July 4 – 7

Stamford Grand Adelaide, Glenelg, South Australia

The Australian Society of Animal Production and the New Zealand Society of Animal Production have joined together to bring Animal Production 2016 to Adelaide, South Australia.

Over the past few decades we have witnessed a proliferation of societies dedicated to single disciplines such as genetics, nutrition, physiology, molecular biology, ruminant nutrition and the like.

While this has allowed the development of discipline-specific technologies, it is becoming increasingly clear that animal industries need to develop ‘whole-of-chain’ approaches to the application of these technologies. As consumers become more aware of, and involved in, the origins of their food and fibre, it is critical that technological solutions to animal production are developed with consumers in mind.

To this end, Animal Production 2016 brings together scientists, educators, social scientists, extension experts, consultants, consumer advocates, processors and producers to share the latest information on all aspects of animal production. We have invited national and international leaders in animal production and are thrilled to have Professor Temple Grandin, the world leader in animal behaviour and welfare, as our keynote speaker. We have also made students a focus of the conference with a dedicated session for them to present their research in a three-minute ‘Student Snapshot’.

On behalf of the Australian and New Zealand Societies of Animal Production, we hope you have a tremendous conference, make new contacts, reconnect with old friends and leave feeling re-energised and enthusiastic about your role in animal production!

Prof Phil Hynd
President
Australian Society of Animal Production

Dr Chris Logan
President
New Zealand Society of Animal Production
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ORGANISING COMMITTEE

Phil Hynd, President, Australian Society of Animal Production
Wayne Pitchford, Vice President, Australian Society of Animal Production
Mariana Caetano, Secretary, Australian Society of Animal Production
Michael Wilkes, Treasurer, Australian Society of Animal Production
Bruce Hancock, Rural Solutions SA: PIRSA and Sheep CRC - Lamb Supply Chain Group
Emily Buddle, PhD Student, University of Adelaide
Chris Logan, President, New Zealand Society of Animal Production

CONFERENCE ORGANISER

www.agcommunicators.com.au
AgCommunicators specialises in communication, education, executive support and events for primary production, science and natural resources.
We tailor conferences, workshops and forums to suit your target audience. Events are key opportunities to communicate your message, teach and inspire delegates or provide industry leadership and collaboration.
Our team can assist with all areas of event management such as program planning, online registrations, event marketing, media liaison, seeking sponsorship, budget and finance coordination and post-event evaluation and reporting. We can work with you from the outset, taking your idea from the concept stage through to execution, or we can help with specific event elements, such as media, marketing or logistics. We aim to bring a clever and creative approach to your event, while ensuring we manage every minute detail that will guarantee success.
If you have an event, workshop or conference on the horizon, we look forward to considering how we can add spark to your program and delivery.
Contact AgCommunicators Event Manager Rebecca Jeisman, 0438 683 436 and rebecca.jeisman@agcommunicators.com.au
The University of Adelaide was established in 1874 and began teaching in 1876. The first official lecture was in Latin and the Bachelor of Arts the first degree offered. The University was the first in Australia to grant degrees in science starting in 1882. The University constitutes over 25,000 students and 3500 staff and is consistently ranked in the top 1% of Universities worldwide.

Australia’s first Agricultural College was established in 1883 at Roseworthy, approximately 50km north of the city. The College joined the University in 1991 and is now home of the School of Animal and Veterinary Sciences. The degrees taught are Veterinary Medicine, Animal Science and Agricultural Science which is in collaboration with the School of Agriculture, Food and Wine located on the Waite Research Institute, 7km SE of the city. The South Australian Research and Development Institute is a strong research partner. Research activity at Roseworthy is rapidly growing and just this month three centres have been established. The Davies Research Centre which is focussed on the red meat industries; The Animal Welfare Science Centre; and The Centre for Anti-Microbial Resistance in Animals.

We are delighted the University is a Platinum sponsor, we welcome you to Adelaide and hope you enjoy a stimulating conference which will lead to increased profitability of our primary industries.

Meat & Livestock Australia Limited (MLA) delivers research, development and marketing services to Australia’s cattle, sheep and goat producers. MLA has approximately 50,000 livestock producer members who have stakeholder entitlements in the company.

MLA’s vision is to be the recognised leader in delivering world-class research, development and marketing outcomes that benefit Australian cattle, sheep and goat producers.

Working in collaboration with the Australian Government and wider red meat industry, MLA’s mission is to deliver value to levy payers by investing in initiatives that contribute to producer profitability, sustainability and global competitiveness.
PIRSA is a key economic development agency of the Government of South Australia. PIRSA assists primary industries to grow, innovate and maximise their economic growth potential.

PIRSA works with industry to manage resources sustainably and enhance value chains, and fosters environmentally sustainable and internationally competitive industries.

PIRSA leads the delivery of the State Government’s *Premium food and wine produced in our clean environment and exported to the world* economic priority.

PIRSA leads and coordinates the state’s regional development agenda to improve economic and social outcomes for regional South Australia through the Government’s Charter for Stronger Regional Policy.

Baiada Poultry Pty Ltd is a privately-owned Australian company which provides premium quality poultry products throughout Australia.

Our business operations include broiler and breeder farms, hatcheries, processing plants, feedmilling and protein recovery. Our products include sales of live poultry including breeding stock, poultry feed, fertile eggs, day-old chickens, primary processed chicken (raw) and further processed chicken products, and pet food.

At Baiada Poultry, our aim is simple – to provide our customers with quality products and an excellent service.
ALLTECH
www.alltech.com
Founded in 1980 by Irish entrepreneur and scientist Dr. Pearse Lyons, Alltech improves the health and performance of people, animals and plants through nutrition and scientific innovation, particularly yeast-based technology, nutrigenomics and algae.

Alltech has three major bioscience centers, complemented by 20 formal research alliances with leading universities and research institutions around the world, from Uruguay to China.

AUSTRALIAN PORK LIMITED
www.australianpork.com.au
APL is a unique rural industry service body for the Australian pork industry. It is a producer-owned company delivering integrated services that enhance the viability of Australia’s pig producers. The organisation aims to enhance opportunities for the sustainable growth of the Australian pork industry by delivering integrated marketing, innovation and policy services along the pork industry supply chain.

AUSTRALIAN WOOL INNOVATION
www.wool.com
Australian Wool Innovation Limited is a not-for-profit company that invests in R&D and marketing to increase the long-term profitability of Australian woolgrowers. Based in Sydney, AWI has offices in key markets around the world to help us increase the global demand and market access for Australian wool.

DAIRY AUSTRALIA
www.dairyaustralia.com.au
Dairy Australia is the national services body for the $13 billion Australian dairy industry. We act as the ‘investment arm’ of the industry, investing in projects that can’t be done efficiently by individual farmers or companies to help them adapt to the changing operating environment, and achieve a profitable, sustainable dairy industry.
ELANCO ANIMAL HEALTH
www.elanco.com.au
Elanco is a global leader in the discovery and development of products that improve animal health, performance and well-being. In doing so, our products play a direct role in maximising the health and efficiency of livestock animals; ensuring consumers have access to an abundant, affordable and safe source of food and fibre. Likewise, our expanding range of innovative companion animal products enables veterinarians to help pet’s live longer, healthier and higher-quality lives.

GRIBBLES PATHOLOGY
www.gribblesvets.com.au
Gribbles Veterinary Pathology is the longest-established veterinary pathology provider in Australia, and has had a long standing relationship with PIRSA in South Australia. Our focus is to provide expert pathology services and excellent customer service, by partnering with our clients to develop innovative solutions that meet their needs. We have nine pathologists (including four registered specialists) operating in Melbourne and Adelaide.

STEGGLES
www.steggles.com.au
With a heritage that dates back to 1919, Steggles is an iconic Australian brand and one of the most progressive in the poultry industry. Steggles is renowned for quality and innovation. The Steggles brand is highly recognised by Australian consumers and has a proud reputation for upholding traditional, family oriented values.
## EXHIBITORS

Located in Ballroom 1

<table>
<thead>
<tr>
<th>Booth Number</th>
<th>Exhibitor</th>
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<tbody>
<tr>
<td>5</td>
<td>Baiada</td>
</tr>
<tr>
<td>3</td>
<td>CSIRO Publishing</td>
</tr>
<tr>
<td>2</td>
<td>JS Davies Beef Research Centre</td>
</tr>
<tr>
<td>8</td>
<td>Natural Resources SA Murray-Darling Basin</td>
</tr>
<tr>
<td>9</td>
<td>Performance Feeds</td>
</tr>
<tr>
<td>10</td>
<td>Primary Industries and Regions SA</td>
</tr>
<tr>
<td>4</td>
<td>Sheep Connect</td>
</tr>
<tr>
<td>7</td>
<td>Smart Farm Data</td>
</tr>
<tr>
<td>1</td>
<td>The University of Adelaide</td>
</tr>
</tbody>
</table>

Primary Industries and Regions SA (PIRSA) leads the delivery of the State Government’s Premium food and wine produced in our clean environment and exported to the world economic priority. It seeks to capitalise on the growing global demand for premium products that are cleanly, safely and sustainably produced, including realising opportunities in the livestock industry. PIRSA supports the livestock industry in a range of ways.

The South Australian Research and Development Institute, a division of PIRSA, assists the livestock industry to achieve economic and sustainable levels of production of high-quality, competitively priced produce by conducting research and encouraging technological improvement.

PIRSA’s Agriculture Food and Wine division assists the livestock industry to explore potential trade, export and investment opportunities.

PIRSA’s Biosecurity SA division manages the risks to South Australia posed by animal pests and diseases, food borne illnesses and the misuse of rural chemicals, as well as overseeing emergency management arrangements for the livestock industry.

For more information go to www.pir.sa.gov.au
Access a wide range of free online tools at www.mla.com.au/tools and help bolster the profitability of your business.

Try the online calculator that predicts the maximum stocking rate or one which determines your cost of production and compares your performance annually, as well as other handy applications that will help your property prosper.

It’s all there for you at:

www.mla.com.au
STUDENT SNAPSHOT PEOPLE’S CHOICE

Invitation to vote

The Student Snapshot is a competitive presentation session where students present their research to the conference within three minutes.

There are two rules!

1. Each student has two slides - a title slide and research slide. The research slide must contain only text and images (no videos or moving graphics) and use easy-to-read font and font size.

2. Each Student Snapshot will be given strictly three minutes ... not a second more! Only one student can present at a time.

While the Student Snapshots will be judged by a guest panel, we invite you to participate in awarding one student the Animal Production 2016 People’s Choice Award.

The panel will review each student across the following themes:

<table>
<thead>
<tr>
<th>Engagement</th>
<th>Extension</th>
<th>Communication</th>
</tr>
</thead>
<tbody>
<tr>
<td>Overall assessment of how the student used their three minutes. Was it creative? Were slides in the required format?</td>
<td>Student’s ability to take the core of their research and share it in an easy-to-understand format. Was their language relevant? Did they engage listeners?</td>
<td>The manner in which the student presents. This is the student’s tone, pace and clarity.</td>
</tr>
</tbody>
</table>

You’re invited to cast your vote.

My vote goes to:

ID number: __________________

Student name: ____________________________

Tear this page out and hand it into the Conference Reception Desk by 5pm Wednesday, July 6.

Announcement of the winning Student Snapshots – Judges and People’s Choice – will be made at the Conference Dinner on Wednesday, July 6 at the Stamford Grand, Glenelg.

And the People’s Choice winner is ...
CONFERENCE FEEDBACK

Please rate the following aspects from your involvement at Animal Production 2016:

<table>
<thead>
<tr>
<th>Conference Program</th>
<th>Disappointed</th>
<th>Poor</th>
<th>Neutral</th>
<th>Good</th>
<th>Excellent</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Invited speakers</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Networking</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Registration and inclusions</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Venue and catering</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Organisation</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Exhibition displays</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Involvement of students</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>

Please let us know any specific comments regarding your scores:

If Animal Production 2016 has challenged your thinking or shifted your paradigms, please share briefly how or on what topic?

This year’s conference theme was *Animal Welfare – meeting consumer needs and increasing productivity*. With 2016 now at a close, we’d value your suggestions for the Animal Production 2018 conference theme?

Animal Production 2016 offered opportunities for sponsorship as well as exhibition for organisation exposure to the industry. Do you have any suggestions of potential sponsors for Animal Production 2018?

THANK YOU!
**Program — At a Glance**

**Conference Venue:**
Stamford Grand Adelaide  
2 Jetty Road, Glenelg South Australia  
Telephone: 08 8376 1222  

**Conference Organiser:**
Rebecca Jeisman  
AgCommunicators  
Telephone: 0438 683 436  
Email: rebecca.jeisman@agcommunicators.com.au

### Monday, July 4, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
<th>Attire</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:45pm – 5:00pm</td>
<td>Careers Master Class for students</td>
<td>Ballroom 5</td>
<td></td>
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<tr>
<td>4:30pm – 5:30pm</td>
<td>Poster collection and mounting</td>
<td>Plenary</td>
<td></td>
</tr>
<tr>
<td>5:00pm – 5:30pm</td>
<td>Speakers’ Briefing</td>
<td>Plenary</td>
<td></td>
</tr>
<tr>
<td>6pm – 8pm</td>
<td><strong>Animal Production 2016 Welcome Reception</strong></td>
<td>Ballroom 2 and 3</td>
<td>Business Attire</td>
</tr>
</tbody>
</table>

### Tuesday, July 5, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
<th>Attire</th>
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</thead>
<tbody>
<tr>
<td>8:00am – 8:10am</td>
<td>Speakers’ Briefing</td>
<td>Plenary</td>
<td></td>
</tr>
<tr>
<td>8:30am – 5:00pm</td>
<td>Conference Day One</td>
<td></td>
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<tr>
<td>5:00pm – 6:00pm</td>
<td><strong>Alltech Networking Hour</strong></td>
<td>Plenary Room</td>
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<tr>
<td>6:00pm – 7:00pm</td>
<td><strong>Society General Meetings</strong></td>
<td>Plenary Room</td>
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<tr>
<td>7:00pm</td>
<td>Explore Glenelg’s local dining options</td>
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### Wednesday, July 6, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
<th>Attire</th>
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<tbody>
<tr>
<td>8:00am – 8:10am</td>
<td>Speakers’ Briefing</td>
<td>Plenary</td>
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<tr>
<td>8:30am – 5:30pm</td>
<td>Conference Day Two</td>
<td></td>
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<tr>
<td>7:00pm – 11:00pm</td>
<td><strong>Animal Production 2016 Conference Dinner</strong></td>
<td>Ballroom 2 and 3</td>
<td>Cocktail attire</td>
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### Thursday, July 7, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Event</th>
<th>Location</th>
<th>Attire</th>
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<tbody>
<tr>
<td>8:00am – 8:10am</td>
<td>Speakers’ Briefing</td>
<td>Plenary</td>
<td></td>
</tr>
<tr>
<td>8:30am – 4:30pm</td>
<td>Conference Day Three</td>
<td></td>
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<tr>
<td>4:30pm</td>
<td>Conference Concludes</td>
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</table>
### Monday, July 4, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:45pm – 5:00pm</td>
<td>Ballroom 5</td>
<td><strong>Careers Master Class for students</strong></td>
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<tr>
<td></td>
<td></td>
<td>Session chair: Phil Hynd and Emily Buddle</td>
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<tr>
<td></td>
<td></td>
<td><strong>Prof Mike Looper</strong> University of Arkansas USA  Building your brand: turning opportunities into a career</td>
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<td></td>
<td><strong>Prof James Sartin</strong> Journal Of Animal Science  Scientific publications: Surviving the editorial process</td>
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<tr>
<td></td>
<td></td>
<td><strong>Geoff Lucas and Felicity Davies Lucas Group</strong>  Getting your resume into shape</td>
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<tr>
<td>4:30pm – 5:30pm</td>
<td></td>
<td>Poster collection and mounting</td>
</tr>
<tr>
<td>5:00pm – 5:30pm</td>
<td></td>
<td>Speakers’ Briefing</td>
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<tr>
<td>6pm – 8pm</td>
<td></td>
<td><strong>Animal Production 2016 Welcome Reception</strong></td>
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<td></td>
<td>Ballroom 2 and 3  Business Attire</td>
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</table>

### Tuesday, July 5, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Event Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30am – 10:30am</td>
<td>Plenary Room</td>
<td><strong>Animal welfare – what is it? How do we measure it? How can we make animals’ lives better?</strong></td>
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<td></td>
<td>Session chairs: Phil Hynd and Chris Logan</td>
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<tr>
<td></td>
<td></td>
<td><strong>Prof Temple Grandin - 1433 University of Colorado USA</strong>  Animal handling and welfare</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Alan Tilbrook - 1288 SARDI</strong> Hormones, Stress and Animal Welfare (BARNETT MEMORIAL LECTURE)</td>
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<td></td>
<td></td>
<td><strong>Tina Widowski - 1422 University of Guelph</strong>  Translating animal welfare science into animal care standards</td>
</tr>
<tr>
<td>Morning Tea</td>
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<tr>
<td>11:00 – 12:30</td>
<td>Plenary Room</td>
<td><strong>Major welfare issues facing the animal industries in Australia.</strong></td>
</tr>
<tr>
<td></td>
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<td>Session chairs: David Scobie and Kate Collins</td>
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<tr>
<td></td>
<td></td>
<td><strong>Jojo Jackson - 1493 AECL</strong> Poultry eggs: Australian animal welfare priorities</td>
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<tr>
<td></td>
<td></td>
<td><strong>Jim Rothwell - 1400 Meat and Livestock Australia</strong>  Red meat: Australian animal welfare priorities</td>
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<td></td>
<td></td>
<td><strong>Andrew Spencer - 1432 Australian Pork Limited</strong>  Pork: Australian animal welfare priorities</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Kathryn Davis - 1147 Dairy Australia</strong>  Dairy: Australian animal welfare priorities</td>
</tr>
<tr>
<td></td>
<td></td>
<td><strong>Kylie Hewson - 1287 RIRDC</strong> Chicken meat: Australian animal welfare priorities</td>
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<td></td>
<td><strong>Geoff Lindon - 1432 AWI</strong> Wool: Australian animal welfare priorities</td>
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<td></td>
<td><strong>Cameron Hall - Elders</strong> Commercial live export: Australian animal welfare priorities</td>
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<td>Cross-species facilitated discussion</td>
</tr>
</tbody>
</table>
### Lunch

**1:30pm – 3:00pm | Plenary Room**  
**Consumers and animal welfare: consumer attitudes to, and influence on, animal welfare.**  
Session chairs: Wayne Pitchford and Juan-Felipe M Rocha

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grahame Coleman - 1202</td>
<td>Relevance of public attitudes to animal welfare for the pork industry</td>
</tr>
<tr>
<td><em>University of Melbourne</em></td>
<td></td>
</tr>
<tr>
<td>Heather Bray - 1421</td>
<td>Not all Australian families find it easy to talk about where meat comes from</td>
</tr>
<tr>
<td><em>University of Adelaide</em></td>
<td></td>
</tr>
<tr>
<td>Emily Buddle - 1420</td>
<td>Consumers link ‘better’ farm animal welfare with better quality products</td>
</tr>
<tr>
<td><em>University of Adelaide</em></td>
<td></td>
</tr>
<tr>
<td>Lenka Malek - 1419</td>
<td>Consumer valuation of and attitudes towards farm animal welfare claims</td>
</tr>
<tr>
<td><em>University of Adelaide</em></td>
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</tbody>
</table>

### Afternoon Tea

**3:30pm – 5:00pm | Plenary Room**  
**Animal health, survival and resilience.**  
Session chairs: Geoff Hinch and Lydia Farrell

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Topic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Joanne Conington - 1495</td>
<td>Breeding better health and welfare in sheep – what is compromised if we do?</td>
</tr>
<tr>
<td><em>Scotland’s Rural College</em></td>
<td></td>
</tr>
<tr>
<td>Jason Trompf - 1498</td>
<td>Survive and Thrive ‘You can have your cake and eat it too’</td>
</tr>
<tr>
<td><em>JT Agri-Source</em></td>
<td></td>
</tr>
<tr>
<td>Kate Plush - 1415</td>
<td>Preparing the neonate for the transition from intra- to extra-uterine life</td>
</tr>
<tr>
<td><em>SARDI</em></td>
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</tbody>
</table>

### Alltech Networking Hour

5:00pm – 6:00pm  
Opportunity to engage presenters on their poster topic with a glass of wine and cheese.

### Society General Meetings (for members and prospective members)

6:00pm – 7:00pm  
**ASAP BGM – Plenary Room**  
**NZSAP AGM – Ballroom 5**

### 7:00pm - Explore Glenelg’s local dining options
### Wednesday, July 6, 2016

**8:30am – 10:00am | Plenary Room**

**Grazing systems: integrating crops and animals; animals and the environment.**

Session chairs: Michael Friend and Carolina Gallardo

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hugh Dove - 1431 CSIRO</td>
<td>Systems impacts of introducing crop grazing into pasture-based systems <strong>(MCCLYMONT MEMORIAL LECTURE)</strong></td>
</tr>
<tr>
<td>Antonio de Vega - 1179 University of Zaragoza, Spain</td>
<td>Grazing systems: integrating crops and animals <strong>(STOBBS MEMORIAL LECTURE)</strong></td>
</tr>
<tr>
<td>Richard Eckard - 1270 Primary Industries Climate Challenges Centre</td>
<td>Climate challenges for pastoral agriculture in Australia</td>
</tr>
</tbody>
</table>

**Morning Tea**

**10:30am – 12:15pm | Plenary Room**

**ASAP Student Snapshot – Concurrent Session 1 of 2**

Session chairs: Cindy Bottema

Judges: Temple Grandin, Geoff Lucas and Hamish Dickson

<table>
<thead>
<tr>
<th>Speaker</th>
<th>Title</th>
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<tbody>
<tr>
<td>1303 Victoire De Raphelis-Soissan</td>
<td>Feeding frequency and rate of nitrate ingestion affect nitrite toxicity in sheep supplemented with dietary nitrate</td>
</tr>
<tr>
<td>1172 Cassius Coombs Sponsor: ASAP NSW</td>
<td>Effect of eight weeks chilled or frozen storage on consumer-defined sensory quality traits of lamb</td>
</tr>
<tr>
<td>1255 Lea Labeur</td>
<td>Effect of combined cold, transport and handling stress in mid- and late-pregnancy on morphometric measures in lambs</td>
</tr>
<tr>
<td>1210 Joshua Philp</td>
<td>Withholding lucerne in summer to feed in subsequent winter feed deficits modestly increases feed efficiency of small mixed farms in western China</td>
</tr>
<tr>
<td>1220 Alannah Mackay</td>
<td>Testing a model to initiate feather pecking in free-range laying hens</td>
</tr>
<tr>
<td>790 Jaime Manning Sponsor: ASAP NSW</td>
<td>The impact of forage availability on livestock behaviour in Australian heterogeneous paddocks</td>
</tr>
<tr>
<td>1323 Laura Villar</td>
<td>Nitrate and canola oil are synergistic in reducing methanogenesis in cattle</td>
</tr>
<tr>
<td>1014 Muhammad Shoalb Tufail</td>
<td>Development of village-based forage seed enterprises through farmer participatory research approach by varietal selection and evaluation</td>
</tr>
<tr>
<td>1262 Peta Taylor</td>
<td>Productivity, leg health and range use of individual broiler chickens on a free-range commercial farm</td>
</tr>
<tr>
<td>1215 Carolina Munoz</td>
<td>Reliability and feasibility of animal-based indicators to assess the welfare of extensively managed ewes.</td>
</tr>
<tr>
<td>1222 Emma Pettigrew</td>
<td>Can farmers select good rams based on phenotype?</td>
</tr>
<tr>
<td>1239 Emily Grant</td>
<td>Qualitative behavioural assessment (QBA) of remotely captured video footage can identify positive and negative welfare states in sheep</td>
</tr>
<tr>
<td>1052 Paula Alejandra Gonzalez-Rivas</td>
<td>Reducing rumen starch fermentation of wheat with 3% NaOH has the potential to ameliorate the effect of heat stress in grain-fed sheep.</td>
</tr>
<tr>
<td>1265 Lucy Watt</td>
<td>Lamb growth and in vivo organic matter digestibility of arrowleaf clover and bladder clover hay</td>
</tr>
<tr>
<td>1230 Maddison Corlett</td>
<td>Including biserrula chaff in the diet of sheep reduced methane yield on the basis of energy intake</td>
</tr>
<tr>
<td>1249 Dr Kate Loudon</td>
<td>On farm factors increasing dark cutting in beef cattle</td>
</tr>
<tr>
<td>1307 Lauren Staveley Sponsor: Pork CRC</td>
<td>The effect of maternal parity and birth weight on ovarian follicle population of female pigs (gilts).</td>
</tr>
<tr>
<td>1200 Mandy Bowling Sponsor: Pork CRC</td>
<td>Heart rate variability as an indicator of pig welfare</td>
</tr>
<tr>
<td>1243 Patricia Condous Sponsor: Pork CRC</td>
<td>Use of strategic sow confinement with farrowing induction can achieve similar stillborn mortality and reduce overlay caused piglet mortality compared to loose housed sows</td>
</tr>
<tr>
<td>1199 Jamee Seccafien Sponsor: Pork CRC</td>
<td>The effects of heat stress on porcine oocyte maturation, Fertilisation and embryo development and methods of alleviation</td>
</tr>
</tbody>
</table>

**Sponsored by:**

**mla**

**Alltech**

**Pork CRC**

**ANIMAL PRODUCTION 2016**
<table>
<thead>
<tr>
<th>Session Code</th>
<th>Presenter</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>1201</td>
<td>Farrah Preston</td>
<td>Pre-slaughter washing increases dark cutting incidence in beef</td>
</tr>
<tr>
<td>1205</td>
<td>Octavia Kelly</td>
<td>Lamb survival should be considered separate genetic traits across different birth types</td>
</tr>
<tr>
<td>1204</td>
<td>Josephine Webb</td>
<td>JBS Southern Producer of the year 2015 – utilising Livestock Data Link (LDL) as a model for Supply Chain incentivisation.</td>
</tr>
<tr>
<td>1273</td>
<td>Hussein Al-Moadhen</td>
<td>Implementing the Australian Funded ‘On-The-Ground’ Aid Program at the Holy Karbala Sheep Research Station in Iraq</td>
</tr>
<tr>
<td>1286</td>
<td>Emily Buddle</td>
<td>Meat Consumers Ignore Online Animal Welfare Activism</td>
</tr>
<tr>
<td>1310</td>
<td>Haylee Clifford</td>
<td>Grape marc inclusion in ruminant diets reduces protein absorption</td>
</tr>
<tr>
<td>1254</td>
<td>Risa Antari</td>
<td>Metabolisable energy intake but not crude protein intake or bovine somatotropin hormone (bST) increased hip height in Bos indicus cross steers</td>
</tr>
<tr>
<td>1268</td>
<td>Jarud Miller</td>
<td>Are neonatal beef calves getting enough to drink in northern Australia?</td>
</tr>
<tr>
<td>1260</td>
<td>Andrea Wallage</td>
<td>Exposure of bulls to high heat load decreases efficacy of scrotal thermoregulation</td>
</tr>
<tr>
<td>1251</td>
<td>Tanya Nowland</td>
<td>Caffeine increases an neonatal piglets body temperature and negatively effects survival at 24 hours of age</td>
</tr>
</tbody>
</table>

10:30am – 12:15pm | Ballroom 5
**NZSAP Presidential Address & NZ Young Scientists** – Concurrent Session 2 of 2

Session chairs: Chris Logan

<table>
<thead>
<tr>
<th>Session Code</th>
<th>Presenter</th>
<th>Title</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZSAP 26</td>
<td>Rhiannon Handcock</td>
<td>More dairy heifers are achieving liveweight targets</td>
</tr>
<tr>
<td>NZSAP 2</td>
<td>Gabriella Gronqvist</td>
<td>Does ewe nutrition during pregnancy affect the neonatal behaviour of twin-born lambs?</td>
</tr>
<tr>
<td>NZSAP 6</td>
<td>Catherine O’Connell</td>
<td>Sustained diuretic effect of plantain when ingested by sheep</td>
</tr>
<tr>
<td>NZSAP 12</td>
<td>Lisa Box</td>
<td>Milk production and urinary nitrogen excretion of dairy cows grazing perennial ryegrass-white clover and pure plantain pastures</td>
</tr>
<tr>
<td>NZSAP 7</td>
<td>Lydia Jane Farrell</td>
<td>Urine excretion of non-lactating dairy cows in late gestation fed fodder beet and kale based diets in winter</td>
</tr>
<tr>
<td>NZSAP 48</td>
<td>Irene Lingjun Zhang</td>
<td>Using genomic information to predict sex in dairy cattle</td>
</tr>
</tbody>
</table>

Lunch
<table>
<thead>
<tr>
<th>1:15pm – 3:15pm</th>
<th>Colley</th>
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</thead>
<tbody>
<tr>
<td><strong>Breeding</strong> – Concurrent Sessions 1 of 3</td>
<td></td>
</tr>
<tr>
<td>Session chairs: Forbes Brien and Kate Loudon</td>
<td></td>
</tr>
<tr>
<td>NZSAP 31 ST Morris</td>
<td>Days to calving and inter-calving interval in beef and dairy-beef crossbred cows</td>
</tr>
<tr>
<td>NZSAP 45 Patricia Johnson</td>
<td>Preliminary Investigations into the Genetics of Residual Feed Intake in Sheep</td>
</tr>
<tr>
<td>1228 Tracie Bird Gardiner</td>
<td>Relationships among methane traits in cattle fed ad libitum roughage diet</td>
</tr>
<tr>
<td>NZSAP 19 Alan M Hurley</td>
<td>Genetics of alternative definitions of feed efficiency in grazing lactating dairy cows</td>
</tr>
<tr>
<td>1252 Claire MacLeay</td>
<td>Feed intake for sheep can be measured precisely in less than 35 days</td>
</tr>
<tr>
<td>NZSAP 42 Kathryn McRae</td>
<td>An update on genetic parameters for facial eczema tolerance in sheep</td>
</tr>
<tr>
<td>NZSAP 30 John Booker</td>
<td>NZ Corriedale Performance Recording</td>
</tr>
<tr>
<td>1219 Dr Kath Donoghue</td>
<td>The impact of divergent selection for methane yield on age at puberty</td>
</tr>
<tr>
<td>NZSAP 32 Felipe Lembye</td>
<td>Estimation of genetic parameters for milk yield traits at different herd production level in cows milked once- or twice-daily</td>
</tr>
<tr>
<td>NZSAP 40 Jamie Ward</td>
<td>DEERSelect – review of the first decade</td>
</tr>
<tr>
<td>1238 Nicholas Corbet</td>
<td>Genetic parameters of female reproductive traits measured by ultrasound in beef cattle</td>
</tr>
<tr>
<td>NZSAP 51 Sharon McIntyre</td>
<td>Impact of date of birth recording in genetic evaluation in sheep</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>1:15pm – 3:15pm</th>
<th>Plenary Room</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Grazing / Pastures / Supplements</strong> – Concurrent Sessions 2 of 3</td>
<td></td>
</tr>
<tr>
<td>Session chairs: Paul Kenyon and Andrea Wallage</td>
<td></td>
</tr>
<tr>
<td>1138 Dr Di Mayberry</td>
<td>Quantifying the scale of livestock yield gaps in India and identifying opportunities for investment</td>
</tr>
<tr>
<td>1148 Dr Cesar Pinares</td>
<td>Influence of integration of dual-purpose wheat and canola crops in a pasture system on liveweight of Merino sheep</td>
</tr>
<tr>
<td>1272 Ian McFarland</td>
<td>Pastures from Space - a practical application</td>
</tr>
<tr>
<td>1283 Renelle Jeffrey</td>
<td>It’s Ewe Time - a national productivity stimulation campaign</td>
</tr>
<tr>
<td>1118 Dr Lindsay Bell</td>
<td>Feed-base strategies that reduce risk of feed-gaps in livestock systems across Australia’s mixed farming zone</td>
</tr>
<tr>
<td>1136 Dr Maree Bowen</td>
<td>The profitability of forage options for beef production in the subtropics of northern Australia</td>
</tr>
<tr>
<td>1203 Dr Robin Dobos</td>
<td>Inferring rumination behaviour from a tri-axial accelerometer</td>
</tr>
<tr>
<td>NZSAP 63 David Pacheco</td>
<td>Plasma amino acid profiles of lactating dairy cows feed fodder beet and ryegrass diets</td>
</tr>
<tr>
<td>NZSAP 14 Lydia Cranston</td>
<td>Effect of early weaning onto a plantain-clover mix on ewe and lamb performance</td>
</tr>
<tr>
<td>NZSAP 24 Aimi Nabilah Hussein</td>
<td>Social dominance and milk production of grazing dairy cows in New Zealand.</td>
</tr>
<tr>
<td>NZSAP 20 Racheal Bryant</td>
<td>Does mowing before grazing increase dry matter intake and milk yield of late lactation dairy cows?</td>
</tr>
<tr>
<td>NZSAP 61 Rene Corner-Thomas</td>
<td>The use of Farm management tools by New Zealand sheep farmers: changes over time</td>
</tr>
</tbody>
</table>
### Welfare Issues / Measurement – Concurrent Sessions 3 of 3

**Session chairs:** Kate Plush and Patricia Condous

<table>
<thead>
<tr>
<th>NZSAP 34</th>
<th>Mhairi Sutherland</th>
<th>An investigation of automated measures for assessing pain-induced distress in dairy calves</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZSAP 18</td>
<td>Melissa Hempstead</td>
<td>A physiological evaluation of the efficacy of pain-mitigation strategies for cautery-disbudded goat kids</td>
</tr>
<tr>
<td>NZSAP 5</td>
<td>Jamie Ward</td>
<td>Development and evaluation of a temperament scoring system for farmed deer - genetic and environmental components</td>
</tr>
<tr>
<td>NZSAP 9</td>
<td>C. Trotter</td>
<td>Liver Abscessation in Pasture Based Beef Bulls in the South Island of New Zealand - The Incidence and Effect on Carcass Weight.</td>
</tr>
<tr>
<td>1261</td>
<td>Brett Wilson</td>
<td>Wild dog predation and flock productivity - field methods to quantify stress and behavioural responses of sheep in the line of fire</td>
</tr>
<tr>
<td>1197</td>
<td>Dr Amanda Doughty</td>
<td>Remote monitoring for wellbeing in grazing sheep: are social behaviours useful?</td>
</tr>
<tr>
<td>1266</td>
<td>Tellisa Kearton</td>
<td>Positioning of sensing microchips for detecting core temperature changes in sheep.</td>
</tr>
<tr>
<td>1037</td>
<td>Dr Edward Narayan</td>
<td>Optimising non-invasive cortisol measurement in sheep (Ovis aries)</td>
</tr>
<tr>
<td>1180</td>
<td>Dr Cathy Burnard</td>
<td>Longer distances are better for measuring flight speed in sheep</td>
</tr>
<tr>
<td>1174</td>
<td>Joanna Blunden</td>
<td>Beyond consumer defined welfare - paddock based egg production</td>
</tr>
<tr>
<td>1156</td>
<td>Dr Greg Cronin</td>
<td>The impact of a feather-pecking outbreak in an experimental free-range layer flock on growth, egg production, plumage damage and mortality</td>
</tr>
<tr>
<td>1181</td>
<td>Dr Brian Horton</td>
<td>Mortality in adult ewes associated with cold conditions despite moderate length wool</td>
</tr>
</tbody>
</table>

Afternoon tea

### Meat Science – Concurrent Sessions 1 of 3

**Session chairs:** David Rutley and Jena Alexopoulus

<table>
<thead>
<tr>
<th>NZSAP 43</th>
<th>PJ Back</th>
<th>Do different grazing strategies affect pre-weaning calf growth rates?</th>
</tr>
</thead>
<tbody>
<tr>
<td>NZSAP 47</td>
<td>Wendy Bain</td>
<td>Variation in total body fatness, and fat distribution in maternal sheep estimated using computed tomography scanning</td>
</tr>
<tr>
<td>1193</td>
<td>Dr Shawn McGrath</td>
<td>Turning dual-purpose wheat into meat: comparison of Merino and White Dorper maternal systems on a mixed-farming feedbase</td>
</tr>
<tr>
<td>1454</td>
<td>Dr Robert Banks</td>
<td>Balancing efficiency of production and product quality with new tools – the example of lamb</td>
</tr>
<tr>
<td>1221</td>
<td>Bruce Hancock</td>
<td>The Lamb Supply Chain Group provides a model for engaging value chains</td>
</tr>
<tr>
<td>1313</td>
<td>Stephanie Fowler</td>
<td>Prediction of beef eating quality using Raman spectroscopy</td>
</tr>
<tr>
<td>1195</td>
<td>Dr Janelle Hocking Edwards</td>
<td>Genomic breeding values for Lean Meat Yield, Intramuscular Fat and Shear Force do not affect live lamb production traits</td>
</tr>
<tr>
<td>NZSAP 56</td>
<td>PJ Back</td>
<td>Calf grazing behaviour and preference</td>
</tr>
<tr>
<td>NZSAP 4</td>
<td>Bryan Thompson</td>
<td>The impact of lamb pre and post weaning growth rate on farm profitability</td>
</tr>
<tr>
<td>NZSAP 38</td>
<td>Laura Deeming</td>
<td>Variability in growth rates of goat kids on 16 New Zealand dairy goat farms</td>
</tr>
<tr>
<td>NZSAP 17</td>
<td>Nicholas W Sneddon</td>
<td>Lactation curves for yields of dairy products from Holstein Friesian, Jersey and Holstein Friesian-Jersey crossbred cows.</td>
</tr>
</tbody>
</table>
### Grazing / Pastures / Supplements – Concurrent Sessions 2 of 3

**Session chairs:** Dennis Poppi and Jaime Manning

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Plenary Room</td>
<td>Demonstrating a successful premium pasture-fed beef value chain</td>
<td>Tim Hillier</td>
</tr>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Plenary Room</td>
<td>Offering legume based pastures to sheep reduced methane emissions and increased growth rates compared with perennial ryegrass pastures in spring and summer</td>
<td>Dr Stephanie Muir</td>
</tr>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Plenary Room</td>
<td>Can an Australian native plant (Eremophylla spp.) reduce methane output from cattle?</td>
<td>Dr Megan Sullivan</td>
</tr>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Plenary Room</td>
<td>Phenotypes to meet pasture-fed market requirements</td>
<td>Greg Ferrier</td>
</tr>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Plenary Room</td>
<td>Offering legume based pastures to sheep reduced methane emissions and increased growth rates compared with perennial ryegrass pastures in spring and summer</td>
<td>Dr Stephanie Muir</td>
</tr>
</tbody>
</table>

**Sponsored by:**

### Neonatal survival – Concurrent Sessions 3 of 3

**Session chairs:** Peter Wynn and Cara Meyer

<table>
<thead>
<tr>
<th>Time</th>
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<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Ballroom 5</td>
<td>The influence of age and breed of cow on colostrum indicators of suckled beef calves</td>
<td>Rebecca Hickson</td>
</tr>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Ballroom 5</td>
<td>The success of immediate removal of goat kids from the doe as a colostrum management strategy</td>
<td>Gosia Zobel</td>
</tr>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Ballroom 5</td>
<td>Does Viagra protect fetal lambs against pregnancy toxaemia?</td>
<td>Sam Peterson</td>
</tr>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Ballroom 5</td>
<td>The intake and performance of high-yielding Holstein cows offered a TMR and with access to grazing for six hours per day</td>
<td>Dr Karen Harper</td>
</tr>
<tr>
<td>3:45pm – 5:45pm</td>
<td>Ballroom 5</td>
<td>Effect of grazing system on nitrogen partitioning in lactating dairy cows grazing irrigated pastures in Canterbury, New Zealand.</td>
<td>Norton Atkins</td>
</tr>
</tbody>
</table>

**Sponsored by:**

### Animal Production 2016 Conference Dinner

**Ballroom 2 and 3 | Cocktail attire**

**7:00pm – 11:00pm**

**Animal Production 2016 Conference Dinner**

**Sponsored by:**

**ANIMAL PRODUCTION 2016**
### Thursday, July 7, 2016

<table>
<thead>
<tr>
<th>Time</th>
<th>Location</th>
<th>Session Title</th>
<th>Chairpersons</th>
</tr>
</thead>
<tbody>
<tr>
<td>8:30am – 10:00am</td>
<td>Plenary Room</td>
<td>Animal nutrition - past, present and future</td>
<td>Hugh Dove and Octavia Kelly</td>
</tr>
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<td></td>
<td></td>
<td>(UNDERWOOD MEMORIAL LECTURE)</td>
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</tr>
<tr>
<td></td>
<td></td>
<td>Animal nutrition: past, present and future – value of thinking across species and across disciplines</td>
<td></td>
</tr>
<tr>
<td>10:30am – 12:30pm</td>
<td>Plenary Room</td>
<td>Epigenetics and genomics</td>
<td>John Williams and Laura Villar</td>
</tr>
<tr>
<td>1:30pm – 3:10pm</td>
<td>Colley</td>
<td>Welfare Biology – Concurrent Sessions 1 of 3</td>
<td>Cameron Ralph and Jarud Miller</td>
</tr>
</tbody>
</table>

### Session Details

**Animal nutrition - past, present and future**

- **John Black** - 1413
  - John Black Consulting
  - Animal nutrition: past, present and future – value of thinking across species and across disciplines
  - (UNDERWOOD MEMORIAL LECTURE)

- **Frank Dunshea** - 1496
  - University of Melbourne
  - The Changing Drivers for Pork Production – Metabolic Modifiers

- **Graham Barrell** – NZSAP 70
  - Lincoln University NZ
  - Signals from inner space
  - (NZSAP LIVING LEGEND ADDRESS)

**Morning Tea**

**Epigenetics and genomics**

- **Tad Sonstegard** - 1418
  - Recombinetics
  - Precision Animal Breeding as a Sustainable, non-GMO Solution for Improving Animal Production and Welfare

- **Tim Doran** - 1438
  - AAHL
  - Sex Selection in poultry

- **Kristen Brennan** - 1269
  - Alltech
  - Nutrition and its influence on early-life programming in animals

- **Kathy Gatford** - 1497
  - University of Adelaide
  - Off to the right start – how pregnancy and early life can determine potential health and production

**Lunch**

**Welfare Biology – Concurrent Sessions 1 of 3**

- **1168 Dr David Scobie**
  - Moulting of tail wool reduced dag accumulation in yearling sheep.

- **1232 Dr Sam Walkom**
  - Importance of ewe and cow body condition in breeding programs

- **809 Dr Helen Golder**
  - Teat sealant lowers milk somatic cell count

- **NZSAP 41 Kathryn McRae**
  - Preliminary estimates of genetic parameters for juvenile and adult dag scores in New Zealand sheep

- **1217 Laura Kemmis**
  - Pedigree MatchMaker accurately identifies dams in naturally joined sheep flocks

- **1162 Dr Angela Lees**
  - Shade utilisation by Bos taurus and Bos indicus steers during summer

- **1240 Prof Paul Hemsworth**
  - Relationships between handling, behaviour and stress in lambs at abattoirs

- **1248 Kate Hartcher**
  - The use of carbon dioxide to stun pigs - benefits, drawbacks, and the way forward from here

- **1253 Jessica Crettenden**
  - Ewes classified as good mothers have greater cortisol responses when separated from their lambs than ewes classified as poor mothers

- **1246 Melina Tensen**
  - Livestock Production - 2050 and beyond
### 1:30pm – 3:10pm | Plenary Room

**Repro – Concurrent Sessions 2 of 3**

Session chairs: Rebecca Hickson and Jose Webb

<table>
<thead>
<tr>
<th>1242 Prof Michael Friend</th>
<th>Changing the sex ratio of lambs may alter gross margins in sheep flocks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1245 Dr Sabine Schmoelzl</td>
<td>Development of a remote sensing device to detect duration of parturition in ewes</td>
</tr>
<tr>
<td>1145 Tim Schatz</td>
<td>The effect of weight and age on pregnancy rates in maiden Brahman heifers in northern Australia.</td>
</tr>
<tr>
<td>NZSAP 27 Chris Rogers</td>
<td>Reproductive production constraints within the New Zealand racing industry</td>
</tr>
<tr>
<td>NZSAP 3 Paul Kenyon</td>
<td>The impact of dam age on ewe reproductive performance at two years of age</td>
</tr>
<tr>
<td>NZSAP 8 David Scobie</td>
<td>The influence of previous lactation on subsequent fertility in multiparous ewes?</td>
</tr>
<tr>
<td>NZSAP 29 Harriet Wishart</td>
<td>Which traits best predict ewe performance and survival the following year on a UK hill farm?</td>
</tr>
</tbody>
</table>

### 1:30pm – 3:10pm | Ballroom 5

**Grazing / Pastures / Supplements – Concurrent Sessions 3 of 3**

Session chairs: Janelle Hocking Edwards and Melissa Hempstead

<table>
<thead>
<tr>
<th>1158 Kieren McCosker</th>
<th>No production response of injectable trace minerals in young cattle grazing pasture based systems in the Northern Territory</th>
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</thead>
<tbody>
<tr>
<td>1139 Prof Nagalakshmi Devanaboyina</td>
<td>Supplementation of zinc-proteinate on serum biochemical parameters, antioxidant status, immune response and ovarian follicles in buffalo heifers</td>
</tr>
<tr>
<td>834 Prof David Cottle</td>
<td>Novel livestock supplementation: reducing shy feeders</td>
</tr>
<tr>
<td>1229 Dr Mariana Caetano</td>
<td>Effect of ensiled crimped grape marc on growth performance and methane emissions of Angus steers</td>
</tr>
<tr>
<td>1290 Dr Rob Dixon</td>
<td>Productivity and phosphorus content of rib and tail bones in reproducing cows ingesting diets deficient or adequate in phosphorus</td>
</tr>
<tr>
<td>1143 Dr Helen Golder</td>
<td>Metabolome and microbiome associations after a grain and sugar challenge</td>
</tr>
<tr>
<td>1296 Michael Wilkes</td>
<td>Pasture quality and pre-slaughter mob movements increase the incidence of dark cutting beef</td>
</tr>
<tr>
<td>1278 Dr Dean Thomas</td>
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**Afternoon Tea**

### 3:30pm – 4:30pm

**Forward Thinking – Where to from here?**

Session chairs: Phil Hynd and Chris Logan

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<td>Being born a twin does not reduce pregnancy rates in 15-month-old heifers</td>
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<td>1141 Jordan Hoban</td>
<td>The Nutritive Value and Eating Quality of Australian lamb cut</td>
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<td>1144 Dr Stephanie Fowler</td>
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<td>Does dam age effect gene expression in fetal and young sheep?</td>
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<td>1153 Emma Babiszewski</td>
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<td>Thermo-alkaline Degradation of Hepatotoxic Indospicine in Camel Meat</td>
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<td>1206 Dr Dave Kleeman</td>
<td>Does melatonin enhance reproductive performance of Border Leicester rams mated to Merino ewes in spring?</td>
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<td>1207 Jane Court</td>
<td>Can farmers select good rams based on phenotype?</td>
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<td>1209 Dr Rachelle Hergenhan</td>
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<td>Providing pasture choice to sheep reduced intensity of methane emissions and increased growth compared with annual ryegrass</td>
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### Student Poster Submissions

**1049 Mammo Erdaw**
- Effects of diet containing raw, full-fat soybean meal and supplemented with high-impact protease for broilers on relative weight of pancreas.

**1053 Paula Alejandra Gonzalez-Rivas**
- Characterization of in vitro rumen fermentation parameters of 3% NaOH treated wheat grain.

**1054 Paula Alejandra Gonzalez-Rivas**
- Rumen bolus is a useful tool to monitor body core temperature as affected by ambient temperature in lactating dairy cows in a sub-tropical summer.

**1173 Abd Al-Bar Al-Farha**
- Evaluation of Recoverability of Mycoplasma-like organisms causing mastitis in dairy cattle in South Australia under different freezing conditions.

**1176 Kayla Kopp**
- Barley grain supplementation in late gestation to improve lamb survival in twin-bearing Merino ewes grazing pasture of high biomass and quality.

**1177 Khaled Kanakri**
- Sponsor: SASAG
- The influence of variable dietary fats on tissue fatty acid composition and growth performance of broilers.

**1208 Abd Al-Bar Al-Farha**
- Microbiology and molecular tools for detection of Mycoplasma mastitis in South Australia.

**1214 Abd Al-Bar Al-Farha**
- The effect of Mycoplasma mastitis on somatic cell counts patterns and bovine milk production in South Australia.

**1218 Pablo Alvarez Hess**
- Analysis of three methods for the estimation of in vitro CH4 production from vented bottles.

**1234 Oanh Le**
- Sponsor: ASAP QLD
- Preference of weaner calves for pellets is improved by inclusion of Bacillus amyloliquefaciens spores as an ingredient.

**1241 Jemma Seyfang**
- Gilts from female-biased litters behave differently than gilts from male-biased litters.

**1244 Cassius Coombs**
- Examining the relationship between colorimetric measurements and microbial loading of beef meat.

**1263 Shernae Woolley**
- Emerging inherited diseases and animal welfare: A case study of congenital mandibular prognathia in Droughtmaster cattle.

**1264 Tiago Alves Correa Carvalho de Silva**
- Sponsor: ASAP QLD
- High protein content stimulates bone elongation on energy-restricted cattle.

**1294 Pardeep Sharma**
- Sponsor: SASAG
- Serological responses to Salmonella Typhimurium infection in laying hens.

**1308 Victoire De Raphelis-Soissan**
- Nitrate encapsulated with paraffin wax inhibits short term methane production in sheep and effectively reduces the risk of nitrite toxicity.

**1343 Madhu Sharma**
- 4- Nonylphenol induced Genotoxicity assessment in blood cells of fish Channa punctatus using Comet Assay.
KEYNOTE SPEAKERS

TEMPLE GRANDIN, UNITED STATES
Professor Temple Grandin is known for her award-winning work on the design of animal handling facilities. She was born in Boston, Massachusetts, and at age two had no speech and showed signs of severe autism. Many hours of speech therapy and intensive teaching enabled Prof Grandin to learn to speak. Mentoring by her high school science teacher and her aunt, who lived on a ranch in Arizona motivated her to study and pursue a career as a scientist and livestock equipment designer. Prof Grandin obtained her BA at Franklin Pierce College in 1970. In 1975 she earned her MS in Animal Science at Arizona State University for her work on the behaviour of cattle in different squeeze chutes. Prof Grandin was awarded a PhD in Animal Science from the University of Illinois in 1989 and is currently a Professor at Colorado State University.

JOHN BLACK, AUSTRALIA
Eric Underwood Memorial Lecture
Dr John Black describes himself as a reductionist scientist with a strong desire to understand underlying mechanisms, but then to integrate the pieces, quantitatively, back into a whole system – the essentials of modelling. He runs a research management company, John L Black Consulting, where as a Research Management Consultant he manages research programs for a wide range of rural research and development organisations and private companies. His activities include working for the beef, dairy, pig, poultry, grains, fodder and honeybee industries. He previously worked as a Chief Research Scientist at CSIRO, was Officer-in-Charge of the Prospect laboratory in Sydney and an Adjunct Professor in veterinary science at the University of Sydney.

KRISTEN BRENNAN, UNITED STATES
Dr Kristen M Brennan is a research project manager at Alltech’s Center for Animal Nutrigenomics and Applied Animal Nutrition in Nicholasville, Kentucky. She received her Bachelor and Master degrees in animal science from the University of Massachusetts Amherst. In 2008, she completed a PhD in Animal Science at Washington State University. Upon completion of her PhD, she joined Alltech as a post-doctoral research fellow. Currently, she manages the animal nutrigenomics and equine nutrition research programs. She is especially interested in establishing a link between nutritional genomics approaches and applied nutrition research in a variety of agricultural animal models. Dr Brennan also serves as the Institutional Animal Care and Use Committee chairperson and is an adjunct assistant professor in the College of Ag at the University of Kentucky.

JOANNE CONINGTON, UNITED KINGDOM
Dr Joanne Conington is a Reader in Applied Livestock Genetics in the Animal and Veterinary Sciences research group, Scotland’s Rural College (SRUC, previously known as SAC).
Her research focuses on the development of new, broader breeding goals for multi-trait breeding programs incorporating aspects of disease resistance and maternal efficiency. Her present research is mostly undertaken in collaboration with industry partners investigating genetic and genomic approaches to breed for resistance to mastitis in sheep and goats, footrot and internal parasites in sheep, lamb survival and ewe longevity. She lectures to undergraduate and postgraduate students at SRUC and the University of Edinburgh and also advises the UK Government on animal breeding issues relating to animal welfare.
ANTONIO DE VEGA, SPAIN

Harry Stobbs Memorial Lecture

Dr Antonio de Vega is currently an Associate Professor at the University of Zaragoza in Spain, and is Head of the Department of Animal Production and Food Sciences. He completed a B Vet Med degree at Zaragoza, and was awarded a PhD in rumen kinetics in sheep. After completing his PhD, Dr de Vega moved to the University of Queensland to work as a postdoctoral fellow for two years, during which he gained experience on the understanding of digesta particle kinetics in ruminants. Dr de Vega is concerned about viable ruminant production in semi-arid and arid environments, where pasture availability is scarce. He has been working for more than 15 years on the use of cereal crops and their by-products as feed for grazing ruminants.

HUGH DOVE, AUSTRALIA

Hugh Dove was an Honorary Research Fellow at CSIRO Agriculture, Canberra, but recently retired after a 40-plus year career with the organisation. After completing an agricultural science degree, a diploma in education and then a PhD at the University of Melbourne, he joined CSIRO Plant Industry in 1975 and since then, has been involved in studies on the nutrition of grazing animals, principally sheep and cattle. Much of his work has been directed toward obtaining data with which to relate animal performance to pasture conditions, and data on the interaction between pastures and supplements. His work has been mainly with sown pastures but in the past decade, he has also worked extensively on the role of dual-purpose winter crops in grazing systems. In 2007, he was awarded the Research Medal of the Nutrition Society of Australia for services to animal nutrition research.

TAD SONSTEGARD, UNITED STATES

Dr Tad Sonstegard is an internationally recognised leader in livestock genetics with more than 25 years of experience in the field. He has made seminal contributions to the sequencing of livestock genomes, been involved in the development of industry-standard genetic diagnostic platforms and elucidation of the genetic basis for traits impacting food animal health, production and well-being. Prior to joining the Recombinetics team, Dr Sonstegard developed and led federally funded projects in applied genomics for ruminant genetic improvement at the United States Department of Agriculture Agricultural Research Service’s Animal Genomics & Improvement Laboratory. He holds a BS in Agricultural Biochemistry from Iowa State University and a PhD in Molecular, Cellular, Developmental Biology and Genetics from the University of Minnesota.

TINA WIDOWSKI, CANADA

Tina Widowski is a Professor of Animal Biosciences and Director of the Campbell Centre for the Study of Animal Welfare at the University of Guelph, Ontario, Canada, and holds BS, MS and PhD degrees from the University of Illinois-Urbana. With training in animal behaviour and physiology, she uses a variety of measures to determine how the housing and management of farm animals affects their welfare. Prof Widowski has studied diverse topics such as the endocrinology of nest building in sows, the behavioural responses of hens to different lighting systems, the ontogeny of feeding and drinking in piglets and motivation for dust bathing and nesting in laying hens. Her research group has tackled some difficult issues including transport and handling of market pigs and methods for euthanasia for piglets and poultry. In 2011, Prof Widowski was appointed the Egg Farmers of Canada Research Chair in Poultry Welfare.
Assessing animal welfare during handling is simpler than assessing welfare in housing. The first step is preventing acts of abuse that everybody interested in animal welfare would want stopped. Acts of abuse include beating animals, poking sensitive areas, dragging downed animals, deliberate slamming of gates on animals and deliberate driving animals over the top of downed animals. The next step is to implement objective scoring of animal handling. The outcome measures that should be used are percentage of animals that fall, strike fences or gates, vocalize during restraint or moved with electric goads. These measures will bring handling up to an acceptable level. Further improvements in handling can be obtained with stockmanship training. Physiological measures of stress such as cortisol, lactate or glucose are useful for assessing handling methods because handling is a short-term stressor.

Introduction
Animal welfare assessments for use in commercial animal production units need to be simpler than assessment tools used in research. Some tools that work well for research are too complex for use by producers or commercial auditing companies. The author has trained many auditors from commercial companies and inspectors to evaluate animal handling at slaughter plants. The commercial reality is that it has to be possible to train people in a one-to-two day workshop. Standards must provide clear guidance for acceptable and not acceptable methods. They must never be vague, because vague standards will be interpreted differently by different people.

Steps to Improve Handling Practices

The first step managers must take to improve animal welfare is to prevent acts of abuse during animal handling. This requires both management supervision and training of employees. Acts of abuse are never acceptable. Examples of acts of abuse that should never be tolerated are: dragging downed animals, throwing animals, beating, poking sensitive areas to move animals, deliberate slamming of gate on animals or deliberate running animals over the top of downed animals. There have been discussions about when tapping an animal with a driving aid becomes beating. To train auditors and inspectors, a video has been produced titled Proper Use of Livestock Driving Tools. Access by typing the title into a search engine. An empty cardboard box is whacked with a plastic paddle. When the box starts crushing, tapping has progressed to beating.

People manage the things that they measure. The use of simple outcome based measurements has been effective in improving animal handling at slaughter plants (Grandin, 2005). During handling in both slaughter plants and feedlots, the percentage of cattle that fell during handling was under 1% (Grandin, 2006; Woiwode 2015). Electric goad use in 28 feedlots averaged at 5% of the animals and some feedyards never used them (Woiwode, 2015). The percentage of cattle that vocalized in the squeeze chute before a procedure was performed or in a stun box can be easily kept at 5% or less (Grandin, 2012 and Woiwode, 2015). Numerical scoring is recommended for evaluating handling and it makes it possible to determine if handling has improved or become worse. Scoring also makes it possible to compare practices between different facilities. This may help motivate people to improve because they want recognition for being better than the other places.

Animal Handling Outcome Measures for Use on Farms, Feedlots and Stockyards

- Percentage of animals that fall during handling.
- Percentage of cattle or pigs that vocalized (moo, bellow, or squeal) during handling and restraint). Do not use vocalization scoring for sheep.
- Percentage of animals moved with an electric goad.
- Percentage of animals that strike gates or fences
- Percentage of animals running when they exit the squeeze chute

These measures will establish a baseline for acceptable handling practices. The author recently visited a feedlot where cattle were handled for vaccinations with 0% electric goads and 0% of the cattle falling. The employees were silent and never yelled at cattle. The handling was definitely acceptable. Stockmanship training further improved handling. Re-positioning of one employee in a different position alongside the race and stopping constant waving of his flag driving aid resulted in quieter cattle. Animal agitation and banging and clanging of the squeeze chute became noticeably quieter.

Australian researcher Paul Hemsworth has found that animals with a large flight zones and fearful of people are less productive (Hemsworth et al., 2000). Further studies have shown that animals are also more productive when stockpeople have positive attitudes towards animals. Training stockpeople on how to use behavioral principles of animal handling is really important. When people learn more about animal behavior, it helps promote a positive attitude.

Video Cameras

Two large beef and pig slaughter companies in the U.S. have installed video cameras that are remotely accessed by an auditing company. This keeps handling standards high when management is not watching. Today many mobile phones are video cameras and everybody who handles animals must stop and think. If I did this, how would it look posted online?
Use of Physiological Measures to Evaluate Handling Practices

Assessing animal welfare during handling is easier and more straightforward than assessing welfare under different housing conditions. Handling procedures, such as vaccinations, loading trucks, and movement through a slaughter plant, take a short period of time. For short-term stressors such as handling, physiological measures of stress may be really useful. Physiological measures such as cortisol, lactate and glucose can easily show differences between low stress and high stress handling methods. For example, when pigs are moved with electric prods or jammed in a race, lactate and glucose levels are higher (Edwards et al., 2010; Benjamin et al., 2001, and Gruber et al., 2010). In cattle, vocalization (moo or bellow) during handling and restraint is associated with higher cortisol (Dunn, 1990; Hemsworth, et al., 2011). Vocalization is also associated with excessive pressure from a restraint device and electric goad use (Grandin, 1998 and Bourquet et al., 2011). For long-term stressors such as comparing the effects of different housing system, physiological measures may be less useful.

Effects of Previous Experience in Stress

An animal’s previous experience with handling and restraint will also have an effect on stress levels (Grandin, 1997; Grandin and Shivley, 2015). Numerous studies have shown that animals can be acclimated to handling or transport. The first trip on a truck was more stressful than subsequent trips (Stockman et al., 2012). Beef heifers that were carefully acclimated to being moved through a race had better conception rates after artificial insemination (Cooke et al., 2009). Animals can be acclimated to the point where they will voluntarily enter a restraint device for a feed rewards (Grandin, 1989). Acclimated animals will have lower cortisol levels (Petherick et al., 2002).

References


Animal nutrition: past, present and future - value of thinking across species and across disciplines

The Eric Underwood Memorial Lecture

J.L. Black

Introduction

Eric Underwood was renowned for his ability to think through problems, as exemplified in solving Denmark Wasting Disease. Sheep and cattle introduced into coastal regions like Denmark in southern Western Australia would, after around three months, start losing weight, become anaemic and frequently die. Anaemia and low haemoglobin concentrations had been associated with iron deficiencies. Working with J.F. Filmer in the early 1930s, Underwood showed that feeding limonite, a hydrated iron oxide compound, or liver from unaffected animals, alleviated the disease. Although the hypothesis that dietary iron cured the problem seemed credible, the iron concentration in liver and spleen from affected animals was 3—6 times higher than from healthy animals. Underwood speculated that another compound must be required for effective iron metabolism (Underwood and Filmer 1935).

Underwood proceeded with a series of extractions from limonite and found the disease was cured by two iron-free extracts, but not a high copper extract. One extract was high in chromium and aluminium and the other in zinc and nickel. Further research with zinc and nickel compounds showed a positive response in sheep to nickel oxide but not to nickel chloride. Underwood speculated that a trace contaminant in compounds used must be responsible and proceeded to include manganese and cobalt in the diets. Cobalt at concentrations as low as 0.1 mg/day cured the disease. This finding raised a conundrum because, liver but not liver ash, from unaffected animals cured the disease. Hence, Underwood presumed that cobalt must be incorporated into an organic compound to be metabolically active; a thought that was subsequently verified with the discovery of cobalamin, or vitamin B12.

This example of the logical approach Underwood took to solve Denmark Wasting Disease provides a great stimulus for creative thinking about the research process and where new advances in animal nutrition and productivity may be derived. Black (2016) concludes that advancement in productivity in any industry or human endeavour comes from new technologies. These novel technologies are commonly derived from curiosity research or research targeted to provide a major change to an industry. This paper outlines how cross species and cross discipline thinking has advanced animal nutrition science in the past and may do in the future.

Past examples

Estimates of protein requirements of growing lambs in the early 1960s ranged from 9.5 to 20% of the diet. The wide range was caused primarily by differences between experiments in the extent dietary protein was degraded in the rumen and energy content of the diets. Research over preceding years with rats had shown that utilisation of protein depended on the essential and non-essential amino acids content of the protein, energy from the diet available for metabolism and weight of rat. Findings from these rat studies led to the conclusion that protein requirements of lambs should be considered in two steps: i) requirements for amino acids of the combined animal tissues in relation to the energy available for metabolism; and ii) modification of dietary ingredients by rumen microorganisms and the resulting supply of amino acids and energy sources for absorption and metabolism (Black 1970). Consequently, my PhD research determined the protein and energy requirements of lambs by infusing complete diets into the abomasum of animals ranging from 10 to 30 kg. Subsequently, these results were incorporated into simulation models which predicted the effects of rumen microbes on amino acid and energy absorption by sheep and their utilisation for body functions including muscle and visceral growth, wool production and fat deposition. These models could then be used to identify amino acid and energy requirements for sheep under a wide range of situations and predict rates of change in growth, body composition and wool production (Graham et al. 1976).

Low nutritional status of honey bees reduces productivity and industry profitability through shorter longevity, smaller foraging distances, poorer brood rearing and increased susceptibility to disease. Commercial honey bees were introduced into Australia from Europe. Low nutritional status of bees, or the 'skinny bee syndrome', is common in Australia because of the dominant flora. Australian eucalyptus species produce large amounts of nectar, small amounts of pollen on stamens distant from the nectar and are typically fertilised by small mammals and birds. Honeybees working eucalyptus flows fly to the nectar without touching the stamen and produce large amounts of honey. However, the number of bees in colonies declines rapidly due to lack of nutrients from pollen. An artificial pollen would be valuable and, if combined with a sugar supplement, assist expansion of colonies following winter and during periods of floral dearth. However, there was little knowledge on nutrient requirements of honey bees. Consequently, a factorial
approach used for domestic livestock to assess nutrient requirements was adopted (Black 2006). The amount of each nutrient deposited in the body of bees during growth to maturity plus an estimate of endogenous losses were used to predict the protein, amino acid, fatty acid and mineral requirements. Energy requirements were calculated based on needs for metabolism, flight and brood-temperature control. The estimated requirements have been used to develop a pollen supplement (Manning 2016) and a simulation model to predict pollen and sugar needs for individual colonies (Black 2006).

**Possible future applications**

A concept could be that, through evolutionary development, a mismatch occurred between microbes optimising their growth and reproduction in the rumen and the animal optimising its performance with the nutrients supplied from the rumen. The consequence of these two partially independent evolutionary outcomes is that the supply of nutrients to the animal from feed and existence of a large microbial population in the gut is not optimised for animal productivity. An example is the production of methane, where 3—12% of the digested energy is converted to methane and lost from the animal for productive purposes. Recent research has shown methane emissions can be substantially reduced, and provide an increase in energy for animal productivity (McSweeney 2016). Methane may not be the only inefficiency for the animal resulting from microbes residing in the rumen. Evidence from monogastric species could be used to develop hypotheses about ways to improve ruminant productivity.

Ruminants are more resistant to infection following surgery than monogastric species. The heightened immune response in ruminants is likely to come at a cost to performance. Large populations of viable non-pathogenic bacteria in pig environments are known to reduce performance by at least 10% due to stimulation of the immune response (Lee et al. 2005). Pro-inflammatory cytokines stimulate the production of prostaglandin E2 (PGE2), which is largely responsible for reduction in feed intake and decreased protein synthesis causing depressed growth. PGE2 synthesis can be greatly reduced by the use of compounds like aspirin and the COX2 inhibitor, meloxicam, in diets fed to pigs. Would similar anti-inflammatory drugs improve productivity of ruminants?

Rumen microorganisms hydrogenate unsaturated dietary fatty acids and increase n6:n3 fatty acid supply to the animal. Strong evidence from monogastric species shows that high n6:n3 ratios in fatty acid consumption reduce disease resistance and performance. High n6:n3 fatty acid increases production of pro-inflammatory cytokines, stimulates the immune system and changes the function of cell membranes (Harbige 2003). These changes are associated with increased cardiovascular disease, cancer, mental disorders in humans and energy metabolism through alterations to cell sodium and calcium pumps (Ibarguren et al. 2013). Recent research has shown that feeding small quantities of poly-unsaturated natural and designed synthetic fatty acids to monogastric animals markedly changes cell membrane composition and function, with positive effects on human health. The impact on animal performance of feeding natural or synthetic n3 fatty acids protected from rumen hydrogenation may result in improved ruminant productivity.

Viral diseases have major consequences for animal production and human health. Outbreaks of Nipah, Hendra, Menangle, Lyssa, Ebola viruses and Rabies in animals and man have been traced to flying foxes, but these mammals show no clinical symptoms of the diseases. Recent research suggests that bats coexist with viruses through rapid control of viral replication resulting from major differences in the interferon, IFN-α, genes compared with other mammals (Zhou et al. 2013). Only one IFN-α gene has been identified in bats compared with 13 in humans. The three interferon regulatory factor binding molecules on this one bat gene are totally disrupted compared to human or mouse genes, which makes it unresponsive to stimulation with challenge viruses, such as Sendai virus. Could disruption of the more abundant IFN-α genes in domestic animals eliminate viral diseases?

**Conclusions**

These few examples suggest that major advances in the understanding of nutrition and improvements in animal productivity can come from transfer of knowledge across species and scientific disciplines.

**References**

Nutrition and its influence on early-life programming in animals

K.M. Brennan

Center for Animal Nutrigenomics and Applied Animal Nutrition, Alltech Inc., Nicholasville KY 40353 USA
Presenting author: Kristen Brennan KBrennan@alltech.com

Summary

Early-life programming is an area of research that seeks to discern links between gestational and post-natal environmental influences and long-term health status. Of particular interest in both animals and humans is the influence of nutrition on early-life programming. Nutritional status during gestation has been shown to potentially alter fetal development, for example, decreasing skeletal muscle mass. Nutrition during the neo-natal or post-hatch period has been shown to have long-term effects on performance, health and nutrient transporter expression. By understanding how nutrition influences early-life programming, we can develop nutritional strategies to optimize the lifetime health and performance potential of animals before they are even born.

Introduction

Early-life programming is an emerging concept that links influences during fetal and post-natal development with health later in life. Over the past few decades, these influences have begun being recognized as key factors in the risk of disorders and diseases in adulthood. Early-life programming hinges on epigenetics, the study of changes in gene expression in the absence of changes to the DNA sequence (Simmons, 2008). Gene expression differences play a key role in normal cellular processes and explain why different types of cells are able to share the same DNA sequence. The regulation of gene expression, both by “turning on” and “turning off” genes, can be achieved by DNA methylation, histone modification, or RNA silencing. One key environmental influence affecting early-life programming is nutrition. Epigenetic mechanisms provide potential insights as to how nutritional status during important developmental periods can lead to long-term health effects in offspring.

Nutrition: Fetal Programming

Perhaps the best example of the influence of maternal nutrition on the health outcome of offspring was the Dutch Hunger Winter of 1944-1945 (Ravellis, 1999). Individuals who were conceived during this period and subject to maternal under-nutrition were prone to an increased incidence of metabolic disorders. Several generations later it was found that the descendants of these individuals showed epigenetic changes to insulin-like growth factor 2 (IGF2), a key gene in human growth and development (Heijmans et al., 2008).

In livestock, maternal nutrient restriction seems to have the greatest impact on skeletal muscle development. Zhu et al. (2006) found that lambs from nutrient-restricted ewes were heavier than those from adequately fed ewes, but had increased fat and decreased muscle mass. This reduction in muscle mass was linked to a reduction in the number of myofibers during fetal development and a decrease in the activation of the mTOR signaling pathway, a key regulator of protein synthesis (Zhu et al., 2006). Underwood et al. (2010) found that cows fed poor quality diets during mid to late gestation produced calves with lower weaning weights. When these calves were followed through the feedlot period, researchers found that they had lower ADG, total weight gain, and hot carcass weights. While more research is needed to thoroughly understand the epigenetics behind these effects of maternal nutrition, it is known that maternal diet can lead to differences in fetal DNA methylation and expression of DNA methyltransferases (Lan et al., 2013; Wang et al., 2014).

Nutrition: Neo-Natal Programming

Early-life programming can also occur during the neo-natal or post-hatch period and have long-term influences on animal productivity and health. In poultry, reducing protein levels in the post-hatch diet can actually improve growth and development later in life and can increase the expression of genes involved in protein translation initiation (Everaert et al., 2010). Ashwell and Angel, 2008 found that in chickens, a low-phosphorus diet fed for 90h post-hatch resulted in increased intestinal Na/P cotransporter mRNA levels and enhanced ability for phosphorus utilization. Feeding higher levels of trace minerals during the first 96h post-hatch in chickens can increase expression of genes such as cyclin D1, which play a key role in cell cycle regulation, a biological function essential for gut mucosal growth and repair, and of nutrient transporter proteins in the small intestine (Brennan et al., 2013). Similarly, long-term growth in fish is improved when an optimal diet of zooplankton, rather than enriched rotifers, is fed during the larval and juvenile periods (Koeduk et al., 2009).

Improvements resulting from post-natal or post-hatch nutrition are not limited to changes in performance or growth. Early-life nutrition can also affect an animal’s ability to respond to immunological challenge. For example, adult dogs had more severe clinical signs of atopic dermatitis after exposure to an allergen if they had been fed probiotics during the first 6 months of life rather than a control diet (Marsella et al., 2012). Also, feeding spray-dried plasma to piglets during the first two weeks post-weaning improved immunological responses and decreased intestinal injury after exposure to S. Typhimurium later in life (Boyer et al., 2015).

Conclusion

Nutrition is a key influence in early-life programming both during fetal development and during the neo-natal or post-hatch period. While more research is needed, we are beginning to understand the epigenetic changes that are triggered by nutritional programming. Further study will allow valuable contributions to the field of animal nutrition and the use of early-life programming to improve animal production and long-term health.

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Breeding for better health and welfare in sheep – what is compromised if we do?

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Summary
Incorporating broader breeding goals into meat sheep breeding programmes such as traits that are important for health, welfare and maternal efficiency are important because they are often antagonistic to other breeding goals at a genetic level. This means that selection for higher productivity alone (e.g. lamb growth and litter size reared) can compromise animal welfare in the longer term particularly if new constraints (e.g. legislative) on farmers to control disease are introduced such as restrictions on the use of antimicrobials. Having key welfare indicators as new breeding goal traits, accurately recorded at birth and measured on animals of strategic importance in the population under selection, and under commercially-relevant rearing conditions widens the opportunity to select higher–performing sheep also with better innate ability to withstand disease in the future.

Introduction
Breeding programmes for sheep bred for meat production typically are geared towards maximising the weight of lamb reared either per hectare or per ewe, per annum. As most of our systems are largely grass-based in extensive rearing systems, unlike other livestock species, they have rarely been the subject of scrutiny from a health and welfare perspective. However as many sheep in extensive rearing conditions often graze poor quality pastures in marginal land areas, aspects of poor welfare are often overlooked, such as sub-optimal nutrition and low body condition score, exposure to climatic extremes of rainfall or temperature and high mortality rates. Also, in some sheep systems, farmers’ ability to identify and individually treat animals for diseases such as mastitis and footrot are limited by the very nature of the extensive grazing systems and lack of access to animal handling facilities in remote rangelands. With the drive to reduce reliance and use of antimicrobials and other pharmaceuticals in farmed livestock, it is logical that breeding more disease-resistant sheep will result in a ‘win-win’ scenario for both sheep and farmers alike. It will also reduce the rate of involuntary culling of ewes, thereby extending productive ewe longevity and lowering ewe replacement rate. However, older ewes tend to have higher litter sizes, which in turn have higher rates of lamb mortality and they also tend to have higher levels of footrot and mastitis. Having a lower annual ewe replacement rate by keeping an older flock age structure increases the generation interval and affects (lowers) the rate of genetic improvement possible in the flock(s). Similarly, we take it for granted that ewes will utilise their body reserves to fuel lactation for lamb growth but our research suggests that this may be at the expense of their own longevity. Such trade-offs – or compromises – that are made by flockmasters across the globe, will differ greatly according to the different sheep systems, yet all of them share the same solution to addressing them within the context of genetic selection index methodology. Combining new breeding goals for aspects of health and welfare into selection indices for sheep and weighting them appropriately, will both enable more profitable sheep farming, whilst halting the deterioration of these traits in the longer term. Four key aspects of sheep breeding systems are considered in the presentation.

Ewe Longevity
The definition of ewe longevity as a breeding goal has been the subject of previous and more recent industry-funded research to define productive longevity and to investigate the relationships with lifetime reproduction (Conington et al 2004). Ewe longevity can be considered as a relatively ‘blunt tool’ to improve ewe welfare because essentially it is the end result of ewes surviving several annual cycles of exposure to disease, tooth loss, pregnancy and parturition. It is a trait that is only expressed once in the lifetime of a ewe, and compared to other breeding goals, the economic value of improving ewe longevity is relatively low. On the positive side, ewe longevity can be automatically recorded within a performance recording scheme without relying on separate, additional recording undertaken by farmers. Our research shows that ewe longevity is under low genetic control, but for some breeds is antagonistically genetically correlated with lifetime productivity, indicating that high levels of performance leads to premature culling and lower longevity EBVs.

Disease resistance
It is usual that purebred rams are bought for use in more challenging environments compared to that of the purebred sector. Having good phenotypes on daughter disease status from these commercial flocks
is a powerful tool to generate genetic and genomic information and to reduce the impact of Genotype by Environment (GxE) interactions if that information is built into selection programmes. Detailed health screening in genetically-linked networks of purebred and commercial phenotype farms is a means to deliver a solution for endemic diseases of economic importance to the sheep industry; mastitis and footrot are examples of such diseases. The UK Texel Sheep Society is currently using this methodology to work towards the delivery of genomic breeding values (GEBV) for resistance/susceptibility to these diseases (Mucha et al., 2015). New, on-farm phenotypes for subclinical mastitis, that are cheap and easy to collect, are highly correlated with somatic cell count, both genetically and phenotypically, and routine screening has been put in place for udder and teat conformation alongside established hoof lesion phenotypes to continue selection for these traits in the future. The first genomic breeding values for such ‘hard to measure’ traits will be estimated this year in the UK.

Lamb survival

Lamb survival is the cornerstone of flock profitability and keeping lambs alive after birth is more profitable and better for welfare, rather than focussing on increasing the litter size of ewes to achieve a higher number of lambs weaned. Industry data from 4 major breeds (Scottish Blackface, Texel, Lleyn and Dorset) were used to estimate heritabilities for lamb survival as a direct trait of the lamb, which were all low (0.05-0.09) but significantly different from zero. Again, this is another ‘blunt’ tool that masks subtle differences in lambs and their behaviour that are indicative of greater ability to survive such as aspects of lamb vigour (Matheson et al 2012; Dwyer et al., 2015). As with ewe longevity, there is a large amount of information available from records currently collected within existing breeding programmes that can be used to estimate lamb survival, so there is not a requirement for additional farmer-dependent recording. Finding new proxy traits indicative of lamb survival and with higher heritabilities, measured quickly on a large number of animals in the recorded population is still needed, despite extensive research on the components of lamb survival behaviours described by Dwyer and Lawrence (2005). Survival rates differ significantly according to gender, litter size and dam age. Lamb survival and litter size born are antagonistically correlated, yet including them together in a breeding programme will enable both selection of sires and dams with higher propensity for survival without compromising greatly on genetic gain in litter size reared.

Body tissue mobilisation

Body condition score (BCS) is indicative of subcutaneous body tissue (fat and muscle) cover over the loin region of sheep (Russel et al., 1969). It reflects previous nutrition and is an indicator of future performance ability of ewes, and carcass attribute of lambs. Despite being widely accepted as a management tool, to date, BCS in ewes has not been included into sheep breeding programmes, yet it is a relatively simple measure that can be taken quickly and cheaply on a large number of animals. The genetic correlations among BCS and ultrasound fat and muscle depths measured from pre-mating through to 2nd weaning are positive and high (between 0.5 and 0.8; Anang 1995) and body tissue depletion and repletion of different fat and muscle depots, as measured by ultrasound and Computer Tomography (CT), has been shown to be under moderate genetic control (Lambe et al., 2004; 2005). The ability to mobilise body tissues is largely positively linked to offspring performance (Lambe et al 2007) and survival, but in part, antagonistically correlated to ewe longevity (unpublished results). Integrating BCS into sheep breeding programmes will enable both selection for ewes that maintain body condition throughout the year as well as supply enough milk without compromising lamb performance.

References

Is sheep meat production viable? The Spanish perspective

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Summary

Taking into account the relationship between rainfall and temperature, 64% of the Spanish territory can be classified as arid (25%) or semiarid (39%). In these areas, vegetal surface includes natural pastures and meadows (34.0%), fallows (13.4%), winter cereals for grain production (21.2%), forage crops (mainly lucerne, and winter cereals harvested as green forage; 2.6%) and woodland hills. Ruminants in these zones account for 24 million heads of which nearly 80% are sheep. In the present paper, the possibilities of integrating sheep in cropping systems are discussed, and an alternative based on the use of permanent sowed prairies (lucerne), self-sowing annuals (Wimmera ryegrass), and winter cereals (barley) will be analyzed.

Introduction

According to the Statistics Division of the Food and Agriculture Organization (FAO) of the United Nations (http://faostat3.fao.org/download/Q/QA/E), in 2014 there were 1,482,144,415 cattle (20% slaughtered for meat production), 1,209,908,142 sheep (44% slaughtered for meat production), and 1,006,785,726 goats (44% slaughtered for meat production) in the world which produced 25% of the overall meat. To this figures, Spain contributed 0.74% of the slaughtered cattle, 1.92% of the slaughtered sheep and 0.28% of the slaughtered goats, and 0.91%, 1.38% and 0.17% of the beef, sheep and goat world’s meat production, respectively. It is worth to note that, although the carcass weight for cattle slaughtered in Spain was well above that of the world’s average (261 vs. 214 kg), the opposite occurred for sheep (11.5 vs. 16.0 kg) or goats (7.4 vs. 12.3 kg), indicating that animals killed in from these two species are younger, on average, than those killed in the rest of the world. This fact, obviously, has a key role in the viability of the farms.

In line with the Emberger’s (1952) climographs, 64% of the Spanish territory can be classified as arid (25%) or semiarid (39%) (http://www.aemet.es). In these areas, vegetal surface includes natural pastures and meadows (34.0%), fallows (13.4%), winter cereals for grain production (21.2%), forage crops (mainly lucerne, and winter cereals harvested as green forage; 2.6%) and woodland hills. Ruminants in these zones account for 15.4 million heads of which more than 80% are sheep (http://www.ine.es).

In 2014, the total cost per kg of lamb meat sold (5.22 €) exceeded the retail price (3.88 €/kg), which led to a negative average net margin per ewe (-4.34 €), mainly due to the cost of concentrates (106.86 kg/ewe and 6.42 kg/kg sold lamb) which accounted for 28.6% of the total production costs (http://www.magrama.gob.es). In these conditions, the search for a cheaper source of feed seems compulsory for the survival, without subsidies, of the sheep meat sector in Spain.

Use of winter cereal crops as pasture

Of the total surface set aside for winter cereals production in the arid and semiarid zones of Spain, 92.2% is not irrigated, and barley is the cereal most cultivated for small ruminant feeding in dry areas (Droushiotis 1984; http://www.ine.es). According to Arnal (2010), it is necessary to harvest at least 2200 kg of barley grain per ha to cover productions costs, whereas average production in these areas is 1500-1800 depending on each specific zone. In those conditions, direct grazing of the crops by sheep would benefit both shepherds and crop producers.

Although grazing of barley crops in the milk-dough stage of the grain would be the best option in terms of yield and quality (Helsel and Thomas 1987), cereals harvested in this stage are usually ensiled (Hristov and McAllister 2002) for dairy cows and beef cattle feeding (Christensen 1991). However, its use for sheep feeding is not spread in the Mediterranean countries. In this area, barley crops can be used as summer pasture in the vitreous (mature) stage of the grain, or as winter/spring pasture in the vegetative stage. In the latter case, animals can either graze the barley completely or for just a few days, allowing the recovery of the crop for grain harvest.

The evaluation of mature barley as pasture for non-pregnant, non-lactating adult sheep (47 ± 1.3 kg average live weight) has been carried out by Valiente (2004) in trials with different stocking rates (60, 120 and 180 ewes/ha) during summer. The effect of supplementation with rumen-degradable nitrogen (6 g/sheep and day as sunflower meal) was also studied. Optimal stocking rates that maximized animal production (kg sheep/ha) were estimated at 83 and 71 heads/ha (average initial biomass availability of 5000 kg dry matter (DM)/ha, including heads and stems), and 20 days of grazing, for non-supplemented and supplemented animals, respectively. Average daily gain (ADG) of 99 and 105 g/sheep were reached. The lower stocking rates and the higher weight gains in supplemented animals were probably due to the fact that nitrogen supplementation increased microbial biomass, fibre degradation and hence intake (Hoover 1986). However, the higher individual ADG in supplemented sheep did not compensate for the lower stocking rate, hence the yield in terms of kg sheep/ha was lower. If no weight change is aimed, the crop could theoretically maintain 166 and 142 ewes/ha, during 20 days of grazing, in case of no supplementation or supplementation with rumen-degradable nitrogen, respectively. As a conclusion, feeding sunflower meal to non-pregnant, non-lactating adult ewes grazing mature barley seems rather useless.

Alkane-estimated DM intake was fairly constant along the grazing period for the lowest stocking rate (60 ewes/ha), where the biomass availability was not limiting, whereas it decreased with time for the highest stocking rate (180 ewes/ha), mainly during the last five days. An interesting
finding was that, when biomass availability was not limiting (60 ewes/ha), sheep tended to consume a “constant” diet (72% heads and 28% stems; alkane-estimated values). However, at higher stocking rates (180 ewes/ha) the animals were able to maintain this constancy for only the first few grazing days. Digestibility values (67%, on average, for DM) followed the same tendency.

With respect to the use of barley crops as winter/spring pasture in the vegetative stage, this practice is widely spread in the Mediterranean countries (Jones 1992). This use of the crops (only once a year) provides the animals with high-quality forage without giving up the harvest of the grain in summer. However, climatic, cultural and management aspects may affect both the production of green pasture and the amount of grain collected. Rainfall and winter temperatures are the main responsible for DM production (Jones 1992) which is also affected by sowing date, fertilization, time and intensity of grazing from seeding.

In non-irrigated lands, early sowing allows a higher DM production in winter, and higher grain production in summer, due to a better use of temperatures and rainfall by the plant in autumn. Regarding grazing conditions, the factors that most influence both forage production in winter and grain production in summer are the number and intensity of grazing periods and, overall, the time from sowing (Olmos 2006). This author found that when barley crop was grazed early in the year (February), the stocking rate that allowed the maximum yield (kg sheep/ha) was 44 ewes during 14 days, with ADG of 132 g/sheep and day. If no weight change is aimed, the crop could theoretically maintain 88 ewes/ha during 14 days, or 43 ewes/ha during 28 days.

Use of self-sowing annuals (Wimmera ryegrass) in combination with lucerne

Lucerne and Wimmera ryegrass (Lolium rigidum) are important resources of integrated sheep farming systems in many semi-arid areas of the world (Keli et al. 2013), but the main problem here is that the amount of protein reaching the abomasum when animals are fed different grass/legume mixtures (Janovick et al. 2005) is largely unknown, with most of the work having been carried out with silages and dairy animals (Mikolayunas et al. 2011). In the work by Keli et al. (2013), the proportion of nitrogen intake recovered as non-ammonia nitrogen in the duodenum increased with the proportion of grass in the diet, and was complete for a NH₃ concentration in the rumen below approximately 110 g/l (equivalent to a crude protein (CP) concentration of 100 g/kg digestible organic matter). This suggests that not only the plants’ CP concentration is important in determining the net transfer of ingested protein to the duodenum, but also its rate of degradation. Exploring ways of reducing it may be worthy, at least in the particular case of lucerne. Such an approach should not have any deleterious effect on efficiency of synthesis of microbial protein.

In conclusion, using permanent sowed prairies (lucerne), self-sowing annuals (Wimmera ryegrass), and winter cereals (barley) all year round would be an adequate feeding strategy for sheep in the arid and semiarid zones of Spain. It is estimated (http://www.magrama.gob.es) that using cereal crops as pasture, instead of the harvested grain, would reduce production costs by 15% of the meat retail price. In addition, a fertility return to the soil, estimated in 225 g organic matter and 8 g nitrogen per sheep and day, would have positive environmental implications. The lack of need of harvest and grain transport would add to these “green” considerations.

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Spanish Ministry for Agriculture, Fisheries and Food http://www.magrama.gob.es

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Systems impacts of introducing crop grazing into pasture-based systems

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Introduction

Many Australian farms involve a mixture of livestock and cropping enterprises, with considerable variability in the extent to which these two enterprises interact. Each enterprise is a ‘system’ in its own right, but the introduction of crop grazing into a previously ‘pasture-only’ grazing enterprise increases the complexity of the system, to the extent that a systems approach is probably the only route toward a better understanding of the crop-pasture grazing system.

A major component of an understanding of a system is a clear appreciation of what the system actually entails. This is certainly the case when dual-purpose crops are introduced into a grazing system. The current interest in dual-purpose crops in Australia focuses on long-season or true ‘winter’ crops, especially winter wheats, which have a marked vernalisation requirement and do not flower until this requirement has been satisfied. Such crops can thus be sown early, so that they can provide a late autumn/winter feed bank, and can then be grazed in winter and subsequently go on to provide a grain/seed crop. The lecture and full paper will discuss how grazing can be achieved with minimal effects on grain production. One must also consider the dual-purpose crop in terms of what part of the system it is replacing. For example, in the cereal-livestock zone, crops are already grown within the mixed farm and dual-purpose crops may simply replace an area that was previously grain-only crop. By contrast, in the high-rainfall zone, dual-purpose crops will more likely replace grazed pasture. This means that the grazing/grain provided by the crop must at least make up for the pasture grazing foregone during crop preparation and growth.

The full paper will also discuss the grazing of long-season brassica crops such as canola. These can be grazed in a manner analogous to dual-purpose cereals, but can also confer major system benefits. For example, introduction of dual-purpose canola provides a break crop to assist disease control in dual-purpose wheat.

Dual-purpose wheat in grazing systems

The impacts of dual-purpose wheat grazing can conveniently be discussed in terms of the effects of the grazing on the crop, and the effects on the grazing animals of the availability of crop forage.

Effect of grazing on the crop

A key component of the use of dual-purpose crops is their early sowing, so that they have time to produce a feed bank for animals by late autumn/winter. Early sowing exposes the crop to greater competition from weeds and fungal disease, which may require greater pre-emergent herbicide or fungicide use. Grazing management of the crop needs to accommodate the withholding periods for these chemicals.

One of the main concerns about the grazing of the developing crop is that grazing might jeopardise subsequent grain yield. Recent data indicate that with appropriate grazing management, this should not be a major concern. Harrison et al. (2011) reviewed the effect of grazing on grain yield and reported that grazing caused a reduction in grain yield of 7±25%. The standard error of 25% implies that in some cases, grazing resulted in an increase in grain yield. Such increases are real and arise from reduced soil-water usage by the crop in winter (due to reduction in canopy mass), which conserves soil water until the grain-ripening stage.

Another system impact of grazing on crop production is that grazing often delays flowering in the crop, such that the possible impact of frosts on grain production are minimised.

In order to achieve rapid early forage production from the early-sown crop, nitrogen supply to the crop is crucial but at the system level, nitrogen management must avoid high nitrate content in crop forage because of the possible risk of nitrite toxicity in grazing stock. This is of particular concern with canola. Nitrogen should not be applied to canola if canola grazing is imminent.

Effect of crop grazing on the animals

To accommodate the ‘winter feed gap’ which often occurs in pasture-only systems, producers must either reduce winter stocking densities or provide supplementary feed or forage. Dual-purpose wheats (and canola) can help fill this feed gap in a cost-effective way, provided they are sown early. The full paper will discuss this in relation to three key questions:

1. When should the crop be sown?
2. When should the crop be grazed, and with what?
3. What stocking rate to use and when to remove stock?

Of all these questions, the decision of when to remove stock is probably the key question in relation to minimising the effects of grazing on crop grain yield.

The forage of dual-purpose wheat is of high nutritive value for grazing livestock, but recent studies have shown that the introduction of such wheats into grazing systems will require producers to pay more attention to the mineral nutrition of livestock grazing the wheat (see Dove et al. 2016), especially in relation to magnesium and sodium. This work will be discussed in more detail in the full paper. Wheat forage is not markedly deficient in magnesium, but often has very high potassium content and very low sodium content, relative to animal requirements. The resultant high forage ratios of potassium:sodium can reduce gut absorption of magnesium (see Dove et al. 2016), and the wheat forage can also be...
considered to be frankly deficient in sodium. As a result, liveweight gain responses of at least 15-25% have been found when livestock grazing wheat are supplemented with either magnesium (MgO) or sodium (NaCl), with somewhat higher responses when both minerals are given (see Dove et al. 2016). There have not been significant liveweight gain responses to these minerals in livestock grazing barley or oats.

**Dual-purpose canola in grazing systems**

The issues which arise when grazing dual-purpose canola are generally similar to those for cereals. In the high-rainfall zone, early-sown winter canola varieties can provide feed of high nutritive value, with high forage yield and little impact of grazing on seed production. Measurements of diet selection and intake in sheep grazing canola have shown that, contrary to frequent producer perceptions, animals spend >85% of their time grazing the canola, which constitutes >85% of their total DM intake.

In relation to mineral supplementation of sheep grazing canola, magnesium/sodium supplementation is not required and may even be contra-indicated. This will be discussed in more detail in the full paper.

**Further impacts of dual-purpose crops in the whole-farm system**

Dual-purpose crops such as long-season wheat or canola can be grazed separately or in sequence, and provided stock are removed before critical growth stages, these crops can be grazed more than once in a season. If the crops are managed so as to minimise reductions in grain yield arising from grazing, increased profits can accrue. However, there are even greater benefits for the whole-farm system, resulting from complementarities between the cereal and the canola, and from the spelling of pasture which occurs in winter, when livestock are grazing the crops. Dove and Kirkegaard (2014) identified the following benefits, which will be discussed in detail in the full paper.

**Impact on crop disease**

Early-sown winter wheat is at greater risk of wheat-streak mosaic virus (WSMV), which can severely reduce yields. Producer perception was that this was due to the virus being spread by grazing. However, the increased WSMV infection is actually related more to crop/weed hygiene over the previous summer. As part of the whole cropping/grazing system, producers in areas prone to WSMV will have to pay more attention to crop/weed hygiene, or must consider sowing the wheat after canola; both approaches can avoid or greatly reduce the virus problem. At the systems level, the dual-purpose canola thus not only provides useful winter forage in its own right, but it also functions as a break crop to reduce the chance of WSMV infection in a subsequent wheat crop.

Canola itself is at risk of the fungal disease ‘blackleg’. Using canola as a grazing resource can increase the severity of blackleg infection, but much less so in canola cultivars which are blackleg resistant. A cropping/grazing system involving canola should thus be based on canola cultivars which are already highly resistant to blackleg.

**Weed management**

Producers have recognised that the incorporation of dual-purpose crops into a grazing system can be a key component of an integrated weed management system on-farm. However, this aspect has not been given the research attention it deserves. Examples of the impact of crop grazing on whole-farm weed management will be discussed. In general, careful attention to the management of weeds in dual-purpose crops will be needed to ensure that weed infestations do not arise from the introduction of crops into the grazing system. Rather, the aim should be to use the cropping phase as part of the whole-farm weed management plan.

**Pasture spelling**

When livestock are removed from pasture to graze one or more crops as part of winter pasture management, the pastures are ‘spelled’ and theoretically should provide increased pasture production in late winter. This is especially the case if different crops are grazed in sequence, and/or grazed more than once. Under these circumstances, the livestock may be off pasture for an extended period. Dove and Kirkegaard (2014) showed that, relative to pasture grazing only, the grazing of a single crop (either wheat or canola) could provide 800-1200 extra sheep grazing days, while the grazing of both crops in sequence provided over 2000 extra sheep grazing days. However, taking the crop and pasture components together, the grazing of crops resulted in about 1600 (one crop) or 3500 (both crops grazed) extra sheep grazing days. Hence, of the total extra sheep grazing days accruing from the introduction of crops into the grazing system, no less than 30-40% of the benefit arose from the extra pasture which accumulated during crop grazing. Further work is needed with other pasture-based systems and with cattle grazing, to fully quantify the ‘pasture-spelling’ benefits arising from the used of grazed crops.

**Crop residue management**

Since grazing usually delays crop flowering and thus grain harvest, and since an early sowing is required to make best use of dual-purpose crops in the following year, there is a limited period in which to utilise/dispose of crop residues. There is a need for much more research on this aspect, to optimise crop utilisation in grazing systems.

**Increased farm carrying capacity**

The extra grazing provided by crop grazing and by pasture spelled during crop grazing means that winter carrying capacities can be increased. Such increases, while real, will decline once the winter stocking rate exceeds that which can be maintained over summer. This is a major issue for the design and management of pasture/crop grazing systems, and much more work needs done in this area. The modelling of grazing systems would seem an ideal approach to explore this aspect, and extend it to other systems and regions.

**References**


Precision Animal Breeding as a Sustainable, non-GMO Solution for Improving Animal Production and Welfare

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Summary

Although dehorning and castration are recognized as requisite practices in modern livestock systems, producers would like to avoid animal welfare issues that arise from current management methods. Increased criticism and scrutiny of both producers and the food industry emanates from a growing number of concerned citizens and NGOs with animal rights/animal welfare agendas. The optimal and simple solution for dehorning cattle is to breed for polled animals, but crossbreeding devalues animals when considering the cost of recovery to re-establish elite performance for production. Similarly, solutions for genetic castration would seem impractical due to obstacles for propagating sterile lines. In this study, we report the efficacy of precision cross-breeding, also known as gene-editing, as a means for elimination of dehorning and surgical castration.

Introduction

Since the first livestock domestication events approximately 10,000 years ago, the efficiency of animal production in the developed world has continued to improve through selection for desirable traits related to protein yield. More recent advances in animal breeding theory (i.e. genomics), advanced reproductive technology, housing, feed and forages, and vaccine and drug treatments have allowed for intensification of production. However, none of these husbandry tools directly addresses some of the most common yet controversial management practices of livestock production, dehorning and surgical castration.

In the United States, an estimated 80% of all dairy calves (7.2 million per year) and 25% (7.5 million animals) of beef cattle are physically dehorned every year (Bouie 2002) to protect animals and producers from accidental injury. Because animal advocacy groups have campaigned for mandated anesthesia during dehorning or complete cessation, global corporate food retailers have prioritized use of humane management alternatives to dehorning in their animal welfare policies (Swanson 2015).

Solutions based on animal breeding are intuitively the most likely method to solve this problem; however, full implementation is hampered by generation interval times, economic feasibility and practicality for low input production systems. For example, the use of existing polled dairy genetics carries a substantial value difference of $252 USD per lactation cycle between horned and polled dairy cows (Spurlock et al., 2013) while taking >20 years of classic breeding to reach a frequency of 50% polled animals (Dorshurst 2015).

Like dehorning, surgical castration has been practiced for centuries in swine production; now affecting hundreds of millions animals annually. The main purposes are to reduce aggressive behaviour of males and remove ‘boar taint’ from pork. Research has proven that castration inflicts pain, even on very young pigs under anaesthesia or analesgesia. Recently, European swine industry leaders voluntarily signed a declaration to abandon all forms of surgical castration by Jan., 2018. DNA-based selection tools have been used to reduce boar taint genetics down to between 0-13% across populations, but this reduction appears associated with reduced libido. Alternatives, like vaccinations against boar taint, possibly have negative effects on carcass yield (Aluwe et al., 2015).

Based on the welfare issues surrounding both dehorning and castration, we set out to demonstrate that advanced breeding techniques, like non-meiotic allele introgression (Tan et al., 2013), offer an alternative non-GMO method for rapid genetic change in a single generation. Furthermore, we show these methods are precise, sustainable, and directly applicable to improved animal well-being.

Materials and Methods

Experimental procedures involving animals were done according to established standard procedures and protocols approved by Integra, MOFA and Trans Ova’s Institutional Animal Care and Use Committees.

Bovine fibroblasts derived from crossbred dairy bull calves were used for somatic cell nuclear transfer (SCNT) and genome analysis as previously described (Tan, 2013). All methods to create and identify properly edited clonal cells, other than HP -24.8 (Carlson, et al., 2016), were described previously (Tan, 2013). Individual colonies were evaluated for introgression of the Pc (polled locus of Celtic origin). Nuclear and embryo transfers were done by Trans Ova Genetics (Sioux Center, IA). Genetic analysis of cloned offspring for both the Pc locus and genome-wide off-target editing events are described Carlson and colleagues (2016). Skull palpations were done by a non-blinded licensed veterinarian at birth, 3, 6 and 10 months of age.

All porcine studies were done at Minitube of America (Verona, WI). Porcine somatic cells and TALen gene knock-out (KO) techniques used for SCNT of gene edited cell lines were previously described (Carlson, 2012). The TALen for genetic castration was designed to break the KISSR gene in the third exon. Individual colonies were propagated and evaluated for KISSR KO as previously reported (Tan 2013).

Puberty induction studies was set up with three groups of KISSR KO cloned male pigs (each N=4): 1) control/sham injected, 2) FSH/slow release treatment and 3) GnRH treatment. FSH was administered using Pluset H, which
includes 52.5 IU of FSH and 17.5 IU of LH per mL. Doses were given as intramuscular injections (i.m.) with a mixture of 150-225 IU of Folitropin to slow release formulation and reduce treatment to a dose every 2d. GnRH treatment consisted of i.m. injections of Cystorelin at 50 ug/injection daily for 4 wks, 2 times/d for 4 wks, and then 4 times/d for 4 wks. The GnRH protocol was not expected to induce puberty; but testosterone, LH, and FSH levels could be determined, to support future testing of hormone treatments. All animals were euthanized humanely for subsequent histology and gene expression studies.

Results and Discussion

For the genetic dehorning, five clonal cell lines with the correct 212 bp insertion/10 bp deletion to replicate the Pc allele were identified after TALEn editing of fibroblasts from two “horned” male animals. After seven rounds of SCNT, 26 of the 70 surviving blastocysts were placed into recipients to yield five live polled animals. Three of these animals were humanely euthanized shortly after birth due to known complications from cloning. The polled phenotype was also confirmed in the remaining two homozygous polled animals at 3, 6 and 10 m of age. These yearling bulls are at UC-Davis for further evaluation of unintended effects from the gene editing process. However, diagnostic sequencing of Pc and whole genome sequence comparison between the two parental cell lines and representative cloned animals revealed no unintended changes caused by the editing process.

Our results appear to provide the first empirical validation of a putative causative allele in livestock, which in this case is a sequence variant duplication in a genomic region with no known function or predicted coding or noncoding genes. The polled bulls created by precision crossbreeding demonstrate that introgression of Pc into elite animals could eliminate the need for dehorning. This solution would be more economically viable than traditional crossbreeding; and if implemented across the industry, should improve the welfare of cattle globally.

For genetic castration of swine, a single edited cell line (KISSR -/-) derived from a White Composite male pig was used for SCNT. Blastocysts were transferred into three recipients, which resulted in two successful pregnancies yielding 19 piglets (2 stillborn). The 17 remaining animals were raised to 200-225 lbs. The KISSR KO edit was diagnosed as a lack of testicular development. The animals looked and acted (low aggression) like barrows in good health, and were phenocopies of humans with hypogonadotropic hypogonadism.

We attempted to initiate testicular development in these pigs using hormone therapy as a potential method to rescue reproductive competency (Fig. 1). The hormone treated testes increased mass and structural histology strongly supported the potential for recovery of sperm production with a more efficacious treatment even though sperm were not detected in any group. Current studies are underway to compare growth efficiencies between normal, castrated, and KISSR KO pigs. These results are needed to validate the market value of genetic castration.

Genetic improvement of livestock using precision crossbreeding (genome-editing methods), establishes an alternative to GMO-based (transgenic) methods for genetic improvement of livestock. Making these changes using natural occurring alleles would be consistent with non-GMO breeding principles and would provide rapid change without admixture-derived devaluation common to traditional crossbreeding. Furthermore, we demonstrated genome editing can be used to benefit animal health and welfare by eliminating stressful management practices in a single generation.

Figure 1. Comparison of testes mass between control and hormone treated pigs with KISSR knock-out.

Acknowledgement

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References


ASAP Animal Production 2016, Adelaide
Translating animal welfare science into animal care standards

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Summary

Public policy for farm animal welfare is continuously evolving through science-based standards and codes of practice. Developing science-based standards is complex because scientific assessment of animal welfare involves multiple measures that capture different viewpoints on what constitutes a good quality of life for animals. Standards for space requirements, for example, can be based on measures of biological function, such as production performance, mortality or stress response or they can be based on the amount of space required to accommodate physical body size or activity patterns. Setting standards for different housing systems is even more difficult because of wide variations across systems and because different measures often lead to different conclusions about the welfare of animal in those systems. Systems that offer greater freedom of movement also generally increase risks for injury, disease and mortality. Future science-based standards for specific aspects of system designs will be important for mitigating these problems.

Introduction

Public policy for the care of farm animals is continuously evolving in the form of nationally- or internationally-developed animal welfare standards, codes of practice and animal care guidelines. Most public standards for farm animals are based on a foundation of scientific information about the effect of housing and management practices on well-being in order to define ethically acceptable levels of animal welfare on farms (Mellor, 2014). However, developing science- or evidence-based standards is a complex venture. The scientific assessment of animal welfare involves multiple measures that capture different viewpoints on what constitutes a good quality of life for animals including measures of health and biological fitness, the emotional or subjective experiences of animals and aspects of their natural lives (Fraser, 2008). Moreover, conceptual frameworks for animal welfare have also evolved considerably. Previously the focus was mainly on identification and alleviation of negative welfare states, but more contemporary frameworks increasingly emphasize the promotion of positive ones (Mellor and Beausoleil, 2015). Thus, different scientific measures of animal welfare can lead to different conclusions about where a standard should be set. Additionally, scientific data concerning other factors such as economic and environmental sustainability may be important (Thornber, 2010). This paper addresses how different types of scientific measures can be used to inform decision-making for animal welfare standards and how values of the broader community play an increasing role in determining which types of scientific measures are used.

Scientific measures used for determining space requirements

The setting of recommended or required space allowances for farm animals would seem to be relatively straightforward. Space requirements for farm animals kept in confinement systems can be derived empirically from measures of biological function, such as production performance, mortality or stress response, and these measures also have economic implications for producers. However, consumers and members of the broader community are demanding that more value be placed on behavioural opportunities for animals (Swanson et al 2011), and thus the minimum space allowances can alternatively be based on sufficient room to accommodate physical body size in different postures, basic movement for changing body postures (e.g. turning around or moving from lying to standing) or the minimum amount of space needed to engage in simple activity patterns such as locomotion. These values can also be derived empirically. In most cases the different sets of measures do not align. For example, Gonyou et al (2006) estimated a threshold for space allowance of pigs at different body weights using a broken line analysis on data from 21 studies on the average daily gain of nursery and growing pigs. Below this threshold the growth rates of pigs were compromised. Alverós et al (2010) used a meta-analytical approach to determine the threshold space allowance for growing pigs to all lie down at the same time. Their values indicated that ability to rest was compromised at a higher threshold of space allowance than that affecting production performance. For group housed sows, indicators of stress together with levels of aggression and injury are generally used for determining space allowance (Hemsworth et al 2015).

Different measures have also been used to determine the minimum space requirements for laying hens (Widowski, et al 2016). For hens housed in cages, space allowances below the range of 432 cm² to 554 cm² per hen generally result in reduced egg production, higher levels of stress response and increased mortality. At or just above the upper end of this range, egg production and stress response may not be affected but feather condition, foot health, keel deformities may be poorer compared to hens given more space. Many basic body postures and activities, however, require a larger space envelope. For example, the amount of space required for standing, turning and wing flapping was determined from kinematic analyses to be 475, 1272 and 1876 cm², respectively, for medium hybrid birds (Dawkins and Hardie, 1989) and 563,
1316, and 1693 cm² for light hybrids (Mench and Blatchford, 2014).

Determining space allowance based on behaviour is complicated by the fact that at any given space allowance, increasing group size alters the dynamics of space use resulting in changes in the amount of space afforded to individual hens (Appleby, 2004). First, the total amount of space increases thereby affording more overall area for locomotion. Additionally, the amount of free space available to individual birds increases at different times of day, as hens cluster together when performing some types of behaviour. This results in higher densities in some areas while leaving other areas largely unoccupied. For intermediate group sizes, for example those in enriched colony cages, theoretical models have indicated that individual space allowance required for hens to perform some behaviours (i.e. wing-flapping) decreases as group size increases. In non-cage systems where groups sizes are in the thousands, it is much more difficult to determine individual space requirements for birds as spatial distribution around resources such as feeders, perches, nests or litter areas varies considerably over the day. System design, as it effects distribution of birds has a greater effect on measures of bird welfare than individual space allowance.

**Scientific measures used for setting standards on housing systems**

For laying hens, a large body of scientific evidence on the effects of housing system on welfare has been gathered from a combination of focused laboratory studies to large field trials on commercial farms (see Lay et al, 2011; Widowski et al, 2013). Scientific approaches range from measuring hen preferences and motivation to perform specific behaviours to assessing health, mortality, and indicators of stress response. Comparisons of the effects of different housing systems on animal welfare are extremely complex because of wide variations across systems. Often specific designs and management within systems have greater effects on welfare than difference between systems.

There is general consensus in the literature that all housing systems have both costs and benefits for hen welfare (Widowski et al, 2013). Laboratory studies indicate that hens are highly motivated to perform nesting, perching, foraging and dust bathing. These behaviour patterns are significantly constrained in conventional cages, and generally well-supported in non-cage and free-range systems. However, the risks for infectious diseases, parasites, injuries and bone fractures are significantly greater in non-cage and free-range systems. The general trend in the literature is that risks for higher mortality increase in the order of cages (conventional and furnished), indoor non-cage systems and free-range systems. A recent study using data from over 3500 commercial flocks in the European Union confirmed these previous reports and also calculated considerable costs in terms of environmental sustainability resulting from these high levels of mortality (Weeks et al, 2016).

Furnished cages and the larger enriched colony cages fitted with nests, perches and scratch mats do appear to maintain the health and hygiene benefits of conventional cages while supporting the expression of some of the hens’ motivated behaviour patterns. Furnished cages have also been shown to have less environmental impact and lower dust and ammonia emissions than non-cage systems (Shepherd et al 2015). However, public perception is driving private sector decisions to require cage free housing for laying hens. To date, there have been few standards developed for specific design features of non-cage and free-range systems (e.g. perch design, ramps and ladders for reducing falls and injury) but new data are emerging. Future science-based standards for specific aspects of system designs will be important for mitigating welfare problems in non-cage and free-range systems. Whether significant improvements can also be made in terms of economic and environmental sustainability is yet to be determined.

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**References**


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The impact of forage availability on livestock behaviour in Australian heterogeneous paddocks

Miss Jaime Manning
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Cattle are selective grazers that actively search their landscape (forage) and selectively graze certain pasture species, especially in heterogeneous (non-uniform) paddocks commonly found in Australian extensive production systems. A variety of pasture (sugar, protein, fibre content etc.) and paddock (elevation, distance to water, temperature etc.) variables influence where cattle select and graze. By understanding the drivers of livestock foraging and fodder preferences, we have the potential to improve the way we monitor and manage livestock, such as through better paddock rotation. Further, with increasing concerns from consumer groups over the welfare of livestock in extensive systems, the ability to monitor livestock remotely using Global Navigation Satellite System (GNSS) technology will enable us to increase the level of monitoring and animal welfare, whilst coincidently gaining information at a paddock level about pasture availability and quality, which should contribute to increased efficiency of livestock production.

Are pre- and post-grazing measurements of nutritive characteristics appropriate for defining what a cow actually consumes?

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The pasture mass and nutritive characteristics data from a three-year grazing management experiment on tall fescue in northern Victoria was used to estimate the nutritive characteristics of the pasture that was actually consumed by the dairy cows, rather than what was on offer by the pasture. Analysis of the estimated metabolisable energy and crude protein concentrations of the consumed pasture revealed that there were many unrealistic values, even when treatment means, rather than individual plots values, were used. When the data was divided into categories based upon the amount of consumed pasture at individual grazings, it was found that most of the occasions with unrealistically high values were associated with grazings in which <0.5 t DM/ha was consumed. This suggests the methodology is not appropriate for determining the nutritive characteristics of consumed pasture in situations when the amount of pasture consumed at any individual grazing is low.

Teat sealant lowers milk somatic cell count

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A total of 2200 dairy cows had all 4 quarters treated with antibiotic dry cow therapy (ADCT) alone or in combination with internal teat sealant (ADCT + TS) at dry-off. Individual milk yield, fat and protein percentage, and individual cow cell count (ICCC) were measured at 14 ± 3 day intervals after calving for the first 60 days in milk (DIM). Clinical mastitis and health events were recorded from dry-off to 60 DIM. The combination of ADCT + TS decreased ICCC, compared to ADCT alone. The odds of at least 1 case of subclinical mastitis (ICCC ≥ 250,000 cells/mL) were 1.9 times higher [95% confidence interval (CI): 1.4 to 2.6] with ADCT alone in the first 60 DIM, compared to ADCT + TS. The combination of ADCT and TS provides benefits over ADCT alone through improved prevention of subclinical mastitis and reduced ICCC in the first 60 DIM.
Novel livestock supplementation: reducing shy feeders

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Mobile feed bin trailers that enable control and monitoring of the maximum daily supplement intake by individual grazing cattle have been developed. Data from four trailers can be integrated via wireless to manage larger mobs within a paddock. Compared to using conventional feed bins and multiple recorded live weights, shy feeders can be removed to different management regimes quickly after supplement introduction. Animals cannot gorge on supplement, so deaths are less likely. Management groups can be fed differently without the need for drafting. Animals’ live weights can be used to remotely adjust individual maximum daily intakes to achieve targeted growth paths and faster finishing. Twice as many grazing heifers at ‘Te Mania’, with access to 2 Sapien trailers and 2 Greenfeed bins, ate supplement from the trailers. Of those heifers accessing both bin types, the proportion of their maximum daily allowance consumed was 3 times higher via the trailers.

Liveweight gain, dry matter intake, hip height change, cortical bone thickness and phosphorus in the plasma and faeces of Bos indicus crossbred steers all increase in response to increasing phosphorus intake

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Thirty Bos indicus crossbred steers were fed a diet representative of early wet season pastures in northern Australia [110 g crude protein (CP), 9.3 MJ metabolisable energy (ME)/kg DM] with increasing phosphorus (P) content (0.9, 1.3, 1.8, 2.0 and 2.4 g P/kg DM) for 172 days. All steers were then offered a diet containing 110 g CP, 9.3 MJ ME and 2.4 g P/kg DM for an additional 84 days after which they were slaughtered. Liveweight (LW) gain (LWG), dry matter intake (DMI), hip height (HH) change, cortical bone thickness (CBT) and the concentration of P in the plasma (PiP) and faeces (FecP) all increased in a linear fashion with increasing P intake (P<0.001). Steers that were deficient in P responded to a high P diet with increased LWG and HH change but their carcasses were lighter and leaner at slaughter than steers that received adequate P throughout the experiment.

Development of village-based forage seed enterprises through farmer participatory research approach by varietal selection and evaluation

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A field study was conducted on Berseem clover (Trifolium alexandrinum L.) crop at smallholder farmer’s fields in Pakistan during 2012-13 and 2013-14 to evaluate the performance of research station (RS) improved variety against conventionally used farmer (FS) and market (MS) seed sources through farmer participatory research approach. Significant differences (P < 0.05) among seed sources were recorded for forage and seed yields, and forage quality parameters across all the research sites. The RS proved to be the best seed source amongst tested, produced highest green forage (89.65 t/ha), dry matter (13.37 t/ha) seed yields (580 kg/ha). The three forage cuts (65, 110 and 150 days after sowing) prior to seed harvest was found the best harvesting regimen; produced maximum forage and seed yields of better quality of all seed sources across all research sites.
**1037  Optimising non-invasive cortisol measurement in sheep (Ovis aries)**

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J. Scherpenhuizen[1], J. Quinn[1,2], E. Narayan[1,2]  

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Faecal glucocorticoid metabolite analysis provides a robust non-invasive tool for assessing baseline and acute stress responses of livestock in relation to environmental stressors. In this research project, we quantified faecal cortisol metabolites (FCMs) in sheep using a broad-spectrum polyclonal antibody enzyme-immunoassay. We quantified the underlying variation in FCMs levels in sheep grazing a "toxic pasture" (Biserrula pelecinus) known to cause primary photosensitization (PS)-skin inflammation. Sheep ingesting B. pelecinus had significantly higher FCM levels than controls suggesting a physiological stress response. In conclusion, non-invasive FCM EIA can be applied to assess physiological stress in sheep on farms to assist in addressing health and welfare concerns.

**1049  Effects of diet containing raw, full-fat soybean meal and supplemented with high-impact protease for broilers on relative weight of pancreas**

Mr Mammo Erdaw  
leulmammo@yahoo.com  

Mammo M. Erdaw [1,3], Rider A. Perez-Maldonado [2], M.M. Bhuiyan [1] and Paul A. Iji [1]  

[1] School of Environmental and Rural Sciences, University of New England, Australia;  

A 3 x 3 factorial study was used, with 3 levels of raw soybean meal (RSBM) (0, 10 or 20 %) and 3 levels of mono-component of protease (0, 200 or 300 mg/kg). Each treatment was replicated six times with nine birds per replicate and housed in cages of environmentally controlled room. Birds fed on starter, grower and finisher diets. Analysed values of trypsin inhibitors were 13098.0 TIU/g in RSBM and ranged from 1730.5 to 9913.2 TIU/g, in diets after mixed with varied levels of RSBM. Because of RSBM, weight of pancreas was increased (p0.05) difference in BWG and FCR, in 1-35 d. A high pancreatic hypertrophy was observed, but had no impacts on broilers performance and it could be helped by supplements of protease.

**1052  Reducing rumen starch fermentation of wheat with 3% NaOH has the potential to ameliorate the effect of heat stress in grain-fed sheep.**

Miss Paula Alejandra Gonzalez-Rivas  
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Thirty-one Merino x Poll Dorset wethers were housed in two climate-controlled rooms and were fed either corn (CD), wheat (WD) or 3% NaOH treated whole wheat grain (TWD) plus forage during three experimental periods: P1) 7 d of thermoneutral conditions and 1.8 times maintenance intake; P2) 7 d of heat stress (HS) and 1.8 times maintenance intake; and P3) 7 d of HS and 2 times maintenance intake. Rectal temperature (RT), respiration rate (RR) and skin flank temperature (FT) were measured. All physiological parameters were elevated during HS, especially during P3. Sheep fed CD had lower RR and RT than WD and TWD especially during HS. Sheep fed TWD had lower RR and RT than WD. FT was higher for WD, while no differences were observed between CD and WTD. These data confirm that reducing the rate of fermentation with TWD improves tolerance to heat stress in grain-fed sheep.
Characterization of in vitro rumen fermentation parameters of 3% NaOH treated wheat grain.

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The fermentation and pH kinetics of ground corn, wheat and 3% NaOH treated wheat grains were quantified using an in vitro gas production system containing buffered rumen fluid incubated at 39 °C for 24 h. The rate of gas production of 3% NaOH treated wheat was 23% slower than of wheat and 7% slower than of corn which in turn had 18% slower rate of gas production than wheat. Corn grain had the lowest maximum gas production at 24 h while there was no difference between wheat and 3% NaOH treated wheat grain. The pH of wheat grain was the lowest and pH of 3% NaOH treated wheat the highest during the incubation. This experiment confirmed the lower starch fermentability of corn and demonstrated that the rate of rumen fermentation of wheat can be reduced with 3% NaOH treatment with protective effect on in vitro rumen pH.

Rumen bolus is a useful tool to monitor body core temperature as affected by ambient temperature in lactating dairy cows in a sub-tropical summer.

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Twenty four Holstein Friesian lactating dairy cows were fed either a TMR-Wheat (TMRW), TMR-Bioprotect (TMRB) or TMR-Corn (TMRC) diet in shaded pens during summer 2015 in Queensland. Rumen temperature (RuT) was recorded during 15 days and rectal temperature (RT) was measured every four days. THI was calculated from data obtained from an on-site weather station. RT was lower for TMRC fed cows than for TMRW and TMRB and was directly correlated to THI and RuT in most of the diets. Diet had no significant effect on RuT and cows had important variations in RuT during the day not associated to THI. There was a positive association between the RuT and THI during the experiment. These data demonstrate the variation of RuT according to the daily THI and the positive association between RT and RuT. Therefore, RuT enables a sensitive prediction of body core temperature variation at high ambient temperature.

Feed-base strategies that reduce risk of feed-gaps in livestock systems across Australia’s mixed farming zone

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Australia’s highly variable climate means there is large variability in the supply of forage for livestock. Mixed farmers can utilise a range of feed sources on their farms to help mitigate the risks associated with this climate variability and to maximise their livestock production. Using a simulation models monthly whole-farm energy balance was calculated from the supply of energy from diverse forage options and the energy demand from a typical livestock enterprise in 6 locations across Australia’s mixed farming zone. Diversifying the feedbase to include combinations of forage sources provided the capacity to increase stocking rate significantly at the same time as reducing or maintaining the risk of feedgaps occurring on mixed farms. This demonstrates that there is significant potential to build forage-based feed systems that overcome critical feed gap periods and their-by mitigate the risks of increasing farm stocking rates required to improve the total productivity from livestock systems.
The profitability of forage options for beef production in the subtropics of northern Australia

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Forage biomass production, diet quality, cattle liveweight (LW) gain, and economic performance were measured for 6 forage types across 21 sites on 12 commercial beef cattle properties in the Fitzroy River catchment of Queensland during 2011-2014 (28 annual data sets in total). Sown perennial legume-grass or annual forages resulted in 1.2-2.6 times the annual cattle LW gain per ha than perennial grass pastures. However, there was no correlation between annual cattle LW gain per ha and gross margin. Furthermore, neither forage establishment and management costs nor cattle price margin (sale price less purchase price, $/kg LW) were correlated with gross margin. The average gross margins were higher for legume-grass pastures than for annual forage crops or perennial grass pastures. This was the result of the combined effects of lower average forage costs and high cattle productivity.

Quantifying the scale of livestock yield gaps in India and identifying opportunities for investment

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Yield gap analyses compare actual and potential yields and are used to provide insights into where and how agricultural production can be increased. Yield gaps are often reported for crops, but are seldom used for mixed crop and livestock production systems. Using dairy production in India as a case study, we combined two different methods (analysis of reported yields and household modelling) to estimate the scale of livestock yield gaps and to identify opportunities to increase production. The biggest increase in milk production and profits came from combining improved livestock genetics with better nutrition. This information can be used by government and development agencies to define reasonable production targets and intervention strategies.

Supplementation of zinc-proteinate on serum biochemical parameters, antioxidant status, immune response and ovarian follicles in buffalo heifers

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Eighteen graded Murrah buffalo heifers were randomly allotted to 3 dietary groups to study the effect of organic Zn (Zn proteinate; Zn-prot) supplementation (80 or 140 ppm) compared to inorganic Zn (ZnSO4) (140ppm) on serum biochemical parameters, antioxidant status and ovarian follicles. Highest (P<0.01) serum Zn was observed with 140 ppm Zn as Zn-prot and concentration was comparable between 80 ppm Zn as Zn-prot and 140 ppm Zn as ZnSO4. Alkaline phosphatase, total protein, globulin, and glucose concentrations in serum, RBC catalase, glutathione peroxidase activities in haemolysate increased (P<0.05) and lipid peroxidation lowered (P<0.01) with organic Zn. Antibody titers against antigens, DTH response and number of large follicles with greater size in ovaries increased (P<0.05) with Zn-prot. To conclude, 140 ppm Zn supplementation as Zn-prot resulted in better antioxidant status, immune response and ovarian folliculogenesis than from ZnSO4 and dose could be reduced from 140 to 80 ppm with Zn-proteinate.
Being born a twin does not reduce pregnancy rates in 15-month-old heifers

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Twin and single born heifers in a commercial herd, grading up to US Meat Animal Research Center Twinner genetics have been mated as heifers. Twin born heifers were as fertile as single born animals, confirming that by 15 months of age they had grown and matured to be equivalent to the singles.

The Nutritive Value and Eating Quality of Australian lamb cuts

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This paper describes work that is being undertaken to provide an information resource regarding large lamb cuts in terms of eating and nutritional qualities, estimated weights and the contribution to total yield, and best cooking methods. Furthermore, efforts to identify potential novel cuts with applicability to large lamb carcases is being undertaken using information from lamb and other animal species within Australian and international markets.

Metabolome and microbiome associations after a grain and sugar challenge

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Associations between the metabolome and microbiome were investigated in a grain and fructose challenge using dairy heifers fed feed additives. Forty Holstein heifers allocated to 5 groups: (1) control (no additives); (2) virginiamycin; (3) monensin + tylosin; (4) monensin + yeast; and (5) sodium bicarbonate + magnesium oxide were fed a total mixed ration and respective feed additives for 20 days (d). Co-inertial analysis explained 31.9% of the total variation in the associations among rumen fermentation products, bacterial community composition, and groups using rumen samples collected 3.6 hrs after heifers were challenged with a ration of wheat and fructose on day 21. Histamine and valerate concentrations explained the most variation in the microbiome. The feed additives appeared to influence different microbial populations after the challenge.
A probe for measuring GR in lamb carcases

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A dual function GR/Impedance probe was tested to determine its potential to accurately measure the GR tissue depth of 1016 lamb carcases measured over 4 days as they entered the chillers approximately 25 - 35 min after slaughter. Carcase weight, palpated fat score, GR depth measured with a GR knife and probe operator were also recorded. Overall, there was a limited ability (R2 = 0.19) to measure GR tissue depth using the dual function probe, although this did vary with measurement days and operator. Despite the low predictions found, this study did highlight several improvements which could be made to the current probe, including reducing its size and weight, which would improve the accuracy of measurements.

The effect of weight and age on pregnancy rates in maiden Brahman heifers in northern Australia.

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Relationships between pre-mating weight and pregnancy rate were established for Brahman heifers mated as yearlings grazing on improved pasture in the Douglas Daly region (4 year groups of about 100 per year), and as 2 year olds grazing on native pasture in the Victoria River District (3 year groups of about 100 per year) where pre-mating weight was recorded in either late October/early November, or in late December. The relationships for these 3 situations were different indicating that there is an interaction between age and weight that modifies the effect of weight on pregnancy rates. These relationships were used to model pregnancy rates that are likely to result from different pre-mating weights for these 3 scenarios. These estimates can be used to identify target mating weights for different situations, and to predict the pregnancy rates likely from groups of heifers when budgeting and assessing the profitability of different management strategies.

Animal welfare priorities for the Australian dairy industry

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The National Dairy Industry Animal Welfare Strategy was developed in 2004 and is supported by the whole dairy supply chain (farmers and processors). The strategy vision is that every dairy animal is well cared for. The five priority areas are: calf management, tail docking, calving induction, disbudding and lameness management. Pain management, heat stress mitigation, management of down cows and euthanasia of livestock are also being actively addressed by industry. The delivery of this strategy involves research, extension/education, evaluation and review. Providers include animal welfare research scientists, veterinarians and consultants, the National Centre for Dairy Education (NCDE), the Dairy Australia Regional Development Programs and partnerships with government extension services. Research currently underway is addressing the impact of farm scale on welfare outcomes, refining pre-weaning calf management practices, remote sensing of lameness and developing genomic markers for heat stress tolerance and health traits.
Influence of integration of dual-purpose wheat and canola crops in a pasture system on liveweight of Merino sheep

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Benefits and risks of incorporating dual purpose crops (DPC, namely wheat and canola) in the pasture feedbase system is being evaluated on the NSW Tablelands. The 4-year study consists of 3 treatments: pasture only (Control) and pasture with DPC grazed by either Merino ewes (ECG) or weaners (WCG). Replicated treatments occupy six plots (0.23 ha each). DPC in ECG and WCG are rotated within four plots. Crops are sown in early autumn and grazed in winter. We report treatment effects on liveweight (LW) of breeding ewes and their weaners during the first three years of the study (2013−2015). The 2014 season was favourable, with no treatment differences in sheep LW. In contrast, 2013 and 2015 were poor or intermediate seasons. In these two years, ECG ewes and WCG weaners were heavier (P<0.05) than their counterparts with partial or no access to DPC. DPC effectively fill the winter feed gap.

Does dam age effect gene expression in fetal and young sheep?

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Young dams provide a constrained uterine environment relative to their mature counterparts resulting in an impaired ability to meet fetal requirements. Offspring from immature dams are born smaller and in humans have a higher risk of obesity and related diseases in later life. The underlying mechanisms that drive these differences are unknown; however, epigenetic changes in gene expression are implicated. Changes in the expression of genes involved in glucose and lipid metabolism may alter these highly regulated and integrated metabolic pathways. The expression of three genes involved in these pathways was investigated; leptin receptor, insulin receptor, and glucose transporter 4. The expression of these genes was analysed in the liver and muscle tissue of offspring from one-year old ewes and compared to offspring from mature ewes. There were no significant changes in the expression of any of these genes between the two dam age groups.

Development of a skin cleanliness scoring system for the Australian lamb industry

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A skin scoring system to evaluate the cleanliness of a mob of sheep or lambs in Australian production systems was developed. Scores were recorded on a scale of 1-3 and take into account visible soiling, wool length and wetness. Implementation of this scoring system showed average cleanliness scores of lambs at saleyards was not different from those scored on-farm, indicating that source does not affect cleanliness. There was a significant correlation between cleanliness score prior to loading and after transport to the abattoir (r=0.93; P<0.001) and there was an increase of 0.14 of a score after transport compared to pre-transport score (P<0.05). This scoring system will enable further research into the correlation of carcase microbial contamination and visual cleanliness, which will facilitate the development of this scoring system into a tool that can be used along the supply chain to predict carcass contamination, assist pre-slaughter management and enhance animal welfare.
**1154**  Variation in nutritional composition of lamb leg cuts

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The nutritional composition of the knuckle, topside, outside and silverside excised from 15 lamb carcases were measured to determine the variation in protein, energy, total fat, minerals and fatty acids between muscles. The findings indicate that the silverside had significantly higher values for most fatty acids (excluding EPA + DHA) and higher energy content while the topside had higher concentrations of cholesterol, iron and zinc and the knuckle had higher concentrations of sodium and zinc. Overall this information will assist industry in promoting the benefits of consuming lamb to increasingly health conscious consumers.

**1155**  Modelling the potential for flushing or improved pregnancy rate to increase gross margins in sheep flocks

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The number of lambs weaned per ewe is an important factor contributing to both the level of production and producer income. The production and gross margins resulting from varying pregnancy rate, twinning rate, and the use of flushing were compared for a Terminal over Merino ewe enterprise using simulation modelling of a farm at Tarcutta (New South Wales) with 20% of area sown to lucerne. A 20% lower pregnancy rate had a larger impact on gross margins than a 50% reduction in twinning rate. Flushing, on average, increased lamb production and gross margins compared with the standard, but was only possible in 50% of years. On-farm management which avoids reductions in pregnancy rate may be more important for producers than aiming to increase twinning rate, but large gains are possible by flushing ewes to increase twinning rates if this can be achieved frequently and the survival of twins is high.

**1156**  The impact of a feather-pecking outbreak in an experimental free-range layer flock on growth, egg production, plumage damage and mortality

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Feather pecking is a serious hen welfare issue with adverse economic consequences for free-range egg production. We investigated the effects of providing straw as forage and imposing â€˜stressorsâ€™ (combined transport, relocation and mixing) during rearing on the development of severe feather pecking and plumage damage. The experiment involved 16 pens of 50 ISA Brown commercial laying hens, with outdoor range access from 21 weeks. A feather-pecking outbreak commenced at 26 weeks, and by 40 weeks 98% of hens displayed plumage damage. Between 16-40 weeks hen mortality was 8.3% of the flock, with the main causes being vent pecking (38.1%), pecked uropygial area (15.9%) and grass impaction of the crop/gizzard (27%). While the experiment did not provide evidence that forage and the combined â€˜stressorsâ€™ were implicated in initiating, or preventing progress of, a feather-pecking outbreak, these results show the impact of a feather-pecking outbreak on production and welfare variables.
The Effect of In ovo Administration of L-Arginine on the hatchability and embryological development of Broiler Chicks

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Arginine is an essential amino acid and a precursor for the synthesis of polyamines, growth hormone, insulin like growth factor and nitric oxide (Chevalley et al., 1998). Arginine is known to influence factors that are involved in cell proliferation and growth and improves intestinal integrity via nitric oxide-mediated vasodilation and blood flow in neonatal piglets (Puiman et al., 2011). Our study aimed to determine if in ovo administration of arginine could alter gut development of broiler chicken embryos for improved gut health and efficiency of meat production. Administration was carried out by injection into different compartments of the egg and at two different time points throughout incubation. Arginine significantly increased gut weight and length, increased jejunal villi number, increased the weight of the liver, gizzard and bursa of Fabricius and improved hatchability of the chicks.

No production response of injectable trace minerals in young cattle grazing pasture based systems in the Northern Territory

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Three existing liveweight gain datasets were analysed where cohorts of animals were systematically allocated to either being provided injectable trace minerals or not. Two datasets represented heifers and steers grazing either native tropical tallgrass pastures or floodplains typical of the Top End major river systems. A third dataset related to 2 y.o. heifers that had been relocated from the Sturt Plateau region to the Adelaide River district for backgrounding was also monitored. In each dataset, there was no production response to injectable trace minerals being provided.

Phenotypes to meet pasture-fed market requirements

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Three distinct phenotypes of Angus steers were finished at pasture as four consignments for a farm assured pasture-fed target market between 14 August 2014 and 8 December 2015. The target market required meeting processor specifications including carcase weight and fat depth as well as meat colour and ultimate pH (pHu). Steers were monitored for weight gains at pasture. After processing meat quality attributes according to Meat Standards Australia (MSA) grading were collated from feed-back sources. Steers were able to be successfully finished on pasture to meet target market weight, fat and meat quality criteria. One phenotype showed pHu>5.7 in 4% and 13% of carcases processed. Weight gains on pasture over summer and winter were maintained to support a rising plane of nutrition up to processing. Carcase feedback provided objective measures to improve understanding of production performance of different phenotypes.
Shade utilisation by Bos taurus and Bos indicus steers during summer

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It has been well established that the provision of shade is advantageous for feedlot cattle. However there are perceptions that shade is only beneficial for Bos taurus cattle. For the current study shade utilisation data were obtained from Angus, Charolais and Brahman steers during summer. Breed, time of day and heat load index (HLI) had the greatest influence on shade utilisation. Maximum shade utilisation was at 1200 h for Angus (85.5% of Angus under shade), Charolais (32.7%) and Brahman (33.3%) steers. Angus steers also showed the highest percentage increase in shade utilisation (61.3% increase in shade utilisation), when HLI increased from cool (HLI ≤ 77) to very hot (HLI ≥ 86), compared with Charolais (28.1 % increase) and Brahman (15.4% increase) steers. These results indicate that Brahman cattle will utilise shade to seek relief from hot conditions.

Moulting of tail wool reduced dag accumulation in yearling sheep.

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Sheep that moulted wool from their tail appeared in an experimental flock that had not been tail docked. Wool moulted during spring in yearlings, and was assessed by gently plucking small staples using the thumb and index finger. Yearlings (n = 1263) either moulted all the wool from along their tail and around the base (46%), part way along the tail (22%), or not at all (32%). Yearlings expressing complete moulting had lower (P<0.001) dag score at shearing (mean Â± standard deviation, 1.2 Â± 1.1), than those that partially moulted (1.9 Â± 1.4), or did not moult at all (2.1 Â± 1.6). Animals that completely moulted had shorter tails (11 mm) at 5 weeks of age, greater breech bareness (0.66 units) at 4 months and 170g lighter clean fleece weight at 14 months than those that did not moult. Together these traits will reduce husbandry costs and improve welfare.

Development of the One Biosecurity program in South Australia

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Biosecurity South Australia (a division of Primary Industries and Regions SA) has been developing a new approach to risk management of livestock diseases through farm livestock biosecurity and market assurance, known as ÒOne Biosecurity." The approach uses a unique biosecurity scoring system for use by farmers to create a biosecure compartment within which intrastate trade can occur. It is designed to assure disease freedom, enhance productivity, bolster market access and prevent exotic disease spread.

This paper describes the concept and mechanisms of One Biosecurity and the background research that has been done to assess its viability.
Effect of eight weeks chilled or frozen storage on consumer-defined sensory quality traits of lamb

Mr Cassius Coombs

Effect of eight weeks chilled or frozen storage on consumer-defined sensory quality traits of lamb

Mr Cassius Coombs

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The effects of eight weeks chilled and frozen storage on lamb m. longissimus lumborum (LL) were evaluated in this study. A total of 24 randomly selected LL were kept under chilled or frozen storage - the latter involving two different frozen storage temperatures of -12°C and -18°C. At the completion of the treatment phase, all LL were sub-sampled, cooked and tested by 30 untrained consumer panellists for tenderness, juiciness, flavour and overall liking quality traits. This study found that all quality traits were lower when LL were kept under frozen storage compared to chilled storage (P < 0.01). No difference between frozen storage temperatures was found (P > 0.05). These results demonstrate the consumer preference for chilled storage, in terms of LL eating quality when the storage duration is eight weeks.

Evaluation of Recoverability of Mycoplasma-like organisms causing mastitis in dairy cattle in South Australia under different freezing conditions.

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The study aim was to estimate the recovery of Mycoplasma spp. isolated from bovine milk samples under different freezing conditions. Recovery of Mycoplasma spp after freezing, in glycerol and DMSO enriched milk samples was 100.0%, 96.3%, 88.9% and 74.1%; for foetal bovine serum and DMSO 77.8%, 66.7%, 48.2% and 40.7% and for raw milks 74.1%, 66.7%, 51.9% and 48.2% for weeks 2, 4, 6 and 12, respectively. For better chance of recovery milk samples stored at -20°C may require addition of glycerol and DMSO.

Beyond consumer defined welfare - paddock based egg production

Ms Joanna Blunden

This paper describes the re-emergence and ongoing development of paddock based egg production systems in response to consumer demand and willingness to pay a premium for the credence values attributed to these eggs, including perceived higher welfare. Paddock based farms make up a high proportion of free range enterprises and are thus a significant part of the layer industry, and continue to grow in number and scale. While these systems meet the expectations of some consumers they produce challenges to welfare and animal health, environmental management, productivity and profitability, and require adaptation, innovation and specialist management.
1176  Barley grain supplementation in late gestation to improve lamb survival in twin-bearing Merino ewes grazing pasture of high biomass and quality

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Lamb mortality from birth to weaning is the most prominent factor leading to the poor reproductive performance of Merinos. Providing a high starch feed prior to lambing can increase colostrum production, which has the ability to increase passive immunity transfer to the lamb following birth, increasing survival. To determine whether lamb survival to marking was increased by this method when grazing abundant pasture, naturally joined twin-bearing Merino ewes (n=240) were supplemented with barley grain in the last two weeks of gestation and first two weeks of lambing. Lamb survival (81%) was similar in supplemented and control treatments. This study indicates that when large quantities of quality pasture are available there may be no increase in the survival of twin-born lambs due to barley grain supplementation of ewes.

1177  The influence of variable dietary fats on tissue fatty acid composition and growth performance of broilers

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Male broilers (n=480) were fed five different diets containing 4% (w/w) plant oils (high in saturated, n-9, n-7, n-6 or n-3 fatty acids) or beef tallow (control) for 42 days. All birds grew well without significant differences (P>0.05) among their growth parameters. Different tissues were analysed for crude fat content and fatty acid composition. The crude fat content differed between the various tissues but were similar across all dietary treatments. There were very strong positive correlations between the fatty acid composition of the diets and those of the blood, adipose tissue, breast and leg meat; the correlation was weaker for the liver and heart but complicated for the brain. N-3 showed a strong correlation in all cases. At the fat level implemented in this study, broilers grew perfectly regardless of the fat type; however, the fatty acid profile of most tissues was highly correlated to the diet.

1178  Offering legume based pastures to sheep reduced methane emissions and increased growth rates compared with perennial ryegrass pastures in spring and summer

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We examined the potential of legume based pastures to maintain growth and reduce methane emissions in “maternal composite” (predominantly Coopworth based) ewes during late spring and summer. Two hundred and forty ewes grazed perennial ryegrass, lucerne, subterranean clover or arrowleaf clover pastures for 6 weeks during late spring and early summer. Live weight gain was greater in legume based pastures than perennial ryegrass pasture. Short term methane measurements using portable accumulation chambers (PACs) during the grazing period suggested lower absolute methane emissions (i.e. g CH4 per day) from sheep grazing arrowleaf and subterranean clover pasture than sheep grazing perennial ryegrass pastures. Legume based pastures may provide an option to increase growth rates and decrease methane emissions (total and emissions intensity) during a period when perennial ryegrass pastures are declining in nutritive value.
**Is sheep meat production viable? The Spanish perspective**

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Taking into account the relationship between rainfall and temperature, 64% of the Spanish territory can be classified as arid (25%) or semiarid (39%). In these areas, vegetal surface includes natural pastures and meadows (34.0%), fallows (13.4%), winter cereals for grain production (21.2%), forage crops (mainly lucerne, and winter cereals harvested as green forage; 2.6%) and woodland hills. Ruminants in these zones account for 24 million heads of which nearly 80% are sheep. In the present paper, the possibilities of integrating sheep in cropping systems are discussed, and an alternative based on the use of permanent sowed prairies (lucerne), self-sowing annuals (Wimmera ryegrass), and winter cereals (barley) will be analyzed.

**Longer distances are better for measuring flight speed in sheep**

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This study investigated the repeatability and variance of flight speed measured at a range of distances from 0.5m to 2.0m in order to recommend the most suitable distance for measurement in sheep. Flight speed was repeatable across days (R² = 0.88-0.97) and within days (R² = 0.54-0.66). Residual correlations between speeds measured at the different distances were very high (>0.82), suggesting that while greater distances are better to maximise variance, shorter distances will still be adequate where necessary. Between sheep variance increased with distance of measurement so within the range of distances assessed, the greater distance is preferable. Ability to detect differences between sheep based on sex, pen and day of measurement increased with distance of measurement. These results indicate that flight speed is better measured over longer distances up to 2.0m, is highly repeatable in young lambs and phenotypic variation exists with which to discriminate between animals.

**Mortality in adult ewes associated with cold conditions despite moderate length wool**

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The survival of Merino ewes in 8 flocks around Australia was examined in relation to weather conditions at the time of loss. Ewes with very low bodyweight or low condition score were at high risk, compared to ewes in good condition. For ewes with up to 190 days of wool growth during periods of cold weather, or when a sudden increase in chill index occurred, the risk of loss was increased 6-fold, compared with periods of warm weather or stable conditions and more than 190 days wool. Ewes with condition score <2.5 were at greatest risk of loss during these periods. Ewe losses in short wool may be reduced by weather localised weather forecasts to warn of high risk events, combined with more frequent monitoring of weight and condition.
Soil moisture monitoring in grazing systems assists decision-making

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In 2013, the Barossa Improved Grazing Group (BIGG) initiated a project to monitor soil moisture in grazing systems. This involved the establishment of automatic weather stations in three local pasture paddocks and represents the first time a farming systems group in Australia has demonstrated soil moisture monitoring in pastures. Through determining the plant available water (PAW) and rate of water use in these paddocks, the project highlighted how soil moisture monitoring may be used to assist producers in making grazing management decisions. In the future, BIGG plans to further develop the soil moisture and climate data being generated from the weather stations into more useable information for producers.

Turning dual-purpose wheat into meat: comparison of Merino and White Dorper maternal systems on a mixed-farming feedbase

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White Dorper ewes joined to White Dorper rams, White Dorper ewes joined to White Suffolk rams and Merino ewes joined to White Suffolk rams grazed dual-purpose wheat during lambing from 27 June and a lucerne and clover pasture from 14 August to weaning on 2 October in a replicated experiment in 2013 at Wagga Wagga, NSW. The feed on offer at the commencement of grazing the wheat crop was low (mean 330 kg DM/ha) but increased during the experiment. Liveweight and body condition score of White Dorper ewes was significantly greater than Merino ewes throughout the experiment. Weaning weight of White Suffolk x Dorper lambs was significantly higher than other lamb genotypes in this study.

Thermo-alkaline Degradation of Hepatotoxic Indospicine in Camel Meat

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Dog deaths have been recorded from the consumption of Australian camel meat and horse meat contaminated with indospicine, a hepatotoxic amino acid that accumulates in meat of animals grazing Indigofera plants. In this study, thermal degradation of indospicine was investigated under different pH conditions in both aqueous solution and in contaminated meat. Aqueous solutions with either indospicine or indospicine-contaminated camel meat were autoclaved for 0–60 min with and without inclusion of food-grade additives, either 0.05% acetic acid or 0.05% sodium bicarbonate. Indospicine in sodium bicarbonate solution demonstrated the greatest breakdown with total degradation after 15 min autoclaving. Similar thermal treatment of sodium bicarbonate treated indospicine-contaminated camel meat produced 50% degradation after 15 min autoclaving and 87% degradation after 60 min autoclaving. The results suggest that alkaline conditions during autoclaving have the capacity to reduce indospicine contamination in camel meat, and could potentially be used to degrade indospicine in indospicine-contaminated meat.
Genomic breeding values for Lean Meat Yield, Intramuscular Fat and Shear Force do not affect live lamb production traits

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The impact of the new research breeding values (RBVs) for lean meat yield (LMY), intramuscular fat (IMF) and tenderness (SF5), was determined in 16 prime lamb production systems. Lambs were finished according to normal on-farm practices for seven lamb supply chains and processed through 13 plants in New South Wales, Victoria, Tasmania, South Australia and Western Australia. In terminal lamb production systems, there were no negative effects of RBVs for LMY, IMF, SF5 on liveweight or liveweight gain across disparate production and finishing systems. The new LMY and eating quality RBVs can be used with confidence in the prime lamb industry.

Sheep producers change their behaviour in welfare, productivity and breeding.

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In 2011 and 2014 surveys of producers were conducted nationally on behalf of the CRC for Sheep Innovation (Sheep CRC) in order to benchmark practices and behaviours of producers in the areas of reproduction and welfare, genetics and breeding and management of parasites. This paper summarises how producers have changed their practices in these important areas during that time. Results from the surveys show that the enterprise mix, size of flocks and proportion of breeds across five regions and states and producers approaches to managing their sheep flocks with best practice have changed significantly. Producers use of techniques such as pregnancy scanning and managing feed for pregnant ewes as a way to improve lamb survival and attitudes to non-chemical management of parasites such as worms and flies are explored.

Remote monitoring for wellbeing in grazing sheep: are social behaviours useful?

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The increase in the use of electronic identification ear tags means that production traits specific to an individual sheep can be recorded and that presence, and possibly wellbeing, of individual sheep may be able to be monitored remotely. If data from monitoring systems is to be used to identify wellbeing status of individual sheep then behavioural measures recorded need to stable in a group of healthy individuals, have a short lag time and, where possible, reflect a variety of welfare and health issues. To date roll call, movement order and social networks have been assessed as potential measures of wellbeing. These measures are not ideal as identifiers of change in welfare state of grazing sheep as they do not meet the time frame or stability and repeatability requirements. Further work on a variety of other measures is underway using additional technologies such as temperature sensing microchips and video image analysis.
The effects of heat stress on porcine oocyte maturation, Fertilisation and embryo development and methods of alleviation

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During summer and early autumn, female pigs experience a decrease in fertility (seasonal infertility) (Lopes et al. 2014) which is caused by the combination of inappropriate photoperiods and elevated ambient temperatures (heat stress) (Auvigne et al. 2010). Seasonal Infertility accounts for an approximate annual loss of $40 million to the pig industry, this is exacerbated by heat stress which reportedly costs the US pig industry $450 million annually (Lewis and Bunter 2011). This project aims to alleviate the negative effects of heat stress through supplementation of antioxidants in order to reduce damaging reactive oxygen species. This will be achieved using an in vitro model that will first assess the stage of oocyte maturation and embryo development most affected by heat stress, in order to target antioxidant treatment. The second experiment involves supplementation with the antioxidants, melatonin or vitamin A, in an attempt to reduce the negative impact of heat stress.

Heart rate variability as an indicator of pig welfare

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Animal welfare has been quantified in animals using behavioural or endocrinological measures. Given the importance of the nervous system in stress perception, a metric of the neural involvement in animal welfare would aid in gauging an animalâ€™s stress response. Heart rate variability (HRV) (variation in the R-R interval on an ECG trace) is thought to reflect individual differences in the strength of the sympathetic versus parasympathetic arms of the autonomic nervous system. In this study, HRV was used to evaluate sow welfare in different housing systems; individual stalls, group pens and ecoshelters. Relationships between HRV, plasma cortisol levels and injury scores were also quantified. Group housing significantly elevated components of HRV associated with sympathetic activity and was associated with plasma cortisol. HRV analysis appears to indicate an involvement of the autonomic nervous system in stress responses of pigs to housing conditions, and may be a useful measure of pig welfare.

Pre-slaughter washing increases dark cutting incidence in beef

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Dark cutting is a significant problem affecting the Australian beef industry, as meat of an inferior quality does not meet consumer expectations. This study aimed to determine the relationship between pre-slaughter hide washing and the incidence of dark cutting beef. Pasture (n=1,437) and grain-finished (n=1,447) cattle were observed at Teys Australia Naracoorte Complex from the time they arrived at the facilities until slaughter. Pre-slaughter washing treatments were recorded and their effect on the incidence of dark cutting determined using a restricted maximum likelihood linear mixed model. Dark cutting incidence in this study was 24% in pasture and 2% in grain-finished cattle. Pre-slaughter hide washing in lairage pens increased dark cutting incidence by 2% per wash (P<0.01). This study confirmed that lairage factors can increase dark cutting incidence in beef. Minimisation of unnecessary pre-slaughter washing could help mitigate this problem, reducing associated financial losses and improving animal welfare.
Relevance of public attitudes to animal welfare for the pork industry.

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Concerns about livestock animal welfare are well documented worldwide. Public attitudes are often studied as indicators of risk for the livestock industries, but are less often studies in relation to the behavioural outcomes that are likely to impact on the livestock industries. This paper examines the relationships between public attitudes, and opinion leadership and self-reported pork consumption and community behaviours that are likely to impact on the sustainability of the livestock industries. While few variables predicted pork consumption and accounted for 10% of the variance, several variables predicted community behaviours and accounted for 43% of the variance in community behaviours. Opinion leaders tended to eat less pork and engaged in many more community behaviours. Together these results suggest that more needs to be done to identify the population segment of opinion leaders and to engage them in dialogue about pork production.

Inferring rumination behaviour from a tri-axial accelerometer

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Feed intake, feeding and rumination time are important parameters for the identification of normal, healthy feeding patterns, as well as suboptimal feeding conditions and possible health and welfare issues. Free-ranging sheep were fitted with a halter that had a tri-axial accelerometer attached to the under jaw strap. Rumination behaviour was captured using video and synchronised to the accelerometer signals. The sequence of movements during rumination was: chewing, swallowing, nothing and regurgitating. The accelerometer identified this pattern adequately whether the sheep was in either a lying or standing position. More testing is required to determine the accuracy, sensitivity, specificity and precision of the accelerometer to infer rumination behaviour.

JBS Southern Producer of the year 2015 - utilising Livestock Data Link (LDL) as a model for Supply Chain incentivisation.

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JBS Australia in conjunction with Meat and Livestock Australia launched Livestock Data Link on the 15th of May 2015, to the JBS Farm Assurance producers. LDL is an industry wide, online carcase analysis tool that links slaughter data from the National Livestock Identification System and Meat Standards Australia databases. This tool identifies non-compliant carcases, non-compliant issues and associated costs. LDL provides a library of solutions and gives producers and processors the ability to benchmark within lots, by property, by region and or at state level. LDL was used to determine the inaugural beef and lamb producers of the year from a cohort of 3000 producers. This was achieved by analysing a number of traits, such as percentage of compliant animals, MSA Index, along with other factors such as number of head supplied, spread of supply and loyalty to the program, and is developing into a model for supply chain incentivisation.
Lamb survival should be considered separate genetic traits across different birth types

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Poor lamb survival is a major limitation to the productivity of the Australian sheep industry. Despite this, lamb survival has not yet been included in the national recording schemes as low heritability and lack of suitable indicator traits have led most to conclude that making genetic gains would be slow. Finding better options to improve survival were investigated using data from the Sheep CRC Information Nucleus Flock. Data was analysed using ASReml to calculate heritability estimates and correlations between survival across birth type with gestation length and birthweight. Heritability of survival was low when calculated across all data but higher for multiples so survival should be considered a separate trait across birth type. Gestation length and survival in multiple-born lambs was positively correlated (0.24) suggesting that gestation length could be a potential indicator trait to improve survival of triplet lambs.

Does melatonin enhance reproductive performance of Border Leicester rams mated to Merino ewes in spring?

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Variable reproductive performance of Merino ewes mated to Border Leicester (BL) rams in spring could be due to seasonality. Previous work by the authors suggested that treatment of young BL rams with melatonin was beneficial. This study examined if the response was repeatable in young and mature BL rams (property 1) and if treated young rams performed as well as either untreated (properties 2 and 3) or treated mature rams (property 4). On property 1, melatonin increased scrotal circumference (P<0.05) but there was no response in pregnancy rate and litter size. On properties 2 and 3, treated young rams performed similarly to untreated mature rams for pregnancy rate and litter size. However, on property 4, pregnancy rate and litter size were both higher (P<0.05) for treated mature rams compared with treated young rams. In conclusion, the response to melatonin of young BL rams is inconsistent between years for pregnancy rate.

Considerations for future research to improve the welfare of livestock held in stock containment areas

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Utilisation of stock containment areas (SCA) is increasing in southern Australia as a management tool to preserve soil and pastures. The strategy involves removing livestock from pastures during prolonged dry seasonal conditions and returning them when the grazing conditions improve. Several surveys of producers experience with SCA have been conducted and as a result guidelines have been updated for SCA management. Reviewed guidelines include feed rations, design, disease issues, location and stocking density. Guidelines have touched on, but not resolved issues of welfare expressed by producers, particularly when stock are contained for long periods of greater than 3 months.

This study reviewed survey responses and identified some potential criteria for future research into improving the welfare of livestock contained in SCA including removal of shy feeders, provision of shelter, minimising boredom, and the effective management of dusty and wet conditions.
Microbiology and molecular tools for detection of Mycoplasma mastitis in South Australia

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Mycoplasma mastitis is an emerging problem in Australia. The objectives of this study were to estimate and compare the detection capability of a novel PCR with traditional bacteriological culture method of Mycoplasma spp from bovine milk samples collected from a single dairy farm in Mount Gambier, South Australia, Australia. The farm had a high incidence of clinical mastitis but also many cows with a high SCC and the treatment with antimicrobials was of little value.

A modified barrier test can be used to assess breed differences in lamb vigour

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The ability of lambs to respond to the ewe in the early neonatal period is important for subsequent lamb survival. This experiment used a modified barrier test to assess lamb vigour in two breeds known to differ in other methods of measuring vigour and at different ages (4h and 10h of age). It was found that Scottish Blackface lambs performed better in the test than Suffolk lambs with more Blackface lambs reaching the ewe (25.4% vs 8.5%). Older lambs reached the ewe more quickly (88.87s vs 150.94s). This test may provide an alternative measure of lamb vigour in terms of the ability of lambs to make contact with the ewe as it can be done at an early age and it does not require the presence of the dam.

Withholding lucerne in summer to feed in subsequent winter feed deficits modestly increases feed efficiency of small mixed farms in western China

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Lambs were fed sub-maintenance rations with or without additional nitrogen in the form of lucerne, which were isometric for metabolisable energy. After 20 days, lambs were transferred to an ad libitum diet that included lucerne for a further 20 days. The capacity for underfed Tan weaner lambs to absorb energy from the low nitrogen ration rapidly degraded whilst lucerne hay prevented this decline. Furthermore, lambs initially denied lucerne were not able to digest as much of the ad libitum ration following underfeeding. Feed use efficiency at most intakes was higher when lucerne was available at underfeeding, however practical implementation of this management would incur costs that are unlikely to be offset at the efficiencies observed, given the small difference in weight between treatments in the observed timeframe. The advantage of withholding lucerne to feed in winter would increase if lambs continued to use feeds with the same mean efficiency.
Can nutritional level and parental EPD for rib eye area influence feed conversion efficiency and carcass yield in steers?

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The objective of this trial was measure the effect of two Winter Stocker Growth Rates (WSGR) and two groups of sires with different values of Expected Progeny Differences (EPD) for Rib Eye Area (REA) on feed conversion efficiency (FCE) and carcass yield of Uruguayan Hereford steers. The evaluated WSGR were ‘low’ and ‘high’ and the REA EPDs were ‘high’ and ‘average’. Tree generations of steers (321 animals) were sorted out into a 2x2 factorial design. After winter treatments, all animals grazed pastures with an herbage allowance of 5% of live weight (LW) per day. When animals reached 350 kg of LW, they started the finishing phase under lot feeding. Slaughtering was reached on average at 525 kg LW. High WSGR did not influence FCE but increased Hot Carcass Weight (HCW) and carcass yield. Sires with high REA EPD did not influence FCE but generated animals with higher carcass yield.

Growth, meat yield and meat quality of lambs born to ewes submitted to energy restriction during mid gestation

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The effect of energy restriction from day 45 to day 115 of gestation in adult ewes bearing single or twin lambs on lamb’s birth, weaning and slaughter weight, carcass and some meat traits was studied. Ewes were fed during mid gestation (45 to 115 days of gestation) with 70 or 100% of their energy requirements. Lambs were weaned at 109 days of age and lot-fed until slaughter. There was no difference in growth between treatments (p>0.05). However, lambs born to restricted ewes deposited more backfat during the finishing period (p<0.05), had lower weight of the French rack and the leg and yield of the French rack compared to lambs born to non-restricted ewes. It is important to remark that the French rack cut is the most valuable cut of the lamb carcass, followed by the leg therefore, it is expected that lamb carcass from restricted ewes would be less valued.

Can an Australian native plant (Eremophylla spp.) reduce methane output from cattle?

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Thirty two Bos indicus steers were used in a replicated study investigating the efficacy of Eremophylla spp. in reducing methane output. Air samples were taken across a 3 day period at 2 hourly intervals in a climate controlled facility after a 28 day dietary acclimatisation period. Overall, Eremophylla spp. is beneficial in reducing methane output from Bos indicus cattle consuming low quality roughage when supplemented at 2.0 and 3.0kg/animal/day. The optimal feeding level in the current study was the MED treatment (2.0kg EP); DMI intake highest and methane output lowest as measured in terms of LW, DMI and dietary energy. CON steers produced 3.48g methane/MJ dietary energy, whereas MED steers produced 2.37g methane/MJ dietary energy. Optimal supplementation rate of EP appears to be between 2-3kg/d, however this requires further investigation. This supplement shows potential as a native forage with the capacity to reduce methane output in cattle.
1214 The effect of Mycoplasma mastitis on somatic cell counts patterns and bovine milk production in South Australia

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Mycoplasma spp. caused mastitis results in elevated somatic cell count (SCC). This is similar to bovine mastitis by any nature. Somatic cells mainly include macrophages, lymphocytes, polymorphonuclear and epithelial cells. The elevation of these cells in affected quarters reflects the possibility of infection and is the standard method to discriminate between healthy and mastitis-infected cows. Most of the world has established acceptable limit of individual cow SCC in raw milk at 200,000 cell/mL. However, currently in Australia the acceptable limit is 250,000 cells/mL. Similarly, mastitis of any nature causes decreases milk production. Specific effects of Mycoplasma spp caused mastitis on SCC and milk production compared to mastitis caused by undifferentiated pathogens are unknown. This study aimed to evaluate the effect of Mycoplasma mastitis on SCC and milk production compared to other undifferentiated mastitis and the rest of the herd in a single farm in South Australia.

1215 Reliability and feasibility of animal-based indicators to assess the welfare of extensively managed ewes.

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The reliability and feasibility of 10 animal-based indicators of ewes welfare (body condition score (BCS), rumen fill, fleece cleanliness, skin lesions, tail length, dag score, foot-wall integrity, hoof overgrowth and lameness) were examined for on-farm use in extensive sheep production systems. The indicators were independently examined on 100 Merino ewes (from 2 to 4 years old) during late-pregnancy (LP), mid-lactation (ML) and weaning (WN) by a pool of nine trained observers. Levels of observer agreement were determined by Kendall’s coefficient (W) and Kappa statistics. Overall, good agreement (from ‘moderate’ to ‘almost perfect’ agreement) were found for the indicators BCS, fleece condition, skin lesions, dag score and lameness, and the inter- and intra- observer agreement of these indicators increased from LP through to WN. This study presents five valid, reputable and feasible indicators for on-farm assessments of extensively managed ewes.

1216 Forage quantity and quality of dual-purpose wheat: changes during grazing and implications for livestock production

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Sheep can graze dual-purpose wheat at feed on offer levels below recommendations for pasture due to the different presentation of feed. The quality of wheat forage can decline during the grazing period, which has implications for the management of livestock.
1217 Pedigree MatchMaker accurately identifies dams in naturally joined sheep flocks
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The Pedigree MatchMaker is a relatively low cost method of determining dam parentage in sheep flocks, and is well suited for use in commercial settings. The Pedigree MatchMaker records ewe and lamb RFID tags as they walk past a panel reader, and a software program determines the association between each ewe and lamb. By reducing animal handling, animal wellbeing is improved and labour is reduced. The number and accuracy of the Pedigree MatchMaker ewe/lamb matches was evaluated across two sites involving 1488 ewes and 1615 lambs. In total, 84.5-93.3% of lambs were matched to a dam after 6-8 weeks of recording. The matches made by the Pedigree MatchMaker were compared to DNA parentage results for 473 lambs; 96-97% of dams matched to a lamb by the PMM were correct.

1218 Analysis of three methods for the estimation of in vitro CH4 production from vented bottles.
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In vitro methane production from three experiments incubating 1.0 gm DM of wheat and Lucerne, different amounts (0, 0.5, 1.0 and 1.5 gm DM) of wheat and lucerne and Lucerne, corn, wheat and barley with different degrees of processing, was calculated using \([\text{CH}_4\text{ concentration in headspace} \times \text{headspace volume}] + [\text{CH}_4\text{ concentration in gas bag} \times \text{GP}]\) as gold standard method and compared to the five algorithms proposed by Hannah et al. (2016). The algorithms predicted methane production well. Method 1a had the greatest correlation and Lin’s concordance correlation coefficient with the gold standard and can therefore be recommended for estimating methane production when vented gas is not collected in gas bags.

1219 The impact of divergent selection for methane yield on age at puberty
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Angus heifers (n=134) that had been divergently selected for Low and High methane yield (MY) were used to examine onset of puberty. Ultrasonography was used to scan the ovaries of 2014-born heifers (n=134) on four occasions following weaning. Weight (WT), height (HT) and fat depth at rump (P8) of the heifers were also recorded. Descriptor traits at onset of puberty were calculated, including age (AGECL), weight (WTCL) and P8 (P8CL). No significant differences were observed between MY selection lines for WT, HT and P8 recorded at the initial and final ovarian scanning. In addition, no significant differences were observed between MY selection lines for AGECL, WTCL, P8CL or proportion of heifers that had ovulated by the last scan. Thus selection for divergent MY had no significant impact on pubertal traits in this study.
Testing a model to initiate feather pecking in free-range laying hens

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Severe feather-pecking and cannibalism are considered major welfare problems in free-range laying hens and with the proportion of eggs from non-cage housing on Australian farms predicted to increase, a better understanding of the factors that elicit these problems is required to improve farm animal welfare and profitability. The aim of the first experiment is to test whether the onset of feather-pecking outbreaks in free-range hens is a consequence of the inability of hens to perform effective dust-bathing behaviour and whether the link between these situations is related to build-up of microbial content on feathers and skin due to ineffective feather and integument cleaning. If this is determined, we propose to conduct further experiments to examine the effects of some specific treatment applications on onset of feather pecking, plumage damage and cannibalism.

The Lamb Supply Chain Group provides a model for engaging value chains

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Blockages in information flow along the value chain still limit the impact of research and development in Australia’s livestock industries. The Sheep CRC and Meat & Livestock Australia (MLA) has developed the Lamb Supply Chain Group as a model to build stronger partnerships and embed research and development and the associated commercialisation and adoption new technologies with the end-users. This has led to engaging five supply chains with a very high collective footprint in the Australian lamb industry. We recommend this as model for future work, and is portable across industries.

Can farmers select good rams based on phenotype?

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Farmers can use genetic and/or phenotypic information to select flock sires. This experiment aimed to determine farmers’ ability to identify high-performing rams based on phenotype alone. The group of 20 rams were available for selection, which consisted of 10 ‘high’ and 10 ‘low’ genetic merit rams based on their breeding values for live weight at 8 months of age. Farmers (n=29) each selected a team of 10 rams from the group on the basis of phenotypic information. All 20 rams were bred with two ewe flocks and lambs were assigned to sires using DNA parentage. The mean number of high merit rams picked by farmers was 4.4, and the farmer-selected ram teams produced lambs with a mean weaning weight of 34.9 kg, which were lighter than the high team (35.4 kg) and heavier than the low team (34.7 kg). Farmers did not identify superior rams based on phenotypic information.
Providing pasture choice to sheep reduced intensity of methane emissions and increased growth compared with annual ryegrass

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Our objective was to assess the influence of a grass/legume choice pasture and novel legumes including the potentially low methane pasture, biserrula on animal performance and methane intensity (CH4/ live weight gain). Ten groups of 24 dry merino ewes were offered unrestricted grazing on duplicate plots of annual ryegrass (ARG), subterranean clover (Sub), side-by-side monocultures of annual ryegrass and subterranean clover (Choice), serradella (Serr) and biserrula (Bis) over two spring growing seasons. Methane was measured fortnightly from individual sheep using portable accumulation chambers. Daily weight gains from the Choice pastures were equivalent to those from Sub pastures and higher than from ARG. Methane intensity tended to be lowest from the choice pasture, pending a full data analysis. Choice pastures can potentially improve sheep production and reduce the impact of greenhouse gas emissions by improving the efficiency of the conversion of pasture into growth.

Functional annotation to understand how imprinting affects phenotypes in pure bred and hybrid cattle

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A fundamental question in developmental biology is how the DNA sequence is linked with the phenotype, and specifically the mechanisms involved in appropriate gene regulation to guarantee that the tissues and organs of an individual are formed and function correctly. Advances in technology mean that data on gene expression, epigenetic variations and chromatin structure can be produced quickly and relatively cheaply in order to annotate functionally important genome features. In the present work, the transcriptome and epigenetic variations in cattle are being examined to contribute to understanding the regulation of gene expression and identify imprinted loci in Bos taurus and Bos indicus cattle that affect development processes and formation of phenotypes.

Relationships among methane traits in cattle fed ad libitum roughage diet

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The objective of this study was to estimate phenotypic relationships among methane traits in yearling cattle fed ad libitum roughage diet. A total of 119 heifers were measured for methane and carbon dioxide using equipment that measure several short-term fluxes in methane and carbon dioxide. The heifers had ad libitum access to a roughage diet during the measurement period. Daily methane production (MPR) was moderate to strongly correlated (rp from 0.63 to 0.78) with all the methane traits studied, except with methane yield (MY; MPR per unit dry matter intake) where the correlation was close to zero (rp = 0.12). Methane yield was moderate to strongly negatively correlated with feed intake (DMI)(rp = -0.63). The low correlation between MPR and MY and the strong negative correlation between MY and DMI indicates the relationship between MPR and DMI, while linear under restricted feeding, may be curvilinear under ad libitum feeding.
Effect of ensiled crimped grape marc on growth performance and methane emissions of Angus steers

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The effect of ensiled crimped grape marc (ECGM) on growth performance and methane (CH4) emissions of beef cattle was examined. Twenty steers (390.3 ± 38.09 kg initial BW) were used in a completely-randomised design to test two diets: control and grape (GP; 30% of ECGM on DM basis). The final BW was 5% greater for steers fed the control diet than those fed GP diet (P < 0.01), but there were no differences between diets in average daily gain (ADG). Steers fed GP had higher DM intake (P < 0.01) and feed:gain (P = 0.02). There were no differences between diets in CH4 per kg final BW, CH4 per kg ADG and CH4 per kg of DM intake, however daily CH4 was lower for GP group (P < 0.01). In conclusion, ECGM reduced total daily methane output but not methane intensity, presumably due to a reduction in energy availability.

Including biserrula chaff in the diet of sheep reduced methane yield on the basis of energy intake

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The legume biserrula has the potential to reduce methane emissions when included in extensive sheep grazing systems. We tested the hypotheses that increasing biserrula in the diet of sheep reduces acetate: propionate in rumen fluid and decreases methane yield (g methane/intake) from sheep. Merino wethers (n = 41) were fed one of four treatments with varying proportions of chaffed biserrula and annual ryegrass at 1.4 times maintenance requirements for 38 days. Daily feed intake, live weight change and 23h methane production in respiration chambers were measured. Rumen fluid was collected two hours after feeding and nutritive values of the chaff were determined by near-infrared spectroscopy supported by wet chemistry analysis. As biserrula in the diet increased acetate: propionate decreased, methane production decreased and methane yield decreased on the basis of metabolisable energy and gross energy intake with intermediate effects from the proportions of biserrula in the diet (P<0.05).

Assessing the biodiversity of kikuyu genotypes: Growth and forage quality

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Kikuyu (Pennisetum clandestinum) has the capability of supporting higher stocking rates and milk production per hectare (Reeves et al. 1996). The milk production potential could be greatly enhanced by selecting ecotypes that are resistant to kikuyu yellows (Verrucalvus flavofaciens), are more digestible, and are tolerant to cool temperatures. A trial to evaluate kikuyu ecotypes commenced with 1600 genetically diverse potted plants which originated from Queensland and NSW. Plant numbers were reduced to 100, based on vigour, summer and winter growth, maturation, growth habit, neutral detergent fibre (NDF) and indigestible NDF (iNDF) content. It was found that some of the lines of kikuyu can perform well at lower temperatures but the top five DM yield producers had higher NDF and iNDF contents. The taller the plants, the more NDF and iNDF was laid down, and as a result the digestibility would decrease. Thus vigour was inversely proportional to digestive quality.
### Importance of ewe and cow body condition in breeding programs

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(AGBU is a joint venture of NSW Department of Primary Industries and the University of New England)

Producers have the potential to improve both the welfare and productivity of sheep and cattle production systems by including body condition score (BCS) in the breeding program. The value of recording BCS is greatest in the breeding dam, with low BCS associated with poor reproduction and health. However, the value of BCS in breeding programs is not found in the weak positive genetic association with reproduction but because selection for BCS will improve the dam’s ability to maintain condition throughout the production cycle and allow her to express her full genetic potential for reproduction.

### Pastures From Space Plus

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New enhancements to Pastures From Space have been developed in conjunction with industry and have been made available via a subscription service for producers and agronomists at the paddock scale. These new enhancements include a paddock digitising tool, higher resolution satellite imagery, improved paddock charting capabilities, a paddock summary report which makes the data easier to interpret and a stocking rate calculator which removes the amount of guess work required for estimating paddock PGRs and FOOs. The new PFS Plus can be accessed at https://pfs.landgate.wa.gov.au.

### Preference of weaner calves for pellets is improved by inclusion of Bacillus amyloliquefaciens spores as an ingredient

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The study investigated the preference of weaned calves for pellets formulated with or without a novel strain of Bacillus amyloliquefaciens (H57). Twenty dairy calves were trained and preference tested over 10 days by monitoring intake of test feed divided to total intake of test feed and intake of control feed, with each feed being offered ad libitum, in adjacent troughs, per calf, for 6 hour per day, with glucose powder being added to -H57 pellets on day 10. Calves showed similar preference (0.50, P > 0.10) when -H57 pellets were offered for day 4, 5 and 6 but preferred the +H57 pellets when offered simultaneously with -H57 pellets for days 7, 8 and 9 (0.67, P<0.001) and this preference rating was maintained even after -H57 pellets were sweetened with glucose on day 10 (0.72, P<0.001). H57 spores have the potential to be used as an attractant in supplements for ruminants.
Effect of dietary natural betaine on broiler breeder hen performance and egg quality characteristics

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The effect of dietary natural betaine supplementation on broiler breeder hen performance was evaluated. In total, 630 Cobb 500 broiler breeder hens were allocated to one of three dietary treatment groups. The control diet was a standard basal broiler breeder diet and the two treatment diets were supplemented with natural betaine at either 1000ppm or 2000ppm. Hens were fed the diets for six weeks. Hens receiving betaine-supplemented diets gained more weight (p=0.006). The average weekly egg production of the hens receiving the 1000ppm and 2000ppm betaine-supplemented diets increased by 2.4 and 5.5% respectively (p<0.0001). The eggs from hens fed 2,000pppm betaine also had greater fertility (p<0.0001). Egg characteristic differences included a decrease in albumen weight (p=0.034) and eggshell thickness (p=0.001) and an increase in yolk:albumen ratio (p=0.009) of eggs from betaine-supplemented hens. Overall, breeder hens supplemented with 2000ppm betaine performed better than control or hens supplemented with 1000ppm betaine.

Developing and implementing the South Australian Sheep Industry Blueprint

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The South Australian Sheep Industry Blueprint (Blueprint) has a target of increasing the value of the industry by 20% from $1.48 billion to $1.80 billion by 2020. The Blueprint development was guided by a working group with experience spanning the sheep industry, a wider reference group, comprehensive industry consultation and consideration of national and state plans. The primary areas of focus of the Blueprint are 1. Resilient and profitable production systems, 2. Efficient value chains that optimize total returns, 3. Enhance consumer and community support and 4. Building industry capability and capacity. An important differentiation to some plans is that the Blueprint has engaged a manager to pursue implementation. Success will be assessed against measurable targets relating to industry expansion, increased usage of the decision support tools of consultants and advisers, enhanced research, development and extension collaboration and effective communications with consumers.

Biserrulla pelecinus reduces leptin secretion in dry merino ewes

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Leptin and insulin are metabolic hormones that are sensitive changes in nutrient intakes and might be linked to animal performance. We investigated the effects of legume and grass pastures on body condition and circulating concentrations of leptin and insulin. Sixty dry merino ewes were offered unrestricted grazing for eight weeks on annual ryegrass, subterranean clover, side-by-side monocultures of ryegrass and subclover, serradella, or biserrulla. Feed on offer, pasture nutritive composition, changes in sheep live weight and body condition were measured weekly and blood samples were taken on three occasions for plasma leptin and insulin quantification. Although there were no differences in growth rate, body condition and blood plasma concentrations of leptin were lower in the biserrulla sheep compared to the ryegrass, subterranean clover and serradella sheep. Leptin appears more sensitive than insulin body condition change and may predict carcass composition and be influenced by pasture species.
Genetic parameters of female reproductive traits measured by ultrasound in beef cattle

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Reproductive status of 4649 heifers and 2051 lactating cows was recorded in 7 herds representing Brahman, Droughtmaster and Santa Gertrudis beef cattle breeds. The traits measured were incidence of ovarian corpus luteum (CL) discerned by real-time ultrasound inspection of the reproductive tract at around 600d of age in heifers, and stage of pregnancy in first-calf lactating cows. At 600d the heifers averaged 340kg and 40% had detectable CL; lactating cows averaged 474kg and a 64% pregnancy rate. Estimates of heritability of incidence of CL at 600d (0.20 to 0.32) and stage of pregnancy in lactating cows (0.10 to 0.17) in the herds suggested that a substantial proportion of the trait variation was due to additive gene action. Small to moderate genetic correlation with other important traits and the range in trait EBVs suggested ample opportunity for genetic improvement of the traits by selection of superior breeding animals.

Qualitative behavioural assessment (QBA) of remotely captured video footage can identify positive and negative welfare states in sheep

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Qualitative behavioural assessment (QBA) may be a useful on-farm technique for measuring both positive and negative welfare states of sheep. Video footage was collected from 36 Merino wethers within four treatments: control, habituated, lame and inappetant, and assessed by a total of 38 observers using the two QBA approaches of Free Choice Profile (FCP) and Fixed List (FL). Generalised procrustes analysis (GPA) was used to generate a consensus profile for each QBA approach, and treatment differences were identified using ANOVA. Using both FCP and FL, observers were able to distinguish habituated and lame individuals from the control group based on their behavioural expression (P<0.05). However, observers were not successful at distinguishing inappetant individuals from control individuals using either QBA approach. Overall, it appears that QBA is sensitive to both positive (habituation) and negative (lamesness) welfare states, and can be used on remotely captured video footage collected on-farm.

Relationships between handling, behaviour and stress in lambs at abattoirs

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Relationships between stockperson, dog and lamb variables pre-slaughter and plasma cortisol and glucose in lambs post-slaughter were studied in 400 lambs. CCTV video footage was used to record stockperson, dog and lamb behaviour immediately pre-slaughter. Blood samples for cortisol and glucose analysis was collected immediately post-slaughter. The regression models that best predicted plasma cortisol and glucose concentrations post-slaughter included a mixture of stockperson and dog variables as well as lamb variables both on-farm and pre-slaughter. These regression models accounted for 21% and 20% of the variance in plasma cortisol and glucose concentrations, respectively. The identification of these predictor variables of cortisol and glucose, which may be a mixture of independent and mediating variables, support the well-demonstrated effect of handling on fear and stress responses in livestock. These relationships, although not conclusive evidence of causal relationships, highlight the value of training stockpeople to reduce fear and stress in livestock at abattoirs.
Gilts from female-biased litters behave differently than gilts from male-biased litters

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Gilts from male-biased and female-biased litters were assessed for anxiety and aggression. Anxiety tests were performed at 11 and 21 days of age in an arena, recording emergence time from a test box, movement, vocalisation, and interactions with an object. Piglet behaviour was recorded for 1 h at 3 and 27 h post weaning, recording fight number and duration. Injury scores were also noted at these times. Female-biased gilts took longer (P=0.016) to enter the anxiety arena on day 21 than male-biased gilts. There were no other differences in anxiety measures. Fight number and duration at weaning were not different but a trend (P=0.063) towards a higher number of scratches for male-biased gilts the day after weaning indicate more intense fights occurred. Further research is needed to determine whether behavioural differences associated with litter gender bias are fixed and so potentially useful as a part of the gilt selection programme.

Changing the sex ratio of lambs may alter gross margins in sheep flocks

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The proportion of male to female lambs weaned has the potential to alter flock performance. A simulation study compared the gross margins resulting from altering the proportion of wether or ewe lambs in a crossbreeding (Merino ewe producing crossbred lambs) flock and in a self-replacing Merino flock in southern New South Wales for the period 1971-2011. The mean gross margin was increased with more ewe lambs when a price premium was obtained for ewe compared with wether progeny, but was increased by more wethers if ewe and wether lambs were sold at the same age. The particular management and price variables used have a large impact on whether an increased proportion of ewe or wether lambs will increase or reduce gross margins. Producers need to consider the market options for their enterprise and systemic effects on production and costs before skewing the sex ratio of their flock.

Use of strategic sow confinement with farrowing induction can achieve similar stillborn mortality and reduce overlay caused piglet mortality compared to loose housed sows

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Sow confinement around farrowing can negatively affect farrowing performance, alternatively reducing confinement can increase live born piglet mortality. This experiment investigated the effect of reducing sow confinement pre-partum and applying confinement prior farrowing on farrowing performance and piglet mortality compared to loose housed sows. Sows were allocated to one of two treatments: 1) OPEN: sows were housed in an open swing-sided pen, and farrowed naturally, 2) CLOSED: sows were housed in an open swing-sided pen until 8am on the day of farrowing and the pen remained closed thereafter, and farrowing was induced with synthetic prostaglandin. Inter-piglet birth intervals, stillborn number and total live born piglet mortality were similar between treatments. CLOSED sows had less piglets die due to overlay (P<0.01). Reducing sow confinement pre-partum and applying confinement prior to farrowing, with the use of farrowing inducement, can achieve similar farrowing performance and reduce overlay mortality compared to loose housed sows.
Examining the relationship between colorimetric measurements and microbial loading of beef meat

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This study aimed to evaluate the relationship between instrumental colour measurements of m. longissimus lumborum (LL) beef steaks and microbial profile. 128 LL were used in this study, kept under simulated retail display and measured for colorimetrics (L*, a*, b*) and the ratio of absorbance at 630 nm and 580 nm (R630/580) daily (0, 1, 2 and 3 days). At the commencement of the display period (day 0), LL were analysed for lactic acid bacteria (LAB) and Enterobacteriaceae (ENT) loading. LAB was significantly correlated to all colorimetrics except L*. The strength of these correlations generally increased with display period. Only ΔE (change in colorimetric measures over the display period) was correlated with ENT. These results suggest that colorimetrics may have potential for monitoring beef microbial content, although the strengths of these correlations severely restrict its practical adoption. Thus, the basis of these correlations and their robustness should be further explored.

Development of a remote sensing device to detect duration of parturition in ewes

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Lamb survival is a multifactorial problem for the sheep industry, with particular relevance to Australian Merinos. Dystocia is a major contributor, both directly and indirectly through increased prevalence of lambs affected by the Starvation/Mismothering/Exposure complex. Prolonged labour is linked to increased risk of hypoxia in lambs, resulting in ischemic brain damage and consequentially impaired cognition, vocalisation and ability to display appropriate behaviours. Here we describe our strategy in developing an accelerometer based movement sensor to detect lambing, with a view to providing a tool for remote measurement of parturition duration in sheep.

Livestock production - 2050 and beyond

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In the debate about feeding a growing world population, rarely is consideration given to the effect this might have on farm animal welfare. Livestock farming practices can adversely affect welfare by failing to provide animals with their basic needs, such as adequate space and the freedom to express innate behaviours. If we are to grow animals for food or fibre, surely we can do so without compromising their welfare? What if we first address the glaring deficiencies in today’s food supply chain? Up to 50% of all food produced is wasted. In addition to food wastage, the livestock industry’s contribution to greenhouse gas emissions poses a challenge to the sector. Poor eating choices contribute to a significant public health concern affecting Australians. It is only when we include ‘animal welfare’ in the mix of these economic, social and environmental factors that livestock production systems will be truly sustainable.
Demonstrating a successful premium pasture-fed beef value chain

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Consumer demand for naturally raised and ethically produced beef, backed up by on farm assurance programs is growing globally. JBS Australia has partnered with the Victorian Department of Economic Development, Jobs, Transport and Resources (DEDJTR) to initiate the development of a value chain project for beef producers supplying into their premium pasture fed branded market, underpinned by a third party audited on farm assurance program. Through the establishment of facilitated supplier groups and engagement with the JBS procurement and marketing team a unique value chain approach has been established whereby regular interaction, open communication, transparency and clear pricing signals through the chain have enhanced relationships and added value to all segments.

The use of carbon dioxide to stun pigs - benefits, drawbacks, and the way forward from here: a review

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The two main methods of inducing unconsciousness in pigs prior to slaughter in Australia are exposure to carbon dioxide gas, and electric stunning. Stunning using carbon dioxide offers benefits including improved meat quality, the ability to stun animals in groups and with minimal restraint, and less pre-stunning handling compared to other methods of stunning. However, in recent years, there have been a number of welfare considerations identified with carbon dioxide stunning. These include the highly aversive nature of the gas, the variability between individual responses, that pigs are not rendered unconscious immediately, and that studies have identified that the procedure is not free of pain and distress as was initially suggested. Further research is urgently needed to develop stunning systems which retain the positives of carbon dioxide stunning while minimising the negatives.

On farm factors increasing dark cutting in beef cattle

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King Island pasture raised cattle (n=3,185) sent for slaughter on mainland Tasmania were evaluated to determine which on farm factors increased the incidence of dark cutting. Cattle were sent in groups (n=61) to slaughter from March - June 2015. Animal and management factors were recorded and forage quantity and quality was measured. The incidence of dark cutting in groups of cattle accessing dam water decreased by 22.9% from 25.2% Â± 3.2 as pasture magnesium concentration increased from 0.18% to 0.28% DM (P<0.01). Groups of cattle with a dam water source had 5.9% higher dark cutting than groups with access to trough water (8.5% Â± 1.8, P<0.01). Groups of cattle which did not receive supplementary feed (hay/silage) had a 6.1% increase in dark cutting compared to groups on pasture alone (8.4% Â± 1.7, P<0.01). Steer groups had an 11.3% Â± 2.6 higher rate of dark cutting than heifer groups (P<0.01).
Maximum survival of lambs to weaning is achieved when Merino ewes are in condition score three prior to lambing.

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We examined the effect of pre-lambing condition score of ewes on the survival of their lambs to weaning. Pre-lambing condition scores from adult ewes (n=1545) were collected over six years and analysed with their lambing and weaning records (n=3582). Maximum survival of both twin and single-born lambs prevailed when the pre-lambing condition score of ewes was between 2.5 and 3.5. This optimum range was consistent across all lambing years and implies that a pre-lambing condition score target of 3 is adequate for Merino ewes carrying single or twin foetuses.

Caffeine increases an neonatal piglets body temperature and negatively effects survival at 24 hours of age

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Piglet pre weaning mortality is a major economic and welfare concern. Caffeine administration prior to, or after, parturition positively affects metabolic parameters associated with neonatal survival. However the impact of dosing piglets with caffeine at varied time points within 24 hours of birth on temperature and survival to post-natal day 20 (weaning) has not yet been evaluated. Piglets received caffeine orally at birth and 24 hours post-partum or 8-12 hours and 24 hours post-partum. Body temperature was collected 10 minutes, 24 and 72 hours after birth and mortality recorded to post-natal day 20. Regardless of timing of administration, caffeine increased piglet body temperature 24 and 72 hours post-partum (P<0.05). Piglet mortality within 24 hours post-partum was higher (P<0.05) for the caffeine at birth treatment group (8.5%) compared to all other treatment groups (range: 2.5% - 3.5%). Although caffeine positively affected thermoregulation, survival of piglets receiving caffeine at birth was reduced.

Feed intake for sheep can be measured precisely in less than 35 days

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The model for measuring feed intake in sheep has been adapted from research with cattle, which recommends a 35-day test period. We used feed-intake data from sheep to see if the optimum test period was different. Variation in daily feed intake of sheep became stable in less than 35 days, and correlations between 21 and 35 day test periods were ≥ 0.95. Feed intake can therefore be measured in less time for sheep than cattle.
Ewes classified as good mothers have greater cortisol responses when separated from their lambs than ewes classified as poor mothers

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This study evaluated the responsiveness of the HPA axis of ewes to lamb removal to assess if HPA axis responsiveness is an important attribute of maternal behaviour. We used a 5 point maternal temperament score to characterise the behaviour of a flock of Merino ewes at Minnipa Agricultural Centre, Minnipa, South Australia, Australia from 2012 to 2015. We selected six ewes that received a maternal temperament score of 4 or 5 in each year and reared 100% of their lambs and defined them good mothers. We selected six ewes that received a maternal temperament score of 1 or 2 and reared <100% of their young and defined them as poor mothers. Ewes categorised as good mothers had a greater cortisol response to lamb removal than ewes classified as poor mothers. The greater cortisol response in good mothers may contribute to behavioural and physiological mechanisms to protect lambs in threatening environments.

Metabolisable energy intake but not crude protein intake or bovine somatotropin hormone (bST) increased hip height in Bos indicus cross steers

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The objective of this research was to determine factors contributing to skeletal growth in growing steers. Thirty Brahman cross steers were allocated to one of six treatments with five steers per treatment. Steers were fed a low crude protein (CP) diet (Mitchell grass ad libitum (MAL)), high CP and high metabolisable energy (ME) diet (lucerne ad libitum (LAL)) or a diet that contained high CP and low ME (lucerne restricted (LR)). All diets were injected with either 500 mg bovine somatotropin (bST) or saline control every 14 days. Feed intake was measured daily, liveweight (LW) and hip height (HH) were measured weekly. Hip width (HW) and body condition score (BCS) was measured every 14 days. LAL steers had higher feed intake, liveweight gain (LWG), HH, HW and BCS compared to steers fed other diets. bST injection increased LWG only if diets contained CP and ME for growth were provided.

Effect of combined cold, transport and handling stress in mid- and late-pregnancy on morphometric measures in lambs

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Lamb mortality is an important issue for animal welfare and livestock productivity. Previous research has shown that shearing during pregnancy can increase lamb birth weights, however, the contributing roles played by stress or resulting cold exposure have yet to be fully understood. This trial was designed to examine the effect of repeated acute and cold stress in pregnant ewes on the live weight, girth circumference, crown-rump length, forelimb length and cannon bone length of lambs. Pregnant animals were exposed to a combination of stressors (yarding, transport, hosing and 3hr cold exposure) 5 times over a period of 10 days at either mid-pregnancy (90d) or late-pregnancy (120d). A control group was not exposed to the stressors. Blood samples were collected in ewes to observe possible changes in glucose levels. Prenatal stress in mid-pregnancy resulted in reduced birth weight in singletons but not in twins.

Variation in sexual activity of young Border Leicester rams treated with melatonin in spring

Dr Dave Kleemann  Poster
Lack of sexual behaviour in young Border Leicester (BL) rams may be responsible for occasional low pregnancy rates when rams are mated to Merino ewes in spring. This study examined if treatment with melatonin improved sexual activity of BL rams managed on two properties in South Australia. All 7 melatonin treated rams and 6 out of 7 untreated rams displayed normal libido at one location. In contrast, 4 out of 7 treated rams were active while none of the untreated rams mounted oestrous ewes at the other site (P<0.05). Reasons for the variation observed between sites are not known and require further study.

1257 The National Grass Seed Action Plan provides a model for addressing an issue impacting the whole supply chain

Grass seed contamination of carcases is a problem that affects all sectors of the lamb supply chain nationally. The Australian lamb industry has adopted an approach to a solution that involves all sectors of the supply chain. Critical success factors have been a shared plan and a desire to collaborate for greater collective benefit, a desire to increase transparency along the supply chain, a focus on delivering quality product that meets customer expectations, and a Research Development Corporation (RDC) that valued the industry productivity and profitability potential of addressing a whole of value chain issue.

This approach has been successful in creating awareness of the issue and providing solutions to create greater transparency within the industry and resulting in ownership of the problem by all sectors.

1258 An evaluation of post-partum re-mating intervals in grasscutter (Thryonomys swinderianus) does

A breeding experiment was conducted using 24 (6 bucks and 18 does) sexually matured grasscutters to evaluate the post-partum re-mating interval on some reproductive traits (number of pups born alive, still born, average litter size at birth, average litter weight at birth, average litter size at weaning and mortality) of grasscutter does. Sexual maturity of the experimental animals were certified using birth records, darkened perineum and vaginal plug (for females) all of which are signs of sexual maturity peculiar to grasscutters. Animals were assigned eight (2males and 6 females) per treatment in a completely randomized design. Treatments were re-mating intervals of 2, 4 and 6 weeks adopted for the study. After first parity was obtained from does in each treatment group, they were re-mated according to re-mating intervals and pups weaned accordingly. Results revealed that re-mating intervals had no effect on reproductive traits assessed.
Saleable meat yield affects lamb carcass value

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The value of saleable meat yield (SMY) to lamb processors was investigated using two Australian abattoirs as case studies. The Lamb Value Calculator was used to simulate the effect of carcass weight and fabrication on yield. The value of SMY to the lamb processor was dependant on carcass weight, level of fabrication and discounts applied to individual cuts. A 1% change in SMY had a greater effect on net return of heavy carcases (27kg) compared to lighter carcases (21kg). However, discounts applied to some heavy carcass cuts decreased the effect on the value of yield. Indeed, there was no difference in the value of yield to the processor between 24kg and 27kg carcases. Increasing the level of fabrication increased the value of yield to the processors. The value of SMY to processors is plant specific and can be used to assist in sorting decisions and to support value based trading.

Exposure of bulls to high heat load decreases efficacy of scrotal thermoregulation

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Optimal sperm production requires bulls to maintain scrotal temperature (ST) within a narrow range below that of body temperature (BT). This experiment examined the bulls' capacity to maintain ST under high heat load. Six Wagyu bulls with temperature recording data loggers surgically implanted in their flank and attached to the visceral vaginal tunic were subject to two types of heat treatments, in a 4 period crossover design with a recovery phase in between treatments. Treatments included a 5 d acute treatment representative of heat wave conditions and a 13 d chronic treatment representative of a hot summer. Climate controlled facilities were used for treatments and outdoor individual pens for recovery. Acute treatment significantly increased the BT diurnal cycle compared with recovery (P < 0.05). Scrotal temperature showed larger ranges during treatments compared with recovery. During acute treatment ST rose to 35.59 ± 0.29 °C potentially indicating compromise of thermoregulatory homeostasis.

Wild dog predation and flock productivity - field methods to quantify stress and behavioural responses of sheep in the line of fire

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Predation of sheep by wild dogs causes a substantial cost to production and animal welfare in dog-affected regions. However, there have been few attempts to measure physiological ad behavioural responses to predation events, mostly because measurement technologies have not been sufficiently developed to remotely measure those responses. Here we describe the use of inexpensive custom-made tools using off-the-shelf technologies to measure core temperature, cortisol and heart rate changes and the movement behaviours of ewes during simulated wild dog attacks. The technologies all showed potential and some preliminary data are presented to demonstrate the efficacy of each tool.
Productivity, leg health and range use of individual broiler chickens on a free-range commercial farm

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Individual broiler chicken range access was monitored until final pick up for slaughter. Birds were weighed and gait scored prior to and post range access (35 and 45 days of age) to investigate the relationships between body weight, leg health and range use. There were no weight differences prior to range access between birds that did and those that did not access the range. Birds that did access the range more than once had lower body weights at first and final pick up than birds that did not access the range. No birds were observed with a gait score ≥3 prior to range access. However by final pick up, birds that used the range more than once had more normal gaits than birds that never used the range. This study provides evidence of relationships between accessing an outdoor range and production and welfare characteristics in commercial free-range broiler chickens.

Emerging inherited diseases and animal welfare: A case study of congenital mandibular prognathia in Droughtmaster cattle

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Emerging recessive inherited diseases within livestock can have detrimental impacts upon animal welfare and can cause significant economic losses. Congenital mandibular prognathia in Australian Droughtmaster cattle is an emerging inherited disease that has a minor impact upon animal welfare. This study aimed to sequence the coding regions of the previously identified positional candidate gene FOXI2 to identify disease-causing mutations. Our results were inconclusive due to failed amplification of one of the exons. This study highlights the ease in which mapping recessive inherited diseases can be achieved, although the identification of disease causing mutations may still be challenging and can therefore delay the development of diagnostic DNA tests that can support the management of emerging inherited diseases through the improvement of animal welfare.

High protein content stimulates bone elongation on energy-restricted cattle

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The effect of metabolisable energy (ME) restriction with high and low (LR and MAL) levels of crude protein (CP) and high ME intake with high CP in the diet was studied using two distinct cattle genotypes. The diet treatments were high ME and high CP (LAL), low ME and high CP (LR) and low ME and low CP (MAL). The steers were fed the treatment diets in individual pens for 103 days. Liveweight (LW) and feed intake were measured weekly and hip height every two weeks. Blood samples were collected on days 78 and 103 for plasma metabolites and hormone analysis, respectively. Higher level of CP during ME restriction (LR) did not increase plasma concentration of IGF-1 but had a small increase in skeletal elongation rate. This suggests that dietary CP has an effect on the endochondral ossification process of cattle, but the role of plasma IGF-1 is not clear.
2265  Lamb growth and in vivo organic matter digestibility of arrowleaf clover and bladder clover hay

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Twenty-four Merino weather lambs were offered a diet of either arrowleaf clover, bladder clover or subterranean clover hay ad libitum for 51 d. Individual liveweight and body condition score was recorded weekly, whilst in vivo organic matter digestibility was measured over a 7 d collection period. Liveweight gain was greater in lambs offered bladder clover hay compared subterranean clover hay. Dry matter intake (g) did not differ between the diets; although, dry matter intake adjusted for liveweight (g/kg) was greater (P = 0.003) in bladder clover hay than subterranean clover hay. In vivo organic matter digestibility was higher (P<0.001) in the bladder clover hay than both the arrowleaf clover and subterranean clover hays.

2266  Positioning of sensing microchips for detecting core temperature changes in sheep.

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Eleven crossbred ewes were implanted with temperature sensing microchips positioned in the neck muscle and tail regions, sites potentially suitable for remote temperature monitoring. Temperature measurements were taken at regular intervals from the microchips and from vaginal (core) temperature using iButton and thermocouple sensors. Temperature change was recorded over baseline and treatment periods where sheep were exposed to challenges designed to increase (i.v. lipopolysaccharide) and decrease (cold water gavage tube) core temperature. The temperature changes caused by the cold challenge were not well correlated with microchip temperatures. However, there were highly significant correlations between neck microchip amplitude and thermocouple and iButton measures when body temperature was rising. These results indicate that the location of the microchip implant affects its ability to accurately reflect core temperature changes and microchips implanted in the neck may be of use in remotely identifying feverish sheep.

2267  Profit Drivers for the Sheep Industry across climate and land class

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Beef and sheep enterprises are run across the most diverse landscapes and variable climates in southern Australia and consideration of profitable systems need to take this into account. Four case study farms were used to test a range of sheep enterprises and management options across farms and land types. Under constant commodity prices, the greater the supply and reliability of pasture production, the greater the reliance on sheep meat and live weight per hectare to increase profit. The higher the proportion of unimproved pastures and the lower and more variable the rainfall, the greater the contribution of wool to profit. The most profitable strategies for increasing live weight sometimes differed across sites, indicating that rainfall and pasture production influence the most profitable system.
Are neonatal beef calves getting enough to drink in northern Australia?

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The incidence of low milk delivery was assessed in 14 Brahman neonatal calves in the dry tropics of northern Queensland. Calf measures included live weight (as growth is primarily a function of milk intake) and urea space (a measure of body water). Urea space data were inaccurate. One calf dehydrated due to the dam having larger teats. Each of the remaining calves was categorised as having early (n=7) or delayed growth pattern (n=6), depending on whether calf live weight versus day of life had higher adjusted R2 for linear or exponential regression, respectively. Delayed calves did not reach the average growth rate of early calves (0.97±0.09 kg/d) until 4.2±0.7 days of life (P<0.05); and gained 0.57±0.1 kg/d prior to reaching this age. The high incidence of delayed growth in neonatal Brahman calves appeared to be related to delayed lactation, which may potentiate calf mortality under more stressful conditions.

Nutrition and its influence on early-life programming in animals

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Early-life programming is an area of research that seeks to discern links between gestational and post-natal environmental influences and long-term health status. Of particular interest in both animals and humans is the influence of nutrition on early-life programming. Nutritional status during gestation has been shown to potentially alter fetal development, for example, decreasing skeletal muscle mass. Nutrition during the neo-natal or post-hatch period has been shown to have long-term effects on performance, health and nutrient transporter expression. By understanding how nutrition influences early-life programming, we can develop nutritional strategies to optimize the lifetime health and performance potential of animals before they are even born.

Climate challenges for pastoral agriculture in Australia

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The Australian grazing industries will be affected by climate change, both through impacts on the animals and pastures, but also through imperatives to reduce livestock emissions. Research has traditionally focused either on mitigation or options to adapt to a changing climate, but both need to be achieved. Recent attempts to reconcile emissions reductions with increased global food demand have shifted the emphasis towards emissions intensity, or the carbon footprint, as a preferred mitigation metric. While a focus on emission intensity is more compatible with productivity gains, this may also lead to less resilience to climate shocks through increased intensification. Options for livestock producers to reduce absolute methane emissions are currently limited, as are options to cope with extreme climate events; both require further research. This paper will discuss these challenges, using case studies from a series of recent farm systems analyses conducted in the Australian grazing industries.
Pastures from Space - a practical application

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Pastures from Space has been commercially available to producers for more than 12 years. The system provides estimates of pasture production during the growing season by means of remote sensing. Satellite data is used to estimate pasture biomass and combined with climate data to produce pasture growth rate estimates. Feedback from producers indicates that there is a general lack of understanding on how they can use the data available and the perceived benefits.

By using a simple spreadsheet and historical data collected from the past 10 years of satellite modelling and from farmer’s records, the impact of the management on the productivity of the pasture system and its capacity to cope with seasonal variability and the effectiveness of strategies adopted over the past can be analysed. However, producers will need on-going support and access to simple tools (beyond Pastures from Space) to assist them with the interpretation of the information.

Implementing the Australian Funded ‘On-The-Ground’ Aid Program at the Holy Karbala Sheep Research Station in Iraq

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The Iraq On-The-Ground (OTG) Sheep Reproduction Technologies project was developed and implemented between 2010 and 2013 as a partnership between the Iraq Ministry of Agriculture and the Australian Government. The project was part of a larger OTG Program to assist Iraq to rebuild its agricultural expertise. A concurrent objective of the OTG methodology was to enable Australian agricultural capability, experience and support to be utilised in Iraq without exposing Australian professionals to the security risks posed by travel to Iraq. This was achieved by providing intensive training to Iraqi agriculturists in Australia, resources to establish on ground projects in Iraq, e-mentoring and online support, and bi-annual workshops in Jordan for “refresher training”, program review, evaluation, and planning. This paper reports on the outcomes of the OTG project during its implementation at the Holy Karbala Sheep Research Station in the Karbala region of central Iraq.

The case for livestock monitoring in the mixed farming region - is it possible to reduce management complexity without adding to it?

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The recent rapid expansion of digital technologies has meant that a range of livestock monitoring systems are becoming commercially feasible. In this paper we report a study to identify and evaluate priority monitoring applications, the feasibility of livestock monitoring technologies, and the level of interest by farmers. An analysis of the distance travelled by sheep grazing wheat stubbles is described, and the practical use of this information is discussed.
1280  Responses of deficient breeder cows to additional diet phosphorus
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An experiment examined the responses of non-lactating breeder cows fed low phosphorus (P) or adequate P diets. Plasma inorganic P concentrations indicated that animals fed low P diets were in severe P deficiency. Adequate diet P increased (P<0.001) voluntary intake of DM and metabolisable energy (ME) and liveweight (LW) gain. These increases were greater (P<0.05) with a higher ME content diet. Rib cortical bone thickness (CBT) was increased (P<0.05) by adequate diet P. The experiment demonstrated that large responses occur when P-deficient cows are supplemented with P during mid-pregnancy.

1281  Effects of time of sampling during the day on the concentration of phosphorus in faeces of cattle
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The concentration of total phosphorus (TotP) and acid insoluble phosphorus (AIP) in the faeces of steers held in metabolism crates was measured at five intervals during the 22 h after feeding. Steers were fed ad libitum once daily a semi-purified diet low in P (LowP), or the same diet with addition of calcium phosphate to provide sufficient P for high growth (HighP). There was no effect (P>0.10) of interval through the daily cycle on the concentration of TotP or AIP in faeces. It was concluded that the time of sampling of faeces after feeding does not affect the concentration of P in faeces of cattle ingesting diets with the P mixed through the diet. The results suggested that when faecal TotP is measured in grazing cattle no significant differences between treatments are likely to be observed unless the actual difference is greater than 0.5 g P/kg DM.

1282  Possible alternatives to methylene blue to treat nitrite-induced methaemoglobinaemia
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Crossbred ewes had blood samples taken which were then washed with sodium nitrite to convert haemoglobin to 100% methaemoglobin. Six treatment alternatives, including riboflavin, nicotinamide, lactate, formate, ascorbate and methylene blue were added to nitrite treated sheep erythrocytes and their methaemoglobin concentrations were measured every two hours over a ten hour period. Methaemoglobin levels reduced in all treatments over time. Methylene blue was the only treatment to significantly accelerate methaemoglobin reduction compared to the control. Ascorbate and lactate showed a trend in reducing methaemoglobin although at a much slower rate than methylene blue. It was concluded that methylene blue remains the most efficient treatment in reducing methaemoglobin back to haemoglobin.
1283  It's Ewe Time - a national productivity stimulation campaign  
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The Australian sheep flock contracted by 31% between the late 1990â€™s and 2010. Concurrent industry restructuring caused a shift away from wethers towards a greater proportion of ewes in the flock. However strong demand for lamb resulted in prime lamb production increasing from a declining ewe base. It’s Ewe Time was initiated to create a timely sense of industry awareness, enthusiasm and urgency to improve on-farm productivity gains and address declining ewe numbers. Seven forums were run during winter 2010 and nine forums during winter 2011 across Australia.  
The forums were highly successful in engaging producers, reaffirming key productivity messages, increasing producer awareness and knowledge of practical, relevant on farm practices and demonstrating the business value for changing and modifying management practices. Itâ€™s Ewe Time reinforced Meat & Livestock Australia (MLA), Australian Wool Innovation (AWI) and Making More from Sheep (MMFS) as credible sources of science based, on-farm management information.

1286  Meat Consumers Ignore Online Animal Welfare Activism  
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Social media has become an integral part of everyday communication for many citizens across the globe. People access news on platforms such as Twitter and Facebook through shared links from news websites, and through images and videos shared by various organisations. The increased adoption of social media sites by organisations such as Animals Australia and People for the Ethical Treatment of Animals (PETA) has sparked concern within livestock production industries, who often claim that such organisations post false or misleading content in order to damage the industriesâ€™ reputation. Ongoing research suggests that content shared by animal welfare activists is considered by some to be extreme and hence does not impact on peopleâ€™s choice to eat meat.

1287  Welfare issues facing the Australian Chicken Meat industry  
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The most important consideration to ensure good animal welfare is that there is science/evidence base to determine and/or inform good welfare practice as opposed to practice based on perception and perceived welfare benefits of current practice. To this end, R&D for the Australian Chicken Meat industry currently, and into the future, aims to identify what constitutes best practice and how to ensure that this information can be translated into action at the human:animal interface. There is also the added difficulty of being able to communicate what constitutes best practice (based on scientific evidence) to the broader community, particularly when this may contradict long held perceptions. An example of this is the move towards free range which is being driven by perception before the R&D has been able to identify what is appropriate or not for this type of production system.
Hormones, Stress and Animal Welfare
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There are numerous endocrine (hormonal) responses during stress and these are often complex. This complexity makes the study of endocrine stress responses challenging and the challenges are intensified when attempts are made to use measures of hormones to assess the welfare of animals because there are so many endocrine systems activated during stress and because there are countless stimuli that trigger these systems. Most research has concentrated on only a small number of these endocrine systems, particularly the hypothalamo-pituitary adrenal axis and the sympathoadrenal system and there is a need to broaden the scope of endocrine systems that are studied. Furthermore, systematic approaches are required to establish when the actions of hormones associated with stress responses result in physiological and/or behavioural consequences that will have negative or positive effects on the welfare of animals.

Productivity and phosphorus content of rib and tail bones in reproducing cows ingesting diets deficient or adequate in phosphorus
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During dietary deficiencies of phosphorus (P) cattle may mobilize bone P. Through an annual cycle of pregnancy and lactation Droughtmaster first-calf cows (initially c. 2.5 Y.O.) grazed as 6 paddock groups (each n 10) at a site in the seasonally dry tropics. Three paddock groups ingested P deficient diets, and the other 3 groups P adequate diets. Cow liveweight (LW), plasma inorganic P (PIP), milk production and calf growth indicated that herds were severely P deficient or P adequate. At the end of the experiment P deficiency had reduced rib cortical bone thickness (CBT) by 31% (3.31 and 2.33 mm, P <0.01), but there was little change in bone mineral density (BMD) of Cy9 tail bone (0.443 and 0.397 g/cc, P<0.05). In conclusion during extended P deficiency of young cows mobilization of bone P was much greater from rib bone than from tail bone.

Social Media as a Contributor to Food Policy Development
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Focus on food and food production practices has increased globally from both consumers and citizens. Parallel to this increase has been development of social media technology, along with capabilities to analyse online dialogue and engage in dynamic conversation across a global network in short time frames. Insights from social media analytics can complement other sources to inform language and scope of policies and communications related to food production, to ensure that societal concerns are addressed and allow opportunities for stakeholders to be engaged. This is particularly important in relation to animal welfare, where science, policy, and societal values are inextricably connected. Organizations can also use insights from social media to monitor the perception of their brand, and reactions to their policies, in near to real-time, while using social media to positively engage stakeholders in discussion of their policies and manage concerns.
1294  Serological responses to Salmonella Typhimurium infection in laying hens

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Salmonella detection by bacteriological culture along with serology is a common practice in poultry industry. The present experiment was conducted to study the antibody response of laying hens to Salmonella Typhimurium infection using enzyme-linked immunosorbent assay. At 14 weeks of age, hens were orally inoculated with 10^9 colony forming units (CFU) of either S. Typhimurium Definitive Type 9 or combination of S. Mbandaka and DT9. Serum samples were collected at day 0 followed by 1, 2, 4, 6, 8, 10, 12 and 14 weeks post infection (wks p.i.). Serological analysis revealed a strong immune response to S. Typhimurium infection. Antibody titers started to rise from 1 wk p.i., peaked at 6 wks p.i. and persisted throughout course of study (14 wks p.i.) in both infected groups. The results of this study suggest that serology can be used as a preliminary screening of S. Typhimurium infected birds for further bacteriological examination.

1296  Pasture quality and pre-slaughter mob movements increase the incidence of dark cutting beef

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Dark cutting beef, defined as meat of pH >5.71 or colour >AUS meat colour score 3, is detrimental to meat quality and results in significant financial losses to both producer and processor. Meat colour and pH are a function of the animals muscle glycogen status, and the resultant levels of lactic acid produced as muscles contract post-slaughter. The incidence of dark cutting in pasture-finished cattle is seasonally variable and in particular, the Limestone Coast region of South Australia experiences greater overall incidence compared to the national average. This study aimed to identify on-and-off-farm risk factors for dark cutting within pasture finished cattle from the Limestone Coast. Data was collected on 39 mobs totaling 2241 animals, with farm management, pasture composition, blood parameters and carcass traits recorded.

1297  Towards a sustainable and effective model for extension and adoption investment in the red meat and livestock industries

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Significant changes in the extension delivery landscape have been occurring over the last 15 years, largely with the public sector withdrawing services and resources. Industry organisations such as Meat & Livestock Australia (MLA) have been heavily reliant on partnerships with the public sector for extension program delivery and with the changes across jurisdictions, MLA has needed to rethink our extension and adoption investment strategy. The review process has incorporated evaluations of existing programs, conducting a skills needs analysis of our producers and engaged industry stakeholders. The result of this process has defined a new model for extension and adoption investment to test with industry, that will support high impact of research and development (R&D) outcomes, while at the same time initiate a model that will enable resources to be self-sustaining for the long term.
1298  Drafting cattle for slaughter should not limit use for genetic evaluation
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Capturing data for genetic evaluation from commercial herds can be problematic. One of the limitations relative to research projects is that in commercial herds it is common for cattle to be drafted prior to slaughter based on carcass price grids. This paper generated an artificial draft factor based on carcass weight and then examined the effect of this on genetic analysis of carcass quality traits. Compared to fitting carcass weight as a covariate for carcass quality traits, the impact of drafting was negligible. Thus, this should provide confidence for greater use of commercial data for genetic evaluation. Even a small proportion of MSA graded carcasses utilised would increase the amount of carcass data in BREEDPLAN enormously.

1299  Size Matters - Heavier and carcasses with greater marbling have greater variation in traits affecting beef eating quality.
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The motivation behind the wider study is to examine the extent to which MSA Index of commercial animals is related to estimated breeding values (EBVs). MSA data from 23,128 lots containing 1.37M carcasses from southern Australia were analysed to determine the amount of variation between lots in the standard deviation of carcass traits within the lot. There was a moderate scale effect observed for carcass weight and marbling, a 100 kg increase in the lot mean carcass weight resulted in an increase in the SD of marbling by 27 points. Therefore predicted gains in MSA Index at a given level of genetic improvement in IMF or carcass weight EBV will depend on the carcass end point for weight and marbling. The implication of this work is that the superiority of progeny from bulls with superior carcass trait EBVs depends on the weight at which steer progeny are finished.

1303  Feeding frequency and rate of nitrate ingestion affect nitrite toxicity in sheep supplemented with dietary nitrate
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Three rumen cannulated sheep were fed 1 kg chaffed hay treated with 2% nitrate either once a day, twice a day or hourly during three periods according to a Latin square design. Blood and rumen fluid samples were taken over the day and residual feed was weighed at each sampling time. Sheep on the hourly feeding regime had significantly lower average blood methaemoglobin (MetHb) levels and lower average plasma nitrate concentrations. There were no significant differences in MetHb concentration between groups fed once or twice daily. Rumen nitrate and nitrite concentrations were variable between sheep but were unaffected by feeding frequency. Frequency and size of meals affects risks of methaemoglobinemia in sheep and is therefore important to consider when sheep are supplemented with nitrate. However, more explanations for the large variability between animals in average blood MetHb concentrations over time, which cannot be adequately explained by feed intake, are needed.
The effect of maternal parity and birth weight on ovarian follicle population of female pigs (gilts).

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We hypothesized the in utero environment in which a female pig (gilt) developed would significantly affect ovarian development. We determined the effect of birth weight (high versus low), maternal parity (gilt versus sow) and the proportion of females in the litter (low; 60%) on the characteristics of the antral follicle population at 21 weeks of age. Ovaries of light birthweight gilts contained more (P < 0.05). These data support the hypothesis that in utero environment affects ovarian development.

Nitrate encapsulated with paraffin wax inhibits short term methane production in sheep and effectively reduces the risk of nitrite toxicity

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Two forms of encapsulated nitrate (coated with palm oil or paraffin wax) were administered intraruminally to sheep and nitrate metabolism was evaluated by determining blood methaemoglobin (MetHb) levels as well as nitrate and nitrite concentrations in plasma and rumen fluid. Methane production was also evaluated with sheep on urea diets used as negative controls. Whereas no significant effect of palm oil coating was observed, coating with paraffin wax lowered MetHb levels, rumen nitrate and plasma nitrate concentrations. When nitrate was supplied directly into the rumen, a large variation between animals in the response of blood MetHb was observed, suggesting that individuals differ in their ability to metabolise nitrate. During the first 6 h of measurement, methane was reduced by nitrate supplementation, without difference between encapsulated and unencapsulated nitrate treatments. Encapsulating dietary nitrate can effectively protect sheep against nitrite toxicity without adversely affecting methane mitigation.

Increasing sire breeding values for post weaning fat improves the condition score of their adult ewe progeny in late pregnancy.

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We examined the effect of sire breeding values for fat on the condition scores of their hogget and adult ewe progeny at joining and during pregnancy. Ewes from the Maternal Efficiency Flock (n=1628) were condition scored regularly over six years. Ewes from sires with higher breeding values for fat were in better condition during late pregnancy than those from lower fat sires, but these differences in condition score were not evident at other stages of the reproductive cycle. Across the range of sires tested, an extra 1 mm of sire fat at post-weaning age was associated with an extra 0.16 of a condition score in their ewe progeny in late pregnancy. The extra condition score prior to lambing could result in improvements in ewe and lamb survival and or reduce the need for supplementary feeding.
Grape marc inclusion in ruminant diets reduces protein absorption

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Grape marc is a waste product of the wine industry with potential as an animal feed. The high content of condensed tannins in grape marc has the potential to protect dietary protein from ruminal degradation and could increase postruminal amino acid absorption. The effects of grape marc inclusion were tested at up to 30% of the ration on nitrogen digestion and wool growth in sheep fed a low-protein or high-protein roughage diet. Grape marc inclusion had no effect on nitrogen intake but increased faecal nitrogen output, indicating a reduction in whole-tract nitrogen absorption. Grape marc tended to reduce all measures of wool growth. There was no significant interaction between grape marc inclusion and basal diet on the variables measured. We conclude that grape marc in ruminant diets reduces protein availability to the animal and its use in rations should be restricted to animals that are unlikely to be ‘protein-limited’.

Prediction of beef eating quality using Raman spectroscopy

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A preliminary investigation to determine the potential for a Raman spectroscopic hand held device to predict sensory traits for 45 beef loins was conducted. Partial least squares regression models using Raman spectra to predict the sensory scores determined by an untrained consumer panel indicated that there was an ability to predict juiciness (R2= 0.41, R2cv = 0.17) and tenderness (R2= 0.36, R2cv = 0.22). However, further research is needed to determine the repeatability and robustness of these models.

Nitrate and canola oil are synergistic in reducing methanogenesis in cattle

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The effects of canola oil and nitrate (NO3), added to diets alone or in combination, on methane (CH4) emissions and rumen volatile fatty acid (VFA) concentrations were evaluated. The experiment was designed as a 4x4 Latin square using 4 cannulated steers over 4 x 15-day experimental periods. Dietary treatments were: control (CON: 40% lucerne chaff and 60% barley grain), OIL (CON + 5% canola oil), NO3 (CON + 2% nitrate) and NO3+OIL (CON + 5% canola oil plus 2% nitrate supplied as calcium nitrate). Total VFA concentration did not differ (P > 0.05) between diets, but NO3 increased acetate proportion and the acetate:propionate ratio, while OIL reduced it (P < 0.01). Compared with CON, NO3+OIL reduced (P < 0.01) methane yield (g CH4/kg DMI) by 29%. Methane-mitigating effects of nitrate and oil are more than additive and CH4 emissions were reduced without compromising feed intake or VFA concentration.
Programming lambs to improve utilisation of novel forages.

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In this study, we explored the role of the ewe as a transgenerational link in familiarising lambs to novel forages. We tested the hypothesis that exposure to saltbush either (a) in utero or (b) pre-weaning with their mother or (c) a combination of both will result in less variation in saltbush intake and better growth than (d) lambs that have had no exposure to saltbush. Exposure to saltbush, both in utero and with mum during lactation, led to lambs having higher growth rates when they grazed saltbush in conjunction with cereal hay after weaning. Lambs that had been exposed grew 60% faster than lambs that had not had prior exposure to saltbush. While there were no differences in mean saltbush intake between treatment groups, lambs subject to exposure with mum had almost half the variation in saltbush as a proportion of the diet, compared to lambs with no exposure.

4- Nonylphenol induced Genotoxicity assessment in blood cells of fish Channa punctatus using Comet Assay

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The present study has been undertaken to study genotoxic effects of endocrine disrupting compound nonylphenol (NP) on Channa punctatus after acute exposure using comet assay. Blood cells were used for the study and percent tail DNA was used as biological indicator. Fish were exposed to three sublethal concentrations (0.15 mg/l, 0.31 mg/l and 0.63 mg/l) of 4-NP for 24, 48, 72 and 96 hrs. Blood cell was found to show genotoxic effect and highest genotoxicity was found at 24 hrs of exposure followed by decrease in the value but at later hrs value again increases. So the present study is intended to shed light on the genotoxic potential of 4-NP in fish, Channa punctatus and to find the time for maximum induction of genotoxicity.

Major welfare issues facing the red meat industries in Australia

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The red meat industry has recently released a strategic plan which emphasises the importance of gaining and maintaining consumer and community support for the industry. This includes demonstrating continuous improvement in animal welfare, and minimising the impact of endemic diseases and the risk of exotic diseases. The key in doing this is how to put producers at the centre of improving welfare practices on their farm, giving them the tools to know what to tackle and how, helping them assess improvement and rewarding them for improvement, with a premium on assured labelled high welfare products.
1413  Animal nutrition: past, present and future - value of thinking across species and across disciplines

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The logical approach taken by Eric Underwood in the 1930s to solve Denmark Wasting Disease in sheep and cattle reared in coastal regions in south western Australia, provides a stimulus for creative thinking about the research process and where new advances in animal nutrition and productivity may be derived. Major advances in productivity in any industry or human endeavour over time have come from the adoption of new technologies. The challenge for animal scientists is to identify which new technologies will result in a major advancement for an industry. This paper provides examples where adopting knowledge from across animal species and across scientific disciplines has in the past, and may in the future, be used to advance the understanding of animal nutrition and to improve productivity of domesticated animals.

1415  Preparing the neonate for the transition from intra- to extra-uterine life

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Offspring mortality limits reproduction as well as animal welfare in livestock industries. A new focus on the neonate itself could improve survival beyond the static 80 to 90% that is commonly cited in both the sheep and pork industries. Neuroprotectants limit the CNS damage caused by oxygen deprivation during the birth process, an issue that has both direct and indirect consequences for survival. We have demonstrated that two compounds, MgSO4 and creatine monohydrate, improve the behavioural and physiological responses of the pig neonate after birth, suggesting they may be suitable for use in livestock species. Similarly, increasing the physiological maturity of the neonate at birth could improve survival, as we have linked maturity with improved behavioural and thermoregulatory outcomes. Development of novel means of enhancing physiological maturity are needed and will be facilitated by applying lessons learnt from one species to others.

1418  Precision Animal Breeding as a Sustainable, non-GMO Solution for Improving Animal Production and Welfare

Dr Tad Sonstegard  Keynote
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Although dehorning and castration are recognized as requisite practices in modern livestock systems, producers would like to avoid animal welfare issues that arise from current management methods. Increased criticism and scrutiny of both producers and the food industry emanates from a growing number of concerned citizens and NGOs with animal rights/animal welfare agendas. The optimal and simple solution for dehorning cattle is to breed for polled animals, but crossbreeding devalues animals when considering the cost of recovery to re-establish elite performance for production. Similarly, solutions for genetic castration would seem impractical due to obstacles for propagating sterile lines. In this study, we report the efficacy of precision cross-breeding, also known as gene-editing, as a means for elimination of dehorning and surgical castration.
Consumer valuation and attitudes towards farm animal welfare claims

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A representative (n=1009) sample of Australian meat consumers completed a comprehensive online survey in 2015. A discrete choice experiment (DCE) was used to determine the relative importance of farm animal welfare status versus other credence attributes, and the trade-offs meat consumers make between credence attributes when purchasing four types of fresh meat (beef, pork, chicken, lamb) products. Credence claims have a significant impact on purchase decisions for all meat types investigated. Overall, meat buyers value the No-Added Hormones claim more than claims relating to animal welfare status, including ‘Certified Humane’ claims and Free-Range or Pasture-Raised claims, as well as other credence claims (Organic and Antibiotic-Free). There is relatively little difference in consumers’ willingness to pay (WTP) for different claims across meat types; preferences for the credence claims are relatively independent of meat cut; and there are few significant interactions between socio-demographic characteristics and credence claims.

Consumers link ‘better’ farm animal welfare with better quality products

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Current consumer concern with farm animal welfare is part of ethical consumerism where consumers seek to reduce the impact of their choices on moral others . We have been examining consumers’ motivations to purchase food with animal welfare claims across two projects using qualitative approaches. Results suggest that consumers strongly link animal welfare claims with superior product quality. Consumer perceive that red meat production is extensive, in contrast to eggs, chicken meat and pork production. However concerns about ‘unnatural’ diets and confinement during transport in red meat production mirror concerns about intensive production systems. Understanding how consumers think about farm animal welfare and the role it plays in purchasing decisions is key to engaging both consumers and producers in discussions about how to develop animal products that are affordable, safe, nutritious, sustainably produced, and humanely produced.

Not all Australian families find it easy to talk about where meat comes from

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The contexts in which Australian families discuss animal production remains largely unexplored, hence we sought to understand how children learn about the origins of meat. Responding to an online survey, 225 primary carers, mostly parents, identified meal preparation as the context where most conversations about meat origins occur. Preference was expressed for having conversations about meat production before children were 5 years of age. Urban parents were more likely to say that they were conflicted about eating meat and to be more empathetic to children who chose to stop eating meat. In contrast, rural parents were more likely to feel that children should eat what they are given and that talking about meat origins is not a major issue. Children’s knowledge about where food comes from was important to both groups. Our findings suggest parental values and attitudes to meat production and consumption influence conversations about meat origins with children.
Translating animal welfare science into animal care standards

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Public policy for farm animal welfare is continuously evolving through science-based standards and codes of practice. Developing science-based standards is complex because scientific assessment of animal welfare involves multiple measures that capture different viewpoints on what constitutes a good quality of life for animals. Standards for space requirements, for example, can be based on measures of biological function, such as production performance, mortality or stress response or they can be based on the amount of space required to accommodate physical body size or activity patterns. Setting standards for different housing systems is even more difficult because of wide variations across systems and because different measures often lead to different conclusions about the welfare of animals in those systems. Systems that offer greater freedom of movement also generally increase risks for injury, disease and mortality. Future science-based standards for specific aspects of system designs will be important for mitigating these problems.

Systems impacts of introducing crop grazing into pasture-based systems

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Many Australian farms involve a mixture of livestock and cropping enterprises, with considerable variability in the extent to which these two enterprises interact. Each enterprise is a 'system' in its own right, but the introduction of crop grazing into a previously 'pasture-only' grazing enterprise increases the complexity of the system, to the extent that a systems approach is probably the only route toward a better understanding of the crop-pasture grazing system. The lecture and full paper will discuss how grazing can be achieved with minimal effects on grain production. One must also consider the dual-purpose crop in terms of what part of the system it is replacing.

Australian pork industry - Shaping our future, leading by example

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Good animal welfare practices are integral to the sustainability and productivity of the Australian pork industry. Australian Pork Limited (APL) is committed to investing in animal welfare research, and the knowledge and outcomes produced all feed into a system of continuous animal welfare improvement.
Assessing animal welfare during handling is simpler than assessing welfare in housing. The first step is preventing acts of abuse that everybody interested in animal welfare would want stopped. Acts of abuse include beating animals, poking sensitive areas, dragging downed animals, deliberate slamming of gates on animals and deliberate driving animals over the top of downed animals. The next step is to implement objective scoring of animal handling. The outcome measures that should be used are percentage of animals that fall, strike fences or gates, vocalize during restraint or moved with electric goads. These measures will bring handling up to an acceptable level. Further improvements in handling can be obtained with stockmanship training. Physiological measures of stress such as cortisol, lactate or glucose are useful for assessing handling methods because handling is a short-term stressor.

Differentiating between males and females pre-hatch, by adding a biological marker to the sex chromosome, is a new gene technology set to impact the poultry industry.

Genomics is transforming many fields of human understanding and endeavour, the agricultural sciences being no exception. The transformations include identifying the DNA responsible for particular conditions, and potential ways to modify such effects, through to ways of identifying individuals’ genetic merit. The latter is particularly relevant to animal production, but both research and implementation carry involve challenges. The idea of genes being something for the majority of attributes of interest is continually being eroded by genomic discovery. At the same time, an ever-expanding array of experimental tools provide increasing scope for understanding the biology of such attributes, which can enrich animal production research and understanding. Genomics demands large volumes of phenotypic data for both estimation of genetic merit and reliable elucidation of biological mechanisms. This means that animal production scientists and geneticists will need to collaborate in large-scale programs to exploit the full potential of genomics.
Balancing efficiency of production and product quality with new tools - the example of lamb

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The Australian lamb industry has been transformed since the late 1980s through a coordinated combination of RD&E, marketing, and implementation of new technologies, particularly around genetic improvement. On-farm, the changes have focussed on developing lambs that will grow to heavier weights without becoming over-fat. Throughout the transformation, the risk of reducing fatness too much has been understood, but industry has had limited tools with which to manage this risk. Over the last 7 years, this gap has been addressed, again by a combination of R&D and implementation, this time focussed on development of genomic tools that allow direct simultaneous improvement of lean meat yield and traits associated with eating quality. This paper outlines those tools, and explores possible lessons for R&D and industry from the experience over the last 30 years.

Improving Hen Welfare – Australian Egg Corporation Ltd’s (AECL) Hen Welfare Research Development and Extension (RD&E) Strateg

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The Australian egg industry has adopted a hen centric approach to welfare and needs tools to assist in demonstrating continuous improvement in achieving best practice. To this end, the Hen Welfare RD&E Strategy was initiated by AECL to inform the welfare debate through the provision of robust scientific knowledge and industry research priorities via a consultative process. The main focus is to provide innovative on-farm solutions through research projects that produce data, information and outputs that generate research outcomes and feed back into skills and knowledge development and quality assurance programs.

There are three key areas of activity necessary to rationally address animal welfare; consumer expectations, robust science and commercial reality. The challenge for R&D is to attempt to resolve some of the unanswered questions surrounding hen welfare, welfare research methodologies and consumer beliefs while factoring in the long term nature of science.

Breeding for better health and welfare in sheep – what is compromised if we do?

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Incorporating broader breeding goals into meat sheep breeding programmes such as traits that are important for health, welfare and maternal efficiency are important because they are often antagonistic to other breeding goals at a genetic level. This means that selection for higher productivity alone (e.g. lamb growth and litter size reared) can compromise animal welfare in the longer term particularly if new constraints (e.g. legislative) on farmers to control disease are introduced such as restrictions on the use of antimicrobials. Having key welfare indicators as new breeding goal traits, accurately recorded at birth and measured on animals of strategic importance in the population under selection, and under commercially-relevant rearing conditions widens the opportunity to select higher–performing sheep also with better innate ability to withstand disease in the future.
The Changing Drivers for Pork Production – Metabolic Modifiers
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Australia has been at the forefront of the development and adoption of technologies to improve the efficiency of pork production. However, there is now a strong tension between the use of these technologies that can have profound effects on improving the efficiency of livestock production and reducing environmental impact and the retailers and consumer groups. Never before has the environmental imperative been so important and yet there is increasing pressure to stop using technologies based on ill-informed perceptions about the environmental impact of farm practices. While these technologies do decrease eating quality these effects can be ameliorated through post-slaughter processes. Uncertainty around whether future technology will be adopted discourages investment in developing new approaches to improving feed efficiency. In conclusion, there is overwhelming evidence for the continued use and development of new technologies but retailers and consumer groups as well as trade barriers may prove to be too disruptive.

Off to the right start – how pregnancy and early life can determine potential health and production
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Animal producers are well aware that a runt animal is more likely to die in the first few days of life, and if it survives is likely to perform poorly. We are now coming to appreciate that early life events can permanently change an animal’s developmental trajectory. This is an area of current interest in biomedicine, where the concept is known as the “developmental origins of health and disease” (DOHaD). Current gaps in understanding include many of the underlying mechanisms, and whether and how we might intervene and restore the potential for healthy and productive development. This brief communication introduces the biomedical perspective of DOHaD, reviews some of the evidence for long-term effects of prenatal growth and other early life exposures on welfare and productivity in animal production, and discusses options for intervening to improve long-term outcomes.

Survive and Thrive ‘You can have your cake and eat it too’
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The on-farm value of sheep meat and wool produced in Australia exceeds $5 billion per annum, despite a national flock of just 42 million breeding ewes, half the number recorded in 1990. In order to ensure consistency of lamb, mutton and wool supply continued improvements in reproduction rates at the farm level are necessary, with the Sheep Industry Strategic Plan (SISP 2015), targeting a 5% improvement by 2020.

The main avenue to improve reproduction rates is to reduce the degree of reproductive wastage from mid-pregnancy to weaning. At an industry level the cost of lamb survival is profound, estimated to be in the order of $700m in potential revenue lost per year (Young et al. 2014). The Lifetimewool research (www.lifetimewool.com.au) improved understanding of ewe nutrition on ewe and progeny performance and developed guidelines for managing ewes that improve whole-farm profit and animal welfare (Young et al. 2010). These guidelines have been extended to over 3000 sheep producers nationally in Lifetime Ewe Management (LTEM) program. The LTEM program design provides a blueprint for future extension programs striving to achieve attitudinal and behavioural change.
NZSAP 1  Feed value of maize silage in New Zealand

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Average yields of maize grown per ha in NZ are high due to favourable climatic conditions which makes it an attractive crop option. Maize silage accounts for about 6% of feed energy supplied to NZ dairy cows. The objective of this paper is to provide information about the quality of maize silage in New Zealand. Six year average (n >3000) samples of fresh-chopped NZ maize show similar chemical composition and ME concentration when compared to overseas maize silage. A multitude of overseas in vivo measurement results show an average Metabolisable Energy (ME) of maize silage of 10.8 MJ ME/kgDM. New Zealand measurements of harvested maize for silage in multiple locations and across 4 years (2010-2014; n=1143) demonstrate that starch plus sugar concentrations are positively correlated with whole plant digestibility (R2=0.75), conversely high NDF concentrations are negatively correlated with whole plant digestibility (R2=0.80). Maize silage samples from Waikato farms in two harvest seasons (2012; n=83 and 2013; n=59) were analysed for a corn silage processing score (CSPS) a new standardized US laboratory method to evaluate kernel processing quality. Processing improved significantly demonstrating that new harvest technologies were adopted quickly from overseas.

NZSAP 2  Does ewe nutrition during pregnancy affect the neonatal behaviour of twin-born lambs?

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In this experiment the effects of feeding treatments during mid- to late-pregnancy on the behaviour of twin-bearing ewes and their lambs under extensive pastoral conditions are described. Fifty seven four-year-old ewes were offered either a medium (1164 ± 31.6 and 819 ± 16.0 kg DM/ha pre- and post-grazing, respectively) or ad libitum (2181 ± 47.6 and 1431 ± 24.6 kg DM/ha pre- and post-grazing, respectively) feeding treatment from day 76 of pregnancy until 12 hours after birth. At tagging (3 to 18 hours after birth) the time taken for the lambs to stand, make contact with, suck from and follow their dam was recorded in the paddock. A maternal behaviour score based on the distance the ewe moved away from her lambs was recorded for the ewes. Survival analysis showed that lambs born to ewes offered the medium feeding treatment from mid- to late-pregnancy until term were quicker to stand, suck and follow compared with lambs born to ewes offered the ad libitum feeding treatment (P < 0.05). It is unclear whether these behaviours indicate that lambs born to ewes in the medium treatment were more vigorous or that they had unmet needs that prompted the apparent increase in vigour. Ewe feeding treatments did not affect the maternal behaviour of the ewes (P > 0.05). Further research in this area is needed.
NZSAP 3  The impact of dam age on ewe reproductive performance at two years of age

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This study was undertaken to compare the reproductive and live weight performance of female singleton and twin ewes born to either mature or young dams between 18 to 2.5 years of age. One hundred and fifteen singleton- and twin-born female offspring born to either ewe-lamb (ELP, 8 months at breeding) or adult ewe (AEP) dams were maintained as one cohort under commercial New Zealand grazing conditions. Ewe live weights and body condition scores were collected as were ovulation rates at a synchronised breeding. Numbers of foetuses carried per ewe were collected. Lamb live weight and size measurements were taken at birth and live weights at weaning.

At 18 months the live weight of ELP ewes were lighter (P < 0.05) than AEP at breeding and during their first pregnancy but not (P>0.05) at the weaning of their lambs. Twin-born ewes were lighter (P < 0.05) than their singleton-born counterparts. There was no difference in the number of ovulations (P > 0.05; 1.49 vs. 1.32 corpora lutea for AEP and ELP, respectively) detected at breeding or number of foetuses carried. Lambs born to ELP ewes were heavier at birth (P<0.05) but there was no difference (P>0.05) in live weight at weaning.

Combined this data suggests there may be no negative long term impacts from selecting progeny born to ewe lambs as replacement ewes. However before this hypothesis can be supported lifetime data of these ewes needs to be collected.

NZSAP 4  The impact of lamb pre and post weaning growth rate on farm profitability

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Sheep and beef farmers often target an increase in lamb weaning weight and post weaning growth rate as a means of increasing on farm profit. Increasing these performance parameters invariably increases feed demand resulting in either a need to increase feed supply or reduce feed demand in some other area of the farm system. Depending on the feed supply profile an increase in these performance parameters may not result in an increase in profit. A model that optimises resource use was used to assess the impact of increasing lamb weaning weight and post weaning growth rate on farm profit and enterprise selection for three farms from different regions with a fixed feed supply. For each farm a number of scenarios were used to create a response surface of optimised systems. Farm profit, as measured by EBITDA, did not always increase with an increase in weaning weight or post weaning growth rate. Profit was highest in the Otago farm when weaning weight was at the base weight (27kg) and post weaning growth rate was 75 g/d greater than the base growth profile. Profit was highest in the Hawkes Bay farm when weaning weight was 32kg (6kg above the base weight) and post weaning growth rate profile was 50g/d greater than the base growth profile. In the Northland farm profit was at its highest at the two extremes, highest weaning weight (30.6kg) and post weaning growth rate profile (100g/d greater than the base profile) and at the lowest weaning weight (24.6kg) and post weaning growth rate profile (50g/d less than the base profile). This research demonstrates the interactions and trade-offs between feed supply and animal performance on farm and highlights that increasing animal production does not necessarily equate to increased profit.
NZSAP 5  Development and evaluation of a temperament scoring system for farmed deer - genetic and environmental components

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New Zealand deer farmers consider temperament to be an important selection trait, yet little is known about the environmental and genetic components of temperament. This study aimed to develop and evaluate a temperament scoring system for farmed red deer in a yarding situation. A total of 7867 observations of hinds and their progeny in a Deer Progeny Test project were obtained from 3 farms. Animals were scored by one handler for aggression, agitation (pen), agitation (crate), ease of handling and exit speed (crate), when yared for management procedures. Data was analysed using a Restricted Maximum Likelihood model (heritability, repeatability and behavioural associations were calculated from the model). Inter-observer reliability was between 70 and 82% (lowest for agitation (pen) and ease of handling), measured as percentage agreement. Heritability for aggression, agitation (pen), ease of handling, agitation (crate), and exit speed was 0.03±0.024, 0.23±0.077, 0.10±0.037, 0.17±0.056, and 0.04±0.021, respectively, for the progeny with a repeatability of 0.19±0.018, 0.24±0.022, 0.24±0.015, 0.25±0.017, and 0.17±0.013 (means±SE), respectively. Repeatability for hinds was 0.23±0.048, 0.16±0.068, 0.45±0.048, 0.38±0.052, and 0.27±0.061 (means±SE) for aggression, agitation (pen), ease of handling, agitation (crate), and exit speed, respectively. The lower repeatability in the progeny could partly be due to animals still habituating to handling and not having an established temperament. Animals that were agitated in the pen were also more agitated in the crate (r=0.35 and 0.48 for progeny and hinds, respectively). Other associations between temperament scores were weak (r≤0.23). Progeny gender did not greatly influence temperament; however, farm, year born, age, and the order of being drafted within a group influenced most scores (P≤0.022 for 16 traits out of 20). In conclusion, temperament of red deer can reliably be scored in a yarding situation. Agitation (pen) showed a moderate genetic component and could therefore possibly be included in future breeding programs.

NZSAP 6  Sustained diuretic effect of plantain when ingested by sheep

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Narrow-leaved plantain (Plantago lanceolata) was investigated for its potential to act as a diuretic in sheep. For 7 days two groups of sheep (n = 8) were provided with either ryegrass or plantain diets that had identical water content. Dry matter in feed, fresh faecal weight, and faecal water content were measured daily, as well as volume, specific gravity and osmolality of urine. Urine volumes on Day 1 of the trial were significantly different to those of Days 2-6 of the trial (P < 0.05) so the results were analysed separately. Plantain sheep had a higher volume of urine (by 1.7 L, P < 0.05) on Day 1 than Ryegrass sheep and continued to produce about 0.5 L more urine each day than Ryegrass sheep for the remainder of the study period. Because intakes of feed and water for the two diets were essentially equal, this study provides the first direct evidence to show that plantain causes a diuresis when it is ingested by sheep, possibly by reducing reabsorption of water in the kidneys.
NZSAP 7  Urine excretion of non-lactating dairy cows in late gestation fed fodder beet and kale based diets in winter

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Quantitative information on urination behaviour of dairy cows grazing winter forages is required to help improve predictions of nitrate leaching from urine patches. A study was conducted at Ashley Dene research farm in Canterbury using 24 Freisian x Jersey non-lactating, pregnant dairy cows fed two diets representative of industry practice. Diet treatments were 10 kg DM of fodder beet with 5.6 kg DM of ryegrass baleage (FB) or 16.4 kg DM of kale with 6.4kg of oat straw (KA). All cows were fitted with a urine harness for 24 to 48 hours which collected data on number, volume and ground cover of individual urine events. Urine volumes were similar (27.6 L/cow/d) though behaviour was affected by diet whereby FB cows urinated less frequently than FB (8.4 vs 10.1 events/cow/d, P>0.05) but with more volume per event than KA (3.58 vs 2.71 L/event, P<0.05). On their own similarity in total volumes (FB vs KA respectively) could not be explained by water intake (55 vs 69 L/c/d, P<0.05), N intake (237 vs 472 g N/c/d, P<0.05) apparent DM intake(13.4 vs 17.1 kg DM/cow/day, P<0.05) or sodium (530 vs 400 mg/cow/day, P<0.05). The urine patch areas on the FB grazing area were similar at 0.16m² than the kale patches at 0.23m² which is attributed to differences in paddock surface microtopography. The smaller, more dense deposits of N in urine patches and the stocking rate being three times at great resulted in a higher predicted volume of N being leaching from the fodder beet paddock at 123 kg/ha compared with 82 kg/ha for the kale paddock.

NZSAP 8  The influence of previous lactation on subsequent fertility in multiparous ewes?

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Ewes often lose live weight while they are lactating, but should be able to regain that prior to the following mating if pasture availability and sheep numbers are managed judiciously. Data was available from ewes (n = 647) lambing across a 13 year period. Since these sheep were Wiltshires, live weight was not complicated by fleece weight at mating or when their lambs were weaned. Average live weight of these ewes increased considerably between two tooth and 3 years of age, so only data from between 4 and 9 years of age were used. The average number of lambs born was (1.77 per ewe per year). Ewes rearing twins (41.4%), singles (43.1%) or not rearing (13.5%) were present at weaning. Though 9.6% of lambs were born as triplets, only 2% of lambs weaned as triplets in the 13 year period and data for triplet rearing ewes were pooled with twin rearing ewes. Ewes that did not raise a lamb (68.0 kg) were heavier than ewes that raised singles (63.0 kg) or twins (59.9 kg) (P < 0.001) when their lambs were weaned. All ewes were grazed together post-weaning and ewes that gained 5 to 10 kg before mating produced 1.9 lambs per ewe at the subsequent lambing, while those that lost 5 to 10 kg produced 1.6 (R² = 0.838). Provided ewes gained weight, there was no significant effect of previous number of lambs weaned on the subsequent number of lambs born.
Liver abscessation is reported as impacting the productivity of beef cattle under intensive total mixed ration production systems. There is anecdotal evidence of increasing liver abscessation on bull beef farms across NZ from meat processors for more than a decade, but no quantitative data published in the field. This study was performed to establish the incidence of liver abscessation in pasture based beef bulls and compare this with published data from lot fed cattle internationally. The study used a database of 137675 bulls slaughtered between 2000-2005. The database included breed, farm location, carcass weight, abscess grading score (absent, mild, moderate, severe). The annual incidence of liver abscessation calculated was a mean of 9.5%. This recorded value is greater than other observed incidences from pasture based systems, and reduced compared with those observed in non-medicated lot fed systems internationally. Incidence of liver abscessation peaked across November-December (11.3 and 11% respectively) and then declined as the slaughter season progressed. The typical NZ beef industry approach to rearing bulls for slaughter makes it likely that age at slaughter is a key influence on the seasonal incidence rate, with most cattle spring born and slaughtered after 18 months, suggesting the late spring and summer peak in incidence is due to bulls older than 2 years. The percentages of abscesses graded were: severe (66.4%), moderate (12.8%), and mild (20.8%). Friesian and dairy cross-breed bulls had overall an abscessation incidence approximately twofold greater than beef breeds (10.3% and 4.71%, respectively). There was also a clear regional difference in liver abscessation incidence, with an apparent ranking of regional incidence of liver abscessation and per hectare dairy production. There was a significant difference in the mean carcass weights of bulls graded with moderate abscessation having a mean heavier carcass weight than severe, minor and no abscess grades.

The objective of this study was to determine milk solids production and urinary nitrogen (N) concentration of late lactation dairy cows grazing a perennial ryegrass-white clover pasture (PA; n = 12), pure plantain (PL; n = 12) and an area that is made of 50% perennial ryegrass-white clover and 50% pure plantain by ground area (PA+PL; n = 12). Milksolids production was greater (P=0.01) for cows grazing PL (1.67 kg MS/cow/d) than PA (1.50 kg MS/cow/d), with cows grazing PA+PL intermediate (1.60 kg MS/cow/d). Urine-N concentration was 56% lower (P<0.001) for PL (2.4 g N/L) and 33% lower for PA+PL (3.6 g N/L) than PA (5.4 g N/L). Plantain may offer environmental benefits to dairy systems by reducing the urinary N concentration deposited on the soil of grazing cows in late lactation.

Plantain-clover mixes have a high metabolisable energy content and have been shown to support greater rates of liveweight gain in lambs both pre-weaning and post-weaning when compared to grass. The aim of this experiment was to determine if the plantain-clover mix could be used as a means to wean lambs earlier than normal. On 10 November 2015 (approximately 8 weeks after the midpoint of lambing), 67 twin-bearing ewes with both lambs at a minimum live weight of 16 kg were allocated to one of three treatments. The treatments were 1) ewe and lambs together on hill country pasture (n=22 ewes, 44 lambs), 2) ewes and lambs together on plantain-clover mix (n=22 ewes, 44 lambs), 3) lambs weaned onto plantain-mix and ewes on hill country pasture (n=23 ewes, 46 lambs). As the experiment is underway final results will not be available until mid-December. However, a pilot experiment in 2014 found that lambs displayed greater liveweight gain on the plantain-clover mix than on grass. Furthermore, the liveweight gain of lambs on the plantain-clover mix did not differ between those that were weaned and those that were still with their dam. Similar results are expected in the current experiment. Therefore this suggests farmers could wean lambs approximately one month earlier than normal practice and utilise their high quality plantain-clover mix for lambs and remove the ewes onto poorer quality pasture.
**NZSAP 15**  
**Effect of grazing system on nitrogen partitioning in lactating dairy cows grazing irrigated pastures in Canterbury, New Zealand.**

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Only 25-30% of the N eaten by milking cows is retained for milk protein and other biological needs. The rest is excreted in dung and urine. The N deposited in urine patches exceeds plant requirements resulting in surplus nitrogen being at risk of leaching, as nitrate, into waterways. Council nutrient limits to address nitrate leaching have brought this issue to the forefront of the dairy farming industry. An understanding of nitrogen intake and patterns of excretion in grazing dairy cows may help decisions around mitigation options such as stand-off areas and low N plants.

The research reported here compared two irrigated farming systems in Canterbury over four years between 2011 and 2015. The high stocking efficient system (HSE, n=34) was based on a stocking rate of 5 cows per/ha with an average application of 300kg/ha/year N fertiliser and ~1T DM/cow/year purchased supplement fed on the milking platform. The lower stocking efficient system (LSE, n=29) was based on a stocking rate of 3.5 cows/ha with 150kg/ha/year N fertiliser, minimal purchased supplement, and 40% of the farmlet sown in a diverse pasture mix containing herbs and legumes.

Urine, faeces, plasma, and milk samples were collected at consecutive afternoon (PM) and morning (AM) milkings, on a monthly basis for four milking seasons. Average faecal N% was 3.4±0.04 for both treatments and did not differ between AM and PM. Urinary N concentration (%) was higher in the AM for both treatments (0.54±0.03 vs 0.41±0.03 for HSE; 0.56±0.03 vs 0.46±0.03 for LSE) but did not differ between HSE and LSE. The opposite trends were observed for plasma urea N and milk urea N where both treatments had higher concentrations in the PM.

These results are discussed in relation to nitrogen intake, partitioning, animal performance and options for dairy farmers to meet environmental targets.

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**NZSAP 17**  
**Lactation curves for yields of dairy products from Holstein Friesian, Jersey and Holstein Friesian-Jersey crossbred cows.**

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The economic efficiency of a milk-processing system is influenced by seasonality of the milk supply, and changes to the product potential of that milk. Data from lactation curves for milk traits including lactose and milk product yields for Holstein-Friesian (HF), Jersey (J) and Holstein Friesian-Jersey crossbred (HFxJ) cattle were used as inputs in a deterministic simulation model to produce lactation curves for daily yields of dairy products. The dairy products were whole milk powder, skim milk powder, cheese, or butter. Dairy product potential was estimated for each cow from a population of 4333 mixed-breed, first-lactation cows. Lactation lengths differed (P<0.0001), among HF, HFxJ, and J, averaging 219, 222 and 221 days respectively. Milk yield was different (P<0.0001) among breeds and averaged 3257, 3092 and 2902 litres for HF, HFxJ and J cows respectively. Whole-milk-powder potential (yield per 1000L of milk) was greatest at the start of the season and least at the end of the season, whereas cheese-production potential (yield per 1000L of milk) followed an opposite pattern. Total-lactation whole-milk-powder yield was different among breeds (P<0.0001) at 366, 338 and 312 kg of whole milk powder for HF, HFxJ and J cows respectively. Total-lactation cheese yield was also different among breeds (P<0.0001), and was 371, 375 and 361 kg for HF, HFxJ and J cows respectively. The lactation curves indicate that milk is best processed into whole or skim milk powder during peak season and cheese and butter at the end of lactation, however this would limit the use of by-product lactose from cheese manufacture in the production of powders.
NZSAP 18  A physiological evaluation of the efficacy of pain-mitigation strategies for cauter-y-
disbudded goat kids

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Cautery disbudding is a painful husbandry procedure often performed on dairy goat kids. Standard practice worldwide typically excludes the use of pain mitigation, however successful administration can reduce pain associated with cauter-y disbudding. The objective of this study was to determine the effect of pain mitigation strategies on physiological responses to cauter-y disbudding in goat kids. Fifty Saanen kids (3 wk old) were randomly allocated to one of five treatment groups (n=10/treatment): 1) cauter-y disbudded (CAUT), 2) meloxicam i.m. and disbudded (I-MEL), 3) isoflurane and disbudded (ISO), 4) isoflurane and meloxicam i.m. and disbudded (MI), and 5) sham handled (SHAM). Blood samples were taken at 0 min (baseline) and 15, 60 and 120 min post-treatment to assess plasma cortisol, glucose and lactate concentrations. Body weight was measured at 24h pre- (baseline) and 24 and 48h post-treatment. Overall changes in cortisol (mean±SED) from baseline were higher (P=0.033) in disbudded than non-disbudded animals. Fifteen min post-treatment, CAUT (76.80±14.59nmol/L) had higher (P=0.033) cortisol levels than SHAM (22.50±14.59nmol/L). However, cortisol was lower in ISO (33.40±14.59nmol/L, P=0.033) and MI (33.40±14.59nmol/L, P=0.033) than CAUT and similar (P>0.050) to SHAM. The change in glucose (from baseline) was lower (P=0.016) in MI (-0.53±0.32mmol/L) than I-MEL and ISO respectively (0.45±0.32mmol/L, 0.21±0.32mmol/L). There were no differences across treatments for lactate (P>0.050). CAUT (0.44±0.10kg) had a lower change (P=0.004) in body weight (from baseline) than SHAM (0.81±0.10kg), MI (0.65±0.10kg) and ISO (0.69±0.10kg) at 48h. In conclusion, the lower change in body weight in cauter-y disbudded kids could be due to a decrease in feed intake in the first 48h post-disbudding. The reduced cortisol response in kids provided with MI and ISO suggests that these methods show promise as pain mitigation strategies for cauter-y disbudding in 3 wk old goat kids and more investigation into optimum treatment regimes is being undertaken.

NZSAP 19  Genetics of alternative definitions of feed efficiency in grazing lactating dairy cows

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The objective of the present study was to estimate genetic parameters for residual energy intake (REI), residual energy production (REP), energy conversion efficiency (ECE), energy conversion efficiency adjusted (ECEadj) and energy balance (EB) across lactations in grazing lactating Holstein-Friesian dairy cows. A total of 8,241 individual measurements of pasture and concentrate intakes were estimated on 2,510 lactations from 1,296 Holstein-Friesian cows under Irish grazing conditions and were used for analysis. REI was defined as energy intake minus energy predicted for production, maintenance and mobilization of body reserves, ECE was defined as net energy of lactation (NEL) divided by net energy intake (NEI), ECEadj was refined to consider the energy kinetics from live-weight and BCS change, while EB was determined by subtracting energy required for maintenance and lactation from NEI. Genetic and phenotypic (co)variances for the efficiency traits and EB were obtained with single trait and bivariate animal models using a restricted maximum likelihood methodology. The models included the fixed effects of contemporary group (herd-treatment-test date), parity, days in milk, the random effects of animal and cow permanent environment. Heritability estimates were 0.07 ± 0.02 for REI, 0.14 ± 0.03 for REP, 0.06 ± 0.02 for ECE, 0.06 ± 0.03 for ECEadj and 0.07 ± 0.02 for EB. A strong genetic correlation existed between EB and REI (0.76) suggesting similar genes are influencing each which has repercussions for genetic selection. Similarly, ECE and ECEadj were strongly genetically correlated (0.91). A strong negative genetic correlation existed between EB and ECE across lactations (-0.84) indicating that selection for more efficient cows would favour a lower energy status. Genetic parameters presented from Holstein-Friesian dairy cows fed predominantly grazed grass imply that genetic improvement in selected efficiency traits is possible.
NZSAP 20  Does mowing before grazing increase dry matter intake and milk yield of late lactation dairy cows?

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The inverse relationship between intake and utilisation of pasture at increasing herbage allowances often results in compromises between long term feed quality and intake. Mowing pasture before allocation to livestock is one management strategy suggested to improve both utilisation and herbage intake. To test this hypothesis a 2 x 2 factorial design grazing experiment was used to compare pastures at high (2800 kg DM/ha) and low (2200 kg DM/ha) herbage mass which was either mown three hours prior to allocation or was allocated as standing pasture. Forty-eight late lactation, Friesian x Jersey dairy cows were blocked into four mobs, randomly allocated to each treatment and offered the same herbage allowance (15 kg DM/cow/day above 3.5 cm) from each treatment. There was no effect of mowing on botanical composition or DM utilisation at high or low herbage mass. Nutritive composition of herbage was altered by mowing with increasing DM% (13.2 and 18.4% DM, P<0.05) and fibre concentration (31.8 and 39.4 % NDF in DM) compared with standing pasture. Apparent dry matter intake was reduced by mowing (16.0 vs 14.7 kg DM/cow/d). Milk lactose concentration tended to be reduced by mowing leading to lower milk volumes compared with cows grazing standing pasture. The difference in milk yield between mown and standing pasture was more pronounced for pastures at lower mass. Milk protein (590 v 535 g/cow/day, P<0.10) and milk lactose (660 and 610 g/cow/day, P<0.05) yield were lower for mown compared with standing pasture although this did not result in significant differences in milk solids yield. At similar herbage allowance, there is no benefit for milk production in mowing pasture before allocation to dairy cows in late lactation.

NZSAP 21  The success of immediate removal of goat kids from the doe as a colostrum management strategy

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A dam’s colostrum ensures that her kids gain immunity in their early life, however it can also transfer disease. Therefore, around the world, many dairy goat farmers have begun routinely removing kids from does immediately after birth to prevent colostrum consumption and potential disease transference. The kids are then fed alternatively sourced, bovine or heat-treated caprine colostrum to provide immunity, while eliminating a disease source. The goals of this study were to: 1) determine the prevalence of immediate kid removal on NZ farms, and 2) compare the number of kids successfully removed as reported by the farmer to the number of kids with serum caprine IgG concentrations indicating they had ingested dam colostrum. A total of 416 kids (24-33 kids/farm) on 16 farms in NZ’s Waikato region were enrolled. Blood samples were collected between 24-48 h after birth to establish serum IgG concentrations. For each kid, farmers recorded whether they removed it immediately after birth and the colostrum (type and volume) fed. Results are presented as farm means±SD. Of the 16 farms, 8 were actively attempting to remove kids immediately after birth. However, the reported prevalence of this practice varied on these farms (61±35%, range: 7~100% of enrolled kids were removed immediately). On three of the farms practicing immediate removal, it was not possible to determine if kids consumed dam colostrum because they were fed heat-treated goat colostrum. None of the remaining 5 farms prevented ingestion of goat colostrum in all their kids. Three farms had high success (90±5% of kids) and two farms had low success (18±9% of kids). These results indicate that many farmers attempt to employ immediate kid removal from the doe. Nonetheless, some farmers struggle to remove the kids in a timely fashion, and therefore fail to prevent colostrum ingestion and potential disease transference.
**NZSAP 22**  
**Dietary preference of dairy cows for perennial ryegrass cultivars growing with and without white clover**

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Dietary preference among eight perennial ryegrass cultivars (AberMagic, Alto, Base, Bealey, Commando, Kamo, One50 and Prospect) growing with and without white clover was examined at two vegetative stages (May and October) and one reproductive stage (November). Groups of dairy cows (n = 8 per group) were offered free choices among perennial ryegrass cultivars in monocultures or in mixtures with white clover according to a split plot design with four blocks. A preference index was defined as the relative decline in sward surface height. Preference was higher for Base (tetraploid), Bealey (tetraploid) and AberMagic (high sugar diploid). Preference was negatively correlated with herbage mass, the proportion of dead material and neutral detergent fibre (NDF) and positively correlated with sward surface height, perennial ryegrass proportion, ryegrass lamina length, tiller mass, organic matter (OM) content, water soluble carbohydrates (WSC) concentration and organic matter digestibility in dry matter (DOMD). Although the proportion of white clover was low (<7% DM) in all these stages, the interaction between perennial ryegrass cultivar and the presence of white clover was significant, with differences among preference indexes of perennial ryegrass cultivars narrowed when white clover was present.

**NZSAP 24**  
**Social dominance and milk production of grazing dairy cows in New Zealand.**

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The objective of this experiment was to study factors determining social dominance of grazing dairy cows and the relationship between dominance and milk production. A total of 189 multiparous Friesian × Jersey crossbred dairy cows grazing perennial ryegrass and white clover pasture were observed for 3 months to determine their dominance value (DV). Dominance value was calculated using two methods, one was based on aggressive behaviour and the other based on the number of interactions with other cows. The correlation between DV calculated based on these two methods was high (r = 0.98). Positive correlations were observed between age, liveweight (LW) and milk production, and DV. These results indicate that either aggressiveness or number of interactions can be used to calculate DV of dairy cows. Factors like age and LW can determine DV in which older cows with higher LW are associated with higher DV. In addition, social dominance affects milk production of cows, as cows with higher DV produced more milk.

**NZSAP 26**  
**More dairy heifers are achieving liveweight targets**

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Dairy heifers should meet industry liveweight targets in order to achieve good reproductive performance and milk production. Industry targets are 30%, 60% and 90% of mature live weight at six months of age, mating and pre-calving. Previous research on heifers born between 2006 and 2010 (historical) found 61% were below target at mating and 74% were below target pre-calving. The aim of this study was to determine if more heifers born between 2011 and 2014 (current) are achieving target liveweights. From birth to 7 months of age the mean liveweight of heifers from both groups were slightly above target. From 7 to 8 months of age current heifers remained above target, whereas the mean liveweight of historical heifers fell below target and remained below target. The mean liveweight of current heifers was below target from 8 until 15 months of age. At 16 and 17 months of age the mean liveweight of current heifers was above liveweight targets, and then below from 18 months of age. At all age groups a higher percentage of the heifers in the current study were at or above their target liveweight compared with the historical heifers, suggesting that the rearing of dairy heifers has improved. Despite the improvement in the achievement of liveweight targets at mating, by 22 months 65.4% of heifers were below target, only slightly better than the historical group. The improved growth of heifers earlier in the rearing period is not being captured at 22-months and is likely to result in lost potential milk production as heifers that are closer to target liveweight at calving produce more milk in their first (and subsequent) lactations. Farmers need to focus on the management of heifers from 18 to 22 months to fully capture the benefits of meeting target liveweights.
Reproductive production constraints within the New Zealand racing industry

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The New Zealand Thoroughbred industry has seen rationalisation in relation to changes in the domestic market and more recently the Global Financial Crisis. To quantify changes in production end-of-season reproductive data for active Thoroughbred sires (> 10 mares bred per season) were extracted from an online database (www.nzracing.co.nz) from 1989/90 to 2011/12 breeding seasons.

There were reductions in the numbers of mares bred and foals produced (10,176 mares & 5,882 foals vs.5,826 mares & 3,927 foals, respectively in 1989/90 and 2011/12 seasons) resulting in a greater relative proportion of foals registrations (57% vs. 67%). During this period the number of active sires decreased (265 vs. 94) and number of mares per sire increased (33 IQR 18-53 vs. 49 29-91). The 2007/08 season (the Global Financial Crisis) was associated with an acute reduction in the number of shuttle stallions imported for breeding (from 23% in 2006/07 to 11% of active sires in 2007/08), and a temporary increase in number of mares bred (13%), in response to the 2007 Equine Influenza outbreak in Australia.

The proportion of sires covering >100 mares per season increased from 6% (1989/90) to 25% (2011/12). Despite the reduction in active broodmares during the same period (43%) there has not been a proportional decrease in export numbers (24%) or domestic numbers of horses racing (6.5%).

The rationalisation of the Thoroughbred industry has seen a reduction in the numbers of mares bred to service the domestic market while the export focused sector has seen little change in numbers. Reduced numbers of active broodmares was associated with increased in reproductive efficiency and less supply chain wastage.

Which traits best predict ewe performance and survival the following year on a UK hill farm?

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Increasing ewe longevity and reproductive output can improve whole flock efficiency and reduce environmental impact. To achieve this, it is essential to retain ewes that will survive and be productive. Flock managers often select ewes to keep or cull based on current appearance and, commonly on UK hill farms, ewe age. Selection on Estimated Breeding Values (EBVs) is recommended but these are rarely available in hill systems. Another option is using performance data over the ewe’s lifetime, which can now be collected and collated by RFID ear tags and an evolving set of associated technologies. The aim of this study was to identify traits which are associated with successful ewe performance the following year. Scottish Blackface ewe performance data were collected over two years on a hill farm in Scotland (764 records; ewe mortality 7%; mean lamb wean weight 28.6Kg, s.d. 4.2; average 0.98 lambs weaned per ewe mated). Data were grouped in three categories: 1) appearance post-weaning (17 traits; e.g. teeth, feet and udder); 2) EBVs (11 traits); and 3) recorded performance, during early life and the previous year (22 traits). These groupings of traits were each compared against performance the following year, as defined by number (NL) and weight of lambs (WL) successfully weaned and ewe survival (ES), using Generalized Linear Regression Modelling. Using recorded performance data or EBVs explained a similar amount of variation in WL and NL (~10-15% in each case) compared to a lower prediction accuracy from appearance traits (~6%). Ewe survival was predicted with low accuracy by appearance scores or EBVs (~7%), whereas performance data doubled this prediction accuracy. Recorded performance data is likely to be more valuable than ewe appearance in developing an objective system to select ewes for breeding the following year. This could be particularly useful when EBVs are not available.
Prior to the 1970's, most New Zealand Corriedale sheep breeders were very traditional in their selection of sires and ewes. It was generally by subjective assessment of phenotype, with very little regard for productive traits. Animals of good "show type" were highly prized as the accumulation of prize certificates at A & P shows were regarded as a measure of success and attracted commercial buyers to a stud.

This paper will discuss the journey to objective measurement and analysis that Corriedale sheep breeders have made over the last 45 years. This progressed from a breed wide initiative in the 1970’s to screen for fertility – the Merit Scheme. Two progeny tests were also run. The first at Lincoln University, under Phil Beatson and the second on a breeder’s property, conducted by David Cottle, of WRONZ. By the 1980’s, many studs were starting to record on Animal Plan. The drive to increase production on commercial farms was on.

The breakthrough for the breed occurred in 1998/99. A meeting of interested breeders was chaired by George Cruikshank of Animal Plan. The outcome was a group of breeders dedicated to recording five traits and the data entered on Animal Plan. An across flock comparison was conducted. They also agreed that the results be made public.

In June 2005, representatives of SIL, Lambplan and a breeder from both New Zealand and Australia met to discuss the first Trans Tasman comparison of a sheep breed – namely, Corriedales. Initially data was transferred to run on both countries respective genetic engines. The results showed more similarities than differences when EBV’s were calculated and reported in an index form. Across Tasman data runs are now run routinely and reports are generated in each country’s format. This has been a great initiative for the breeders in both countries.

One important attribute of a beef-breeding cow herd is the ability to wean a calf every year. Furthermore an earlier born calf is likely to be heavier at weaning and its dam has more opportunity to conceive again the following breeding season. In a spring calving system under the seasonal pastoral grazing system in New Zealand a 365-day inter-calving interval is desirable. A normal gestation length is 280 days and that only leaves 85 days for a cow to resume oestrous cycles and conceive again to maintain the 365-day calving interval. Literature estimates of the interval between calving and the first oestrous cycle post-calving are 60 days in adult cows and 70-80 days in fist calving heifers with adequate nutrition. An alternative reproductive measure to inter-calving interval and favoured in naturally mated beef-cow herds is days to calving and is defined as the number of days from the start of joining to the day of calving.

A study was conducted to investigate inter-calving intervals and days to calving and their relationship to live weight and condition score pre-calving and at mating from first mating as heifers through to their 6th calving and for 5 inter-calving intervals in straight-bred Angus and Angus-cross-Friesian, Angus-cross-Jersey and Angus-cross-Kiwi-cross cows.

There was no effect of cow breed cross on inter-calving interval or days to calving, however there was a significant effect of year (P<0.001) on both inter-calving interval and days to calving. Days to calving was 302.5 days in first calving heifers indicating the majority conceived in the first cycle of mating while their inter-calving interval between their first and second calving was 386 days indicating a prolonged breeding period at the second mating. Cows at their 6th joining had shorter days to calving that cows in their first four joining’s.
Estimation of genetic parameters for milk yield traits at different herd production level in cows milked once- or twice-daily

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In the New Zealand dairy cattle industry, genetic evaluations are realized with lactation records from herds milked twice-daily (TAD), which is the standard milking frequency (MF). Nevertheless between 3-5% of dairy herds are milked once-daily (OAD). Genetic parameters are estimated with data from the population milked TAD, for which there are evidences that they are influenced by level of production level (PL) calculated as herd average milk solids yield (fat + protein), but little is known about the effect of PL on the estimation of genetic parameters in the population milked OAD. Therefore, the objective of this study was to estimate genetic parameters for milk (MY), fat yield (FY) and protein yield (PY) for cows milked either OAD or TAD at different PL (low, medium and high) in grazing systems in New Zealand. Heritability estimates were lower in low PL herds milked OAD compared to low PL herds milked TAD (0.11-0.18 vs. 0.22-0.37, respectively). Across PL, heritabilities estimated for MY at medium and high PL were >0.30 at both MF, while for FY and PY those values were <0.30. In general, genetic and phenotypic correlations showed great consistency across MF and PL; although genetic correlations between MY and PY were greater (>0.70) compared to the correlation of FY with any of the other traits (<0.65). The lowest genetic correlation was observed between MY and FY at low PL (0.09±0.087). In conclusion, the results obtained in this study indicate that different heritabilities at low PL milked OAD reveals unequal genetic expression of milk traits genes compared to higher PL, indicating lower genetic variances at low PL and potentially lower genetic progress in those herds. Ignoring the heterogeneous of variance could result in systematic inaccuracies and biases in the estimation of breeding values.

An investigation of automated measures for assessing pain-induced distress in dairy calves

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To evaluate the effectiveness of different pain mitigation strategies during routine husbandry procedures (eg disbudding) on-farm, intensive physiological and/or behavioural studies are needed. The limitations of these measures are that the methods (eg blood sampling) can cause animal stress and analysis of behaviour video recordings is labour intensive. Automated, non-invasive measures of behaviour are now available, such as feeding behaviour provided by automatic calf feeding systems (ACFS) and activity, recorded using accelerometers (eg Hobo data loggers). Feeding and lying behaviours are altered in calves in response to stress and/or pain during procedures such as hot-iron cautery disbudding, which is commonly performed without pain relief. It is well documented that this procedure causes significant pain. Therefore, the aim of this study was to determine if behavioural data collected from ACFS and Hobo data loggers could be used as an indicator of pain-induced distress in dairy calves. At 3 weeks of age, calves were allocated to 1 of 5 treatment groups including: 1) sham handling (SHAM), 2) hot-iron disbudding (DB), 3) DB+administration of local anaesthetic (LA+DB), 4) LA+DB+ administration of a non-steroidal anti-inflammatory drug (NSAID) and 5) DB+NSAID. Feeding (number of visits to the feeder and number of rewarded visits) and lying behaviour were recorded continuously for 24h before and 48h after application of treatments. SHAM calves visited the feeder more (P=0.01) during the recovery period than calves DB with and without pain relief. However, DB treatment did not affect (P > 0.05) lying behaviour. ACFS have the potential to automatically, non-invasively gather important information regarding pain-induced distress in calves but may not be sensitive enough to evaluate the efficacy of different pain mitigation strategies. Further research should assess what other ACFS information could be used to evaluate the impact of different management practices as well as disease onset on calf behaviour.
NZSAP 35  The effect of milk allowance on performance and starter intake of dairy calves

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This study aimed to investigate the effect of higher milk allowances on performance, visits to the feeder and solid feeding behavior of dairy calves. Fifty-six Holstein group-housed calves received 6, 8, 10, or 12 L of milk per day from an automatic feeder until 34 d. Milk was reduced to 50% of previous allowance from 35 to 42 d, and reduced by 20%/d for the last 5d until weaning at d 48. Calves were provided ad libitum access to calf starter and hay. Calves on 10 and 12 L/d treatments had higher ADG (0.83 ± 0.04 and 0.88 ± 0.04 kg/d, respectively) compared to calves receiving 6 and 8 L/d (0.76 ± 0.04 and 0.76 ± 0.03 kg/d). Final weight at 61 d was highest for those calves receiving the highest milk ration (93.0 ± 2.7, 92.8 ± 3.4, 99.2 ± 3.3, and 102.0 ± 3.6 kg, for 6, 8, 10 and 12 L/d, respectively). Calves on the 12 L/d treatment had the fewest rewarded visits to the milk feeder during the pre-weaning period (7.1 ± 0.3, 7.9 ± 0.4, 7.2 ± 0.2, and 6.7 ± 0.3 visits/d, for 6, 8, 10 and 12 L/d, respectively). Calves receiving milk at 6 and 8 L/d treatment had more unrewarded visits to the milk feeder (9.7 ± 0.7, 7.0 ± 0.6, 5.5 ± 0.5 and 4.5 ± 0.5 visits/d, for 6, 8, 10 and 12 L/d, respectively). Daily starter intake did not differ among treatments (1.4 ± 0.2, 1.6 ± 0.2, 1.7 ± 0.2, and 1.6 ± 0.2 kg/d, for 6, 8, 10 and 12 L/d). These results indicate that higher milk allowances of 10 or 12 L/d can be managed to achieve higher ADG, higher post-weaning weights and fewer unrewarded visits to the milk feeder, without reducing starter intake.

NZSAP 36  The intake and performance of high-yielding Holstein cows offered a TMR and with access to grazing for six hours per day

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Grazing lactating cows is a decreasing practice in Europe despite the potential economic, environmental, milk quality and animal welfare benefits (Hennessy et al, 2015). In parts of Europe, farmers are either incentivised or required by legislation to allow cows to pasture for at least six hours per day during summer, but little is known about the effect on performance of high yielding cows. A study was undertaken to investigate the effects on Holstein cows of a six hour grazing period either directly after morning milking with ad libitum access to a total mixed ration (TMR) when housed (G) or 75% ad libitum TMR allowance (G75); after one hour of TMR access following morning milking then a six hour grazing period then housed with ad libitum access to TMR (G+1); or continuously housed cows (C). Fresh grass was offered daily to provide 6 kg DM/cow above a 4 cm grazing height, and after six hours at grass cows were gathered and housed. Cows remained on treatment for 4 weeks with measurements undertaken during the final week. Data were analysed by ANOVA in Genstat v. 17. Cows receiving G75 had a lower milk yield (P = 0.001) than C and G+1, with mean values of 45.7, 44.9, 44.2, and 41.7 kg per cow (s.e.d 0.99) for C, G+1, and G75 cows respectively. Similarly, TMR intake (P < 0.001) was highest in cows receiving C (26.9 kg DM), no difference between G and G+1 (24.1 kg DM and 23.6 kg DM respectively), with the lowest intake in G75 (20.4 kg DM). Body condition score was not affected by treatment (P = 0.079). In conclusion, there is little impact on the production of high yielding dairy cows from a daily six hour grazing period, provided feed is continuously available while housed.
**NZSAP 38  Variability in growth rates of goat kids on 16 New Zealand dairy goat farms**

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Early life management significantly impacts goat kid growth, health and overall welfare. Currently, the data available to NZ farmers regarding the potential growth rates of kids is largely from overseas sources. The aim of this study was to determine the variation in growth rates from birth until shortly after weaning. A total of 1280 doe kids (80 ± 3 kids per farm) were enrolled on 16 farms in the Waikato region. Kids were weighed four times: at enrolment 24-48 h after birth (A), after 2 weeks (B), at weaning, (C) and two weeks post-weaning (D). Average daily gain (ADG) was calculated between each weighing point. Analyses are descriptive and results presented as farm means ± SD. Enrolment weight was 3.7 ± 0.3 kg, however, across farms there was a large range in weights (1.4 – 6.3 kg). Weaning weight was 19.2 ± 2.7 kg and age 11.9 ± 1.4 weeks. There was a large variability at the individual farm level, even in farms with similar weaning ages. For example, the farm with the lowest weaning weights (14.7 ± 2.2 kg) weaned at 10.0 ± 0.9 wk, while the farm with the highest weaning weights (23 ± 1.6 kg) weaned at 11.2 ± 0.3 wk. The ADG between early weigh points was consistent (AB=178 ± 33 g/d, BC=185 ± 37 g/d). The ADG from weaning to two wk post-weaning was more variable (CD=142 ± 68 g/d). Three farms achieved gains > 200 g/d after weaning. However, a decrease in ADG was recorded on 11 farms, with 7 of these farms experiencing mean ADG of < 100 g/d. This study provides data for NZ farmers to benchmark the growth rates of their replacement doe kids, and suggests that high weight gains, even following weaning, are possible for farmers in the region.

**NZSAP 40  DEERSelect – review of the first decade**

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DEERSelect, the New Zealand deer industry performance recording database has been providing the New Zealand red deer industry objective breeding information since 1995. Over that period the role and functionality of DEERSelect has changed, to the point that it is now at the centre of all genetic information delivery to the New Zealand deer industry. Initially velvet and growth modules traits were included, over time new trait modules for meat and reproduction have been added. With these new modules economic indexes were also included, but have not been widely utilised. Within breed evaluations were added for wapiti and their crossbreds, to cover all breed types. It is now recognised that the wapiti and red types need to be combined in to a single analysis. There have been good genetic gains made over the past 10 years, primarily in growth traits. Impetus provided by the Deer Progeny Test (DPT), and increased breeder education has improved understanding of best practice recording, leading to better data and linkage. While DEERSelect is recognised by industry leaders as being critical to the genetic advancement of the New Zealand deer industry it still has a long way to go to achieve commercial stag buyer adoption. This will involve a large extension effort and new communication strategies to allow commercial producers to translate breeding values to changes in farm system performance and profitability. The future does look promising there are many potential new traits and improvements on existing ones generated by the DPT and good breeder acceptance of objective measures of genetic merit.
**NZSAP 41**  Preliminary estimates of genetic parameters for juvenile and adult dag scores in New Zealand sheep

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Currently lamb dag scores at both 3 (DAG3) and 8 (DAG8) months of age are routinely analysed in Sheep Improvement Limited (SIL). However, there are currently no formally published estimates of the genetic relationship between dag score as a lamb and dag score as an adult (DAGA). Adult dag score has an independent value due to both the cost of dagging adult ewes, and loss of wool value.

Genetic and phenotypic parameters were estimated for lamb and adult dag scores at weaning from 1,952 New Zealand-born Coopworth composite pedigree-recorded animals, born between 2007 and 2013. Performance and pedigree records were downloaded from SIL and lamb dag score data were analysed using previously described models. Fixed effects models for DAGA were determined using the GLM procedure in SAS. The final model included contemporary group (birth year, birth flock, recording year and recording mob) and number of lambs born as fixed effects. Variance and covariance components were estimated using ASReml. Heritabilities were estimated from univariate models, with genotypic and phenotypic correlations obtained from bivariate analysis.

Heritability estimates of DAG3 (0.37±0.06), DAG8 (0.46±0.07) and DAGA (0.55±0.06) were moderate to high, and comparable with previous studies. The genetic correlations among all dag traits were positive and moderate. The correlation between DAGMA and both DAG3 and DAG8 was 0.51±0.10 and 0.51±0.09, respectively. DAGA can be analysed as a repeatable measure, however, there is currently no repeated measurements available on these animals.

Measurements will be collected at weaning 2015 and the final paper will include updated parameters and an estimate of repeatability.

In summary adult dag score has a moderate to high heritability and has a moderate genetic correlation with lamb dag scores, suggesting inclusion of adult dag scores in the routine evaluation of adult ewes may be advantageous.

**NZSAP 42**  An update on genetic parameters for facial eczema tolerance in sheep

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Facial Eczema (FE) is a metabolic disease resulting from liver damage, caused by ingestion of toxic sporidesmin (a type of mycotoxin) from the fungus Pithomyces chartarum. Risk of FE is associated with temperature, humidity and dead leaf matter, and with climatic changes there is an increase in the geographical spread of the fungus and associated sporidesmin in New Zealand. Romney FE selection lines were established in 1975, and selected for tolerance or susceptibility on the basis of liver damage (measured using serum GGT levels) following sporidesmin challenge. The estimated heritability using these section lines was 0.45 ± 0.03. In the early 1980’s a commercial testing programme was developed, RamGuard, which allows ram breeders to generate breeding value estimates for tested and related animals, with GGT levels measured 21 days (GGT21) post a measured sporidesmin dose. Using data generated from RamGuard, a new multi-breed dataset exists consisting of data from 111 flocks, and approximately 20,000 animals with GGT levels. This dataset was used to re-estimate genetic parameters for FE tolerance. Contemporary groups were generated using flock:year:sex:mob information. To be included in the analysis, flocks needed a minimum of 45 animals with recorded GGT21, and any given contemporary group needed to exhibit 30% animals with elevated GGT21 (GGT21>70). The resulting data set consisted of 15,800 animals with GGT21 records. The GGT21 data was analysed two ways, the first using the reported values natural log transformed, and the second reporting it as a binary (tolerant/susceptible) trait, with animals with elevated GGT21 (GGT21>70) categorised as susceptible. Heritability estimates from these two approaches were 0.39 ± 0.02 and 0.24 ± 0.02 respectively. Both estimates are comparable to those reported in New Zealand dairy cattle. This data set is now also being used in conjunction with genomic data to identify genomic regions controlling tolerance to FE.
NZSAP 43  Do different grazing strategies affect pre-weaning calf growth rates?

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Aim of this study was to compare pre-weaning growth rates of calves that are continually offered fresh pasture to those that are set stocked.

Calves (n= 68) were housed indoors for first 3 weeks of life, and fed 6 l per day. Colostrum quality was determined on 200 first milking dam samples and a serum sample from calves within 48 hours of birth. IgG concentration was adequate in 56.5% of individual colostrum samples and 83.5% of calf serum concentrations. There was no relationship between colostral IgG concentrations and serum IGG concentration (r²=0.41, P>0.05). No effect of dam parity (P>0.05) or breed (P>0.05) was demonstrated.

When calves were put onto pasture they were assigned to 1 of 2 treatments: rotationally grazed (RG, n=34) or set stocked (SS, n=34). From the start of September, calves in the RG treatment were moved 3 times a week whereas SS calves were to be moved when pasture cover dropped below 2000 kg DM or if they had been in the paddock for 4 weeks. All calves were weighed fortnightly.

There was no difference (P>0.05) in liveweight between treatments from birth until October. There was also no difference (P>0.05) in average daily gain (ADG) over the experimental period from August to October. However, pasture availability influenced ADG differently between months. No difference in ADG between RG and SS calves was seen in August (RG 0.50 ± 0.03 kg/d vs SS 0.57 ± 0.03, P>0.05) or October (RG 0.67 ± 0.02 kg/d vs SS 0.67 ± 0.02, P>0.05) but was lower in SS calves during September (RG 0.82 ± 0.02 kg/d vs SS 0.75 ± 0.02, P<0.001) as pasture cover decreased to 2000kg DM/ha.

While overall liveweight gain was not affected due to treatment, the results indicate that length of time between shifts to fresh pasture has the potential to impact

NZSAP 45  Preliminary Investigations into the Genetics of Residual Feed Intake in Sheep

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Residual feed intake (RFI) is an estimate of whether or not an animal is eating more or less than expected for its weight and growth rate. RFI has been shown to be under genetic control in a number of production animal species, but no similar published data for maternal breeds of sheep exists. A trial commenced in 2015 which will generate/collect RFI data on 1000 New Zealand maternal sheep from at least 100 sires in order to derive estimates of heritability for RFI and genetic correlations with other traits’. This paper reports on the findings from the first 197 animals (by 24 sires) recorded; sourced from two genetically linked maternal breed progeny test flocks. The animals were approximately eight-months-old at the commencement of the trial. Their daily feed intake of a lucerne pellet diet was measured for 56 days using an automated feeder that recorded weight of feed consumed in real-time. The animals were weighed twice weekly. The standard RFI model involves fitting metabolic mid-weight and liveweight gain to explain feed intake mid-trial. Both measurements fitted were significant (P<0.001), with an overall R² for the model of 0.78. Using the residual from this model as the proxy for the trait RFI; sire was significant (P<0.05) when fitted as a random effect in a mixed model, with some sires whose progeny were consistently efficient (low RFI) or non-efficient (high RFI) evident. Another trait recorded was the daily number of meals each animal consumed. This trait was significantly (P<0.001) affected by the trial mid-weight of the animal, and sire fitted as a random effect in a mixed model was significant (P<0.01). This first cohort of data has already demonstrated that traits associated with feed intake are under genetic control, but more data is required to accurately estimate the extent of this control.
Variation in total body fatness, and fat distribution in maternal sheep estimated using computed tomography scanning

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Fat is an antagonist trait in sheep with decreased amounts desirable in prime lambs, however, fat also has a role in the maternal ewe, with potential to lay down fat desirable. Body fat is commonly assigned to three depots: sub-cutaneous (SCF), intermuscular (INTMF) and internal (INTF) (e.g. kidney fat). Of interest is whether or not individuals lay down their fat in equal proportions across these depots, or if there is variation that could be exploited? A study was undertaken using 37 New Zealand composite maternal ewes computed tomography scanned on four occasions from nine through to 19 months of age, with the images processed to estimate percentage fat in the three depots (along with lean and bone). The raw average total body fat at the first scan was 23% (± 3.0%) of total tissue weight, which had increased to 30% (± 3.7%) by the fourth scan. The within animal repeatability across the four scans was high, ranging from 0.77 for INTMF% through to 0.83 for SCF%. Between-animal variation in fat distribution was tested fitting animal as a random effect in a mixed model, with scan number fitted as a repeated measure. Animal was significant (P<0.001) for all three fat depots, with some animals significantly laying down more or less fat than other animals for a given depot, which was offset in the other depots. These animals will be repeat scanned post-their first lambing at approximately 31 months of age. Given the repeatability of the measurement, these traits will now be investigated on a single scan from a co-hort of 200 animals from different genetic backgrounds to determine the magnitude of the variation in fat distribution, and whether or not there is evidence of genetic control which can be exploited in to the future.

Using genomic information to predict sex in dairy cattle

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Gender misassignment of animals in breeding programmes can arise from sources such as data entry errors. This leads to reduced selection pressure due to a decrease in the number of animals available for selection, and an increase in the cost of selection. With the increasing availability of Single Nucleotide Polymorphism (SNP) genotypes for genomic selection, it is possible to detect and correct gender misassignments using the proportion of heterozygous SNPs on the X chromosome for little additional cost. The aim of this study was to create a tool for determining the gender of dairy cattle by using genotyping information. Genotypes were obtained for 16375 cows and 732 bulls using the GeneSeek Genomic Profiler LD v3. These animals were gender-verified and genotypes were confirmed to either sire, dam, or both. The genotypes were used to select a set of 753 informative SNPs on the X chromosome. Each SNP satisfied two criteria: 1) at least one female was heterozygous at the locus and 2) fewer than 1% of bulls were heterozygous at the locus. A threshold of 1.2% proportion of heterozygous SNPs was chosen to separate males from females. Animals with a proportion of heterozygosity of less than 1.2% were classified as male and those with a proportion of heterozygosity of greater than or equal to 1.2% were classified as female. The test predicted females in the dataset with 99.96% accuracy and males with 100% accuracy; an overall accuracy of 99.96%. The area under the Receiver Operating Characteristic curve was 0.9992. The tool was used to screen genotypes from 3910 contracted offspring and identified 32 calves (16 male and 16 female) where the predicted gender disagreed with the recorded gender.
NZSAP 51  Impact of date of birth recording in genetic evaluation in sheep
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Sharon McIntyre and Sheryl-Anne Newman

Date of birth is used in the genetic evaluation process to correct performance traits for non-genetic differences resulting from being born earlier or later in the season. However recording of actual date of birth is not feasible in some farming systems due to the extensive farming environment, species or breed management difficulties or recording practises such as DNA parentage. The impact of current birth date recording practises was investigated using data from fully recorded flocks. Loss of selection accuracy where no date of birth was available or for date of birth in 10 day intervals, as calculated from foetal age estimated at pregnancy scanning, was investigated for growth traits.

The range in breeding values and indexes increased by 5 to 30% when date of birth accuracy decreased. For example in one flock of the flocks, weaning weight breeding value range increased from 5.50, 5.64 to 7.21 kg and live weight at 8 months breeding value range increased from 10.48, 10.73 to 11.88 kg in analyses with birth date recorded, estimated birth date and no birth date, respectively.

Not having date of birth had the greatest impact on selection accuracy, while date of birth calculated from foetal age at pregnancy scanning resulted in only a small decrease in selection accuracy. If breeders are unable to record actual date of birth then the use of date of birth estimated from pregnancy scanning information will minimise loss of selection accuracy.

NZSAP 52  The influence of age and breed of cow on colostrum indicators of suckled beef calves
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RE Hickson, PJ Back, NP Martin, PR Kenyon, ST Morris

Intake of sufficient quantity of colostrum in the first few hours of life is critical to the likely survival of calves. Factors that may interfere with colostrum intake of calves include aggressive or inattentive maternal behaviour, lethargic calves and poor udder conformation that makes it difficult for calves to find the teats. Beef-cross-dairy cows offer an advantage to the beef industry over straight-bred beef cows because they produce more milk and wean heavier calves, however, farmers often report that the udder of beef-cross-dairy cows become unsatisfactory as they age. This experiment measured colostrum intake of calves at 36-48 hours of age using blood samples analysed for immunoglobulin G (IgG), gamma glutamate transferase (GGT) and total protein. The calves were the first six calves born to Angus (AA), Angus x Friesian (AF), Angus x Kiwicross (AK) and Angus x Jersey (AJ) cows. At the peak of the fifth lactation, udder conformation of the cows was assessed according to Breedplan’s BeefClass Structural Assessment standards by a Breedplan-accredited assessor. Traits assessed were teat size and shape (1=very small/thin, 9=very large/bulbous), udder evenness (1=front heavy, 9=back heavy) and udder attachment (1=low, 5=high attachment). There was no effect of breed-cross on teat size and shape or udder evenness, but udder attachment was higher on AA than on AF or AK cows (P<0.05). Mean IgG concentration was greater (P<0.05) for third and fourth calves than for first, second or fifth calves. Total protein concentration different for all years, and was greatest in second calves and least in fifth calves. Calves from AA cows had less GGT activity than calves from most dairy-cross cows except in the fourth year. Calves from AA cows had least GGT activity in year 2, whereas calves from dairy-cross cows had least GGT activity in year 4.
NZSAP 55  Ad Libitum Fodder Beet and Pasture Beef Finishing Systems – Intake, Utilisation, Grazing Behaviour and Live Weight Gain

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B. Saldias J. Gibbs

In accelerated beef finishing systems, maximised intakes are a primary driver of profit. A recent NZ development is ad libitum intakes of fodder beet with minimal supplement for 130d from weaning to spring, then 90d pasture before slaughter. A trial compared the ad libitum intakes, utilisation, grazing behaviour, intake patterns and liveweight gains of R1 steers grazing a beet crop (SR 20/ha) then pasture (SR 6/ha). In the autumn/winter the percentage of fodder beet allocation consumed was measured 4 times between June and August, at 24, 48, 72h and then 30d after grazing. In spring the process was repeated with steers on pasture. DM utilisation of fodder beet crop was always high, with a total mean of 72.7, 83.7, 94.1 and 97.6% for the 24, 48, 72h and 30d, respectively. Animals grazed fodder beet and spring pasture for on average of 7.1 and 7.8h of the day, respectively. Almost half the eating time occurred within the first 6h (47.1 and 45.4% for fodder beet and pasture respectively). Total DM disappearance of fodder beet crop at 6h was 68.7% of 24h intakes whereas on grass DM disappearance was 76.6%. Total liveweight gain was >1.1kg/day over a period of 130 days on fodder beet and >1.5kg/day over a period of 75 days on spring pasture. The high DM utilisation and intake on fodder beet produced >3775 kg LWT gain/ha, compared with >1450kg LWT gain/ha achieved on pasture. Ad libitum fodder beet intakes resulted in higher utilisation, extended diurnal grazing patterns and reduced intakes in the initial 6h of grazing compared with pasture grazing in R1 steers.

NZSAP 56  Calf grazing behaviour and preference

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The aim of this experiment is to determine if there is a difference in time spent grazing or other behaviours in calves grazing different forages.

64 weaned dairy heifer calves were assigned to 2 different forage feeding treatments: ryegrass-white clover pasture and a herb-red clover mix during December 2014.

Visual observations of behaviours were recorded every 10 minutes over a 72 hour period. Behaviours recorded were standing, walking (W), lying (L), grazing (G), ruminating (R) and combinations these (SG, WG, LG, SR, LR) This enabled 3 complete daily profiles to be created which will be used to evaluate if there were differences in time spent grazing, standing, lying and ruminating between the calves grazing different forages.

Calf preference will also be determined in calves grazing the herb-red clover mix. 20 transects were used to tag 200 plants balanced on the proportion of species in the sward. The recording period was for 3 days, with each plant checked at 24 hour intervals to determine whether it had been eaten or not.

Data input and analysis is currently underway.
NZSAP 58  Does Viagra protect fetal lambs against pregnancy toxaemia?
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Sildenafil citrate increases vasodilatation of uteroplacental vessels and may be used to investigate control of fetal growth. Our hypothesis was that sildenafil citrate would increase birth weights of triplet lambs as it has successfully increased birth weight in rodent models and singleton-bearing ewes. Thirty triplet-bearing Romney ewes were allocated at random to one of six pens where they were offered a commercial lucerne-based sheep pellet containing 9.5 MJME/kgDM. Ewes were treated from P110-140 with either 50 mg sildenafil citrate (SC) or 9 ml water three times daily via subcutaneous catheters. From P126 each pen was supplemented three times daily with 1 kg Fibre Ezy, containing 13 MJME/kg. Starting at P135 ten ewes exhibited clinical signs of pregnancy toxaemia and at day 145 fresh grass was supplied to all ewes ad libitum. Thirty-seven lambs were born alive in the SC group and 22 in the C group. Twelve in the SC group (n=15) gave birth to three live lambs whilst only five ewes in in the C group (n=14) delivered three live lambs. Birth weights of SC lambs (3.75±0.1 kg, n=42) were significantly (P=0.02) heavier than C lambs (3.34±0.1 kg) after adjusting for ewe live weight, sex of lamb, dietary ME consumed, and date of birth. There was a significant (P= 0.01) interaction between treatment and diet, such that SC ewes consumed less energy (795±52 MJME) than C ewes (889±65 MJME) yet delivered heavier lambs, significantly (P=0.01) more of which were born alive. Sildenafil citrate has been used successfully in pregnant women and neonates to treat pulmonary hypertension and lymphangioma, and in boys to treat Duchenne muscular dystrophy. It may also be used to treat heart failure, malaria, cancer and Alzheimer’s disease. Perhaps it also protects neonates against the effects of pregnancy toxaemia.

NZSAP 60  The use of an automated infrared thermography system for early disease detection in dairy calves
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The incidence of neonatal calf diarrhoea (NCD) is a significant concern both economically and from an animal welfare perspective that impacts beef and dairy industries worldwide. By the time an animal presents clinical signs, much of the damage to the intestinal tract has already occurred. In addition, growing herd sizes, less individual animal contact and a decline in experienced stockpeople on-farm leads to more undiagnosed cases that can result in reduced welfare and production and increased mortalities. Therefore, there is a need for automated systems capable of detecting disease before these clinical signs are evident. The objectives of this study were to investigate the physiological and behavioural responses of calves infected with rotavirus, a pathogen known to cause NCD, and to assess the capability of infrared thermography (IRT) as a non-invasive, automated method of early disease detection. Forty-three calves were either infected with rotavirus at 6 days of age (n=20), or acted as uninfected controls (n=23). IRT was integrated into an automated calf feeder (ACF) and eye temperature was recorded continuously during every visit the calves made to feeder. Respiration rate (RR), measured by observing flank movements, was recorded daily and the ACF recorded feeding behaviour continually. Health checks were conducted daily to identify when calves presented clinical signs and faecal samples were taken to verify disease. Preliminary results show that RR and eye temperature decrease continuously between 4 and 6 days prior to clinical signs of disease and that the variability of the eye temperature during this time was higher in diseased calves compared to healthy calves. Results will be presented in full in the article. This system has the potential to alert farmers when an animal displays early signs of disease, enabling earlier treatment and isolation of diseased animals, thereby reducing production costs on-farm and improving animal welfare.
The use of Farm management tools by New Zealand sheep farmers: changes over time

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The utilization of farm management tools by New Zealand sheep farmers can support on-farm decision making thus facilitating improvements in productivity and profitability of the farming enterprise. There are a large number of management tools available to farmers; a recent report identified 127 tools that were available to New Zealand dairy farmers. Although a large number of tools are available to farmers, a survey conducted in 2012 by Corner-Thomas et al. (2015) identified a number of tools that were utilised by only a small percentage of farmers. This indicates that there is potential for farm productivity gains if the uptake of these management tools for relevant situations can be increased.

In the 2012 survey, New Zealand sheep farmers were asked to indicate if had used a range of farm management tools in the previous three years. A subsequent survey was conducted in 2014 and again farmers were asked about their use of farm management tools. For the management tools included in both surveys (n=30) the proportion of respondents that indicated they had used the tool was compared using a generalised model using a binomial distribution and included the fixed effect of tool and year and their interaction. There was a significant interaction of tool use with year (P<0.05) such that for the majority of tools the percentage of farmers that had used a tool increased between 2012 and 2014 but for two management tools (Facial eczema spore counting and weighing sale lambs) there was no change. The greatest increase in use of a tool was seen for feed budget software which increased from 11% in 2013 to 44% in 2014. Similarly, the percentage of farmers that had used individual non-electronic ear tags increased from 28% to 60% between 2012 and 2014, respectively.

Plasma amino acid profiles of lactating dairy cows feed fodder beet and ryegrass diets

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D Pacheco, G. C. Waghorn and D. Dalley

In pastoral systems, nitrogen (N) utilisation efficiency is low, thus a high proportion of N eaten is excreted into the environment, rather than captured in product. Feeds with low N content, such as fodder beet (FB), can ‘dilute’ the amount of N eaten by dairy cattle, and ultimately reduce N pollution of the environment.

As part of a larger study to measure N balance and digestibility, plasma samples were collected from lactating cows fed ryegrass pasture (“RG”), or mixes in which RG was substituted with FB at either 23% (“LowFB”) or 45% (“HiFB”) of the dry matter eaten. Plasma amino acid (AA) concentrations were measured to assess the effect of partial replacement of ryegrass pasture with FB. Total AA concentrations were not affected by diet (P=0.36), but diets with FB reduced (P<0.05) the proportion of arginine, citrulline and ornithine in total AA, most likely as a result of lower hepatic ureagenesis. Further research is required to understand the long term consequences of the decline in arginine concentrations, given the emerging evidence of the role of this AA as regulator of metabolism. Such understanding will inform the development of recommendations on the use of FB as an alternative feed to help mitigate losses of N to the environment in pastoral dairying.

Signals from inner space - Living legend Lecture

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Advances in knowledge of mammalian physiology have been achieved through endocrine studies of sheep and deer. Such advances include the role of the pineal gland as the mediator between changes in daily photoperiod and melatonin secretion, plus the role of thyroid hormones, for controlling reproduction in seasonally breeding livestock. Antlers provide an example of post-maturity bone formation in a mammal and we have shown that additional hardening (mineralisation) of the antlers results from activation of nearby oestriadiol receptors. Based on studies of sheep, C-type natriuretic peptide has emerged in spite of its name as an important adaptive signal for fetal well-being and may be an important regulator of brain function.
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