side test for WEC, more research for lice in long wool sheep, having a social license to produce animal products and WEC training.

Using the data from point 61 in the extract above, the financial value of ParaBoss to the sheep industry at this time was extrapolated*, resulting in an industry value of over \$30 million per annum.

This is quite realistic as it amounts to only about \$1000 value per business.

*The mid-values were used from each value category, multiplied by the proportion of their respondents, and then by the percentage of respondents that answered the question, then multiplied by an estimated 31,000 sheep businesses at the time.

With the project cash budget of Phase II and IIa being approximately \$1.376 million over 4 years (average \$344,000 pa), this amounts to a cost benefit of approx. 87:1 (\$30 million/\$344,000).

As with any survey data, such extrapolation may not be accurate due to limitations of this benchmarking survey funded by AWI. From an industry of over 30,000 producers, 225 people answered the question regarding the value of WormBoss (although this was more than the mean number of responses to each question across all survey questions, which was 194). Also, the respondents are likely to be biased toward people with a greater interest in the survey topic: parasite management, which may favour respondents more likely to look for and value parasite management information.

Even so, assuming this extrapolation is a gross over-estimate, and the estimation was reduced dramatically to say, one quarter of this value, a benefit to cost of 20 to 1 would still be considered a very large success by most extension funders, where values of up to 10:1 are more typical.

Of course, only using producer survey data is also likely to greatly underestimate ParaBoss value to producers, as they certainly gain their knowledge from other people, not just directly from ParaBoss sources as assessed by this survey, and they do not realise that the source of these other people's knowledge may often include ParaBoss.

ParaBoss has provided training and information to numerous advisors through conferences, workshops, webinars, and the multitude of newsletter articles to which so many advisors of all types have been subscribed since 2005. Likewise, producers state that "other producers" are a key source of information; ParaBoss has provided training, and a vast array of communication materials to producers over the years.

Unfortunately, because this indirect information from other producers and advisors is rarely branded as ParaBoss information, it is impossible to estimate its flow on value to producers. But in accepting the recommendations from the Ball and Curtis report, particularly recommendation 1, (see point 4.3.2.2, below), the funders have acknowledged that advisors of all types are a critical source of ParaBoss information for producers, even though the value cannot be quantified.

The survey value figures refer only to ParaBoss for sheep and goats, as the cattle resource had not yet been released, but parasite management for cattle has received relatively little attention during the decline of state-based extension, and therefore the new cattle resource is just as important as the sheep resource.

None of these assessments even consider the cost to markets from poor welfare implications associated with parasites. The community and consumer expectation of high welfare standards may well be enough alone to justify the need for continued or even increased investment in ParaBoss, considering parasites collectively are the number one animal health problem for sheep, goats and cattle, possibly only matched by peri-natal mortality and reproductive issues.

The producer-generated figures, even when significantly dampened down to account for potential survey bias and sample size, still show great value from ParaBoss. Add to that the unmeasured value via advisors and from assisting industry to meet welfare expectations, and continued investment in ParaBoss is highly recommended.

4.3.2.2 ParaBoss Review: Recommendations for products and services

The review conducted by Ball and Curtis in 2020 (*Appendix J[†]: Ball and Curtis 2020 Recommendations for products and Services*) generated 14 recommendations to improve ongoing ParaBoss products and services, shown below. The report was accepted by ParaBoss staff (University of New England) and the funders, AWI and MLA, with these three organisations also being the intellectual property owners (UNE, AWI and MLA).

A number of these recommendations were already implemented, being implemented or intended at the time of this report*, and others will be carried out at the discretion of the ParaBoss Phase III funders and operational staff of ParaBoss Phase II Components 1 [web site management] and 2 [producer communications], and the University of New England (operating ParaBoss Phase II Component 3 [advisor training]).

Recommendation 1. ParaBoss should take a much more active and critical role in the training and certification of resellers and advisors. Consideration should be given to an active training role with an initial focus on introducing and training the reseller networks in the use of ParaBoss products and services.*

*Recommendation 2. The continued delivery of the WEC QA program should be supported by ParaBoss with accredited/certified laboratories promoted in a separate prominent list. The service should be delivered on a cost recovery basis.**

Recommendation 3. A program should be undertaken to assess the knowledge held in the ParaBoss products and services and where necessary, translate it into a form for producers that is less complex, easily comprehended and thus enables and drives practice change.

*Recommendation 4. Develop a mechanism or that highlights new or changed material on the ParaBoss web sites and in newsletters. This should be prominent so that users can easily identify when information of interest to them has changed.**

Recommendation 5. Where appropriate, modify content of the ParaBoss products and services to cover additional regions. Provide guidance on reasons for the differences in advice to assist consults and resellers to further adapt the information to their local environment.

*Recommendation 6. Conduct a study of the usage patterns for the ParaBoss tools. Understand how they are used and how they may be developed to drive adoption of best practice and better suit the needs of the user. Identify any redundant steps.**

Recommendation 7. Conduct a study of the usability of the web sites. Identify the frequently used components and whether a re-design is required to make accessing those components easier, faster, and more intuitive.

Recommendation 8. A full technical review of the ParaBoss web sites should be conducted to ensure all information is relevant, lists and mentions of chemicals and actives are up to date, and advice is consistent with current best practice.

Recommendation 9. A specific engagement plan targeted directly at producers with the objective of raising the profile of ParaBoss should be developed and implemented. The key message being that ParaBoss is the trusted source for independent and authoritative parasite management advice.

Recommendation 10. A proposal for ParaBoss to coordinate the delivery of a regular series of updates to resellers should be scoped. The aim would be to address seasonal activities and parasite issues thus preparing the resellers for the likely demands for knowledge and product. Delivery should be cost-neutral to ParaBoss.

Recommendation 11. That the ParaBoss management committee develop a short communiqué (a plan on a page) that identifies key priorities, objectives, outcomes, and impacts. This communiqué should be published through the Newsletter and made available on the website to inform all stakeholders.

Recommendation 12. That the ParaBoss Management committee appoint an independent chair with industry credibility to help facilitate technical development in line with the committee's TOR.

Recommendation 13. That the ParaBoss Steering Committee review the membership of the Technical committee with a focus on required skills and industry engagement. The case for remuneration should be considered, particularly if face to face meetings are maintained.

Recommendation 14. That the ParaBoss Steering committee enable the Technical committee to achieve better strategic input through the following (a) Update the Terms of Reference (TOR). Roles and responsibilities need to be continually reinforced by having this as a standing agenda item, and (b) Set up a more formal partnership between AWI/MLA and TC with outcomes defined in the TOR.

5. Conclusion

The Australian red meat and wool industries rely on the health and welfare of Australian sheep, cattle and goats, and the management practices applied to them.

Parasites result in some of the most significant animal health costs to these industries. Failure to adequately manage parasites and apply treatment appropriately does not simply result in production loss at a farm level, but can result in unacceptable residues in wool and meat and poor animal welfare. While the cost to industry of parasites of some \$675 million (2015 figures) mostly concerns the farm level costs, it is the latter two issues of residues and animal welfare that have the potential for the biggest threat to these industries by reducing market access and driving consumer and community backlash.

As the alternative providers of parasite management information (mostly state departments of agriculture) have reduced their services over the past two decades, the importance of a one-stop-shop approach for Australia providing regional recommendations for parasite control becomes increasingly important.

The ParaBoss project, run by the University of New England (UNE) since 2014, and with major input from UNE in the years preceding this, under the Sheep CRC program, has improved and matured the

ParaBoss suite to a world-class resource, the envy of many other countries, and during their time extending the resource has greatly increased the use of the resource as shown through website statistics.

The massive estimated benefit to cost ratio of over 80:1 demonstrated from the project to the key funders: Meat and Livestock Australia (MLA) and Australian Wool Innovation (AWI) and their levy payers, and the continued need to achieve high standards of animal welfare, within-limits chemical residue levels and profitability of Australian farmers, is all the justification needed to continue to fund the maintenances and improvement of the ParaBoss resource.

With the resource itself being quite mature in content, the future focus should be on increasing extension and communication of the resource to industry. However, the content should not be left at its existing state—it should be regularly reviewed to ensure currency and should be updated with new industry recommendations as they come to light.

5.1 Key findings

The suite of ParaBoss development, extension, communication and training activities carried out by the University of New England were demonstrated to be successful in achieving an increasing use of the ParaBoss resources and generating a high return on investments to the funders (Meat and Livestock Australia and Australian Wool Innovation) through the value of ParaBoss identified by farmers.

Eight websites providing sheep, goat and cattle parasite management information are in operation and the sheep and goat sites are well-used and it expected that the recently-published cattle sites will receive similar use. The sites provide the repository of information and decision support tools to support a range of parasite management extension, communication and training activities for the sheep, goat and cattle industries.

The following extension and communication activities to meet the diverse preferred learning styles and mediums of industries users have been demonstrated as successful.

- web pages
- interactive web tools
- an e-newsletter
- Facebook posts
- webinars
- audio presentations (both podcasts and short audio)
- videos
- face-to-face presentations (carried out in associated projects)

A Certificate in Sheep Parasite Management has been developed, and while not yet open for enrolments, has received very positive feedback from test-users.

Professional training of industry advisors through the 2018 conference and 2020 workshop were both fully subscribed and received excellent reviews highlighting a continued need for advisor training, which was supported by the Ball and Curtis review (*Appendix J[†]: Ball and Curtis 2020 Recommendations for products and Services*).

A Worm Egg Counting Quality Assurance Program was developed with one annual round undertaken to date and was a success in achieving greater than expected participation, but also identified a

continuing need for the activity, as it did identify significant numbers of providers whose service were inaccurate or too variable.

A Drench Resistance Test Database proposal was developed which highlights the need for such an activity to be operated.

5.2 Benefits to industry

Ongoing use of the ParaBoss resource, using the activities described in the key findings will, based on experience to date, provides significant value to the red meat and wool industries by assisting producers directly, or through their advisors, to apply best-practice recommendations for parasite management. For the sheep, goat and cattle industries, this will improve:

- profitability
- animal welfare
- market compliance

6. Future research and recommendations

It is recommended that investment be continued in:

- The websites and their content, including tools, be maintained and improved to provide a current repository of recommended practices
- The following activities should be continued to extend and communicate the contents of the websites:
 - an e-newsletter
 - Facebook posts
 - webinars
 - podcasts as well as short audio presentations
 - videos
 - face-to-face presentations

Upskilling of industry advisors, as they play an important role in extending and communicating best-practice to producers. This would be through

- the Sheep Parasite Management Certificate
- a new Cattle Parasite Management Certificate
- technical presentations to advisors (conferences, workshops, webinars)
- regular technical updates to advisors

In particular the extension activities should include a considerably larger emphasis on development of all types of multimedia (videos, podcasts, short audio and webinars) so that the current written material achieves a greater usage by users with preferences for audio and visual channels.

A substantial increase in extension/communication using additional methods to those already used, should be used to reach a wider audience based on different learning preferences.

Due to the very high value of drench test results, both to individuals and to the wider industry as a whole, we recommend that the Drench Test Database proposal be implemented.

There are three key areas where resolving gaps in knowledge would significantly improve worm management in sheep, goats and cattle. In particular, the first two points below would help to overcome two major impediments to applying many ParaBoss recommendations; the third point identifies a gross deficiency of current knowledge.

- easier, cheaper methodology to conduct drench resistance tests
- practical, cost effective methods to assess the worm larval contamination on paddocks
- generally a greater all round understanding of worm management in cattle (see detail at the end of section 4.2.1)

Recommendations from the review of ParaBoss products and services (Ball and Curtis, 2020) listed in section 4.3.2.2 should be considered for implementation.

7. References

Australian Venture Consultants Pty Ltd. (2018). ParaBoss Review of Funding and Commercialisation Opportunities. Final Report. *Australian Wool Innovation Limited, Level 6, 68 Harrington Street, The Rocks, NSW, 2000.*

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Lane, J, Jubb, T, Shephard, R, Webb-Ware, J, Fordyce, G. (2015). Priority list of endemic diseases for the red meat industries. Meat & Livestock Australia Limited.

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8. Appendices

Appendices marked with ‡ are commercial-in-confidences and not publicly available.

‡Appendix A: ParaBoss Phase II Business Plan 20170705

‡Appendix B: ParaBoss Steering Committee TOR 201803406

‡Appendix C: ParaBoss Technical Committee TOR 20170425

‡Appendix D: ParaBoss IP register 20210429

Appendix E: ParaBoss Technical Conference 2018 Evaluation Sheet Results

Appendix F: ParaBoss Technical Workshop 2020 Evaluation Report

‡Appendix G: Project Proposal ParaBoss National Drench Resistance Database

Appendix H: Website analytics 20210525

‡Appendix I: Dave Collins 2016 Parasites and Diseases Survey Results

‡Appendix J: Ball and Curtis 2020 Recommendations for products and Services

‡Appendix K: ParaBoss M&E Plan Phase IIa completed for 10 March 2021

Appendix L: ParaBoss Technical Conference 2018 Program

Appendix M: ParaBoss Technical Workshop 2020 Program

‡Appendix N: ParaBoss Review of Funding and Commercialisation Opportunities March 2018

‡Appendix O: Interim ParaBoss Financial Summary Statement

Appendices are grouped into two separate documents, not attached to the main report:

P.PSH.0792 Final report Appendices E F H L M

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