

# ANIMAL PRODUCTION IN AUSTRALIA

Proceedings of the Australian Society of Animal Production

Volume 30

## **Harnessing the Ecology and Physiology of Herbivores**

Thirtieth Biennial Conference

Editors: Pietro Celi, Graeme Martin, Darryl Savage, Michael Friend,  
David McNeill, Graham Gardner, Sabrina Greenwood

National Convention Centre, Canberra, Australia, 8–12 September 2014

The first joint International Symposium on the Nutrition of Herbivores & International Symposium on  
Ruminant Physiology (ISNH/ISRP) with the Australian Society  
of Animal Production

© CSIRO 2014

ISSN 1836-0939  
eISSN 1836-5787

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means, electronic, electrostatic, magnetic tape, mechanical, photocopying, recording, or otherwise, without permission in writing from the Australian Society of Animal Production and CSIRO Publishing.

### **Refereeing of Papers**

The papers in this volume have been refereed to the journal standards. The material is subject to copyright and may not be presented elsewhere.

The criteria for acceptance of papers are that the material is of interest to members, has some novel aspect, is sound, advances scientific knowledge or its application in any field of animal science or animal production, and is presented in a form consistent with instructions to authors. It is also expected that one of the authors of a paper would be present at the conference to present the material as an oral or poster presentation.

### **Ethical Clearance**

It is incumbent upon the authors, where necessary, to have had experiments approved by a relevant animal ethics committee.

### **Authenticity**

The Journal assumes that the authors of a multi-authored paper agree to its submission.

The Journal has used its best endeavours to ensure that work published is that of the named authors except where acknowledged and, through its reviewing procedures, that any published results and conclusions are consistent with the primary data. It takes no responsibility for fraud or inaccuracy on the part of the contributors.

For submitted manuscripts, unpublished data and personal communications the Journal assumes that the authors have obtained permission from the data owner to quote his or her unpublished work.

### **Citation of Papers**

These papers were presented at the first joint International Symposium on the Nutrition of Herbivores & International Symposium on Ruminant Physiology (ISNH/ISRP) and the Australian Society of Animal Production held at National Convention Centre, Canberra, Australia (8–12 September 2014). Invited Plenary and four-page papers are published in two issues of Volume 54 of *Animal Production Science*

Papers should be cited as:

*Animal Production Science*, **54** (followed by the page numbers).

or in the abbreviated form:

*Anim. Prod. Sci.* **54** (followed by the page numbers).

One page papers submitted are published in the Proceedings of the 30th Biennial Conference of the Australian Society of Animal Production.

## Welcome from the 30th Council of the Australian Society of Animal Production

The 30th Biennial Conference is a first for the Australian Society of Animal Production as we host a joint meeting of the International Symposium on the Nutrition of Herbivores (ISNH) and International Symposium on Ruminant Physiology (ISRP) at the Canberra Convention and Exhibition Centre, 8–12 September 2014. This provides an exhilarating opportunity to bring together like-minded researchers and stakeholders from across Australia and over 50 countries from around the world.

The informative and topical program covers a range of issues that will be of interest to members across a wide range of disciplines. The traditional ASAP special lectures will be featured and include: the McClymont (Agricultural Systems), Underwood (Livestock Nutrition), Stobbs (Grazing Management) and the John Barnett (Animal Welfare) lectures. On behalf of the 30th Federal Council I would like to acknowledge and congratulate the local organising committee under the leadership of Pietro Celi for their efforts in convening such a meeting. We would also like to acknowledge Pietro Celi, Graeme Martin, Darryl Savage, Michael Friend, David McNeill, Graham Gardner and Sabrina Greenwood for coordinating the review and subsequent acceptance of the large number of contributed 4-page and Sue Hatcher and Gaye Krebs the 1-page papers. This is a time-consuming task and your efforts are greatly appreciated.

The changing landscape of federal and state politics and funding provides an opportunity for ASAP to capitalise on bridging the widening gap between research and the end user. The Federal Council has acknowledged this by convening a meeting to discuss and plan the future direction of the society. In addition, a major priority over the last two years has been the major revamp of the ASAP website to assist members access Federal and local branch information as well as manage their membership. We wish the South Australian branch the very best in their role as the 31st Council.

Finally, the 30th Federal Council commend this special edition of *Animal Production Science* to you as an invaluable record to assist in the continuing improvement of the livestock industries around the world. The Council trusts that you find these peer-reviewed papers, along with the short papers published by our Society in the companion edition of *Animal Production in Australia*, informative and insightful as we all strive towards improving the productivity and profitability of the livestock sector.

Russell Bush  
President

**Office Bearers 2012–2014**

President	Dr Russell Bush
Vice President	Dr Michael Friend
Honorary Secretary	Prof. Peter Wynn
Honorary Treasurer	Dr Sue Hatcher
Editors	Drs Pietro Celi, Graeme Martin, Graham Gardner, Darryl Savage, David McNeill, Sabrina Greenwood, Michael Friend

**Committee Members**

Dr Marie Bhanugopan  
 Dr Alex Chaves  
 Dr Ed Clayton  
 Dr Greg Cronin  
 Dr Hugh Dove  
 Dr Jeff Eppleston  
 Dr David Hopkins  
 Dr Rob Mulley  
 Dr Gordon Refshauge  
 Dr Diane Ryan  
 Dr Bruce Watt  
 Ms Irene Van Ekris

**Presidents of the Society**

M. C. Franklin	1954–55	Armidale
D. S. Wishart	1956–57	Melbourne
T. K. Ewer	1958–60	Brisbane
H. J. Lee	1960–62	Adelaide
H. N. Turner	1962–64	Sydney
R. H. Watson	1964–66	Melbourne
N. T. M. Yeates	1966–68	Armidale
G. I. Alexander	1968–70	Brisbane
F. H. W. Morley	1970–72	Canberra
I. W. McDonald	1972–74	Sydney
C. H. S. Dolling	1974–76	Adelaide
N. M. Tulloh	1976–78	Melbourne
J. H. Shepherd	1978–80	Perth
D. J. Minson	1980–82	Brisbane
J. L. Corbett	1982–84	Armidale
W. J. Pryor	1984–86	Canberra
G. E. Robards	1986–88	Sydney
J. C. Radcliffe	1988–90	Adelaide
A. R. Egan	1990–92	Melbourne
I. P. Barrett-Lennard	1992–94	Perth
J. H. Temouth	1994–96	Brisbane
C. J. Thwaites	1996–98	Armidale
F. W. Nicholas	1998–00	Sydney
P. I. Hynd	2000–02	Adelaide
A. R. Egan	2002–04	Melbourne
C. M. Oldham	2004–06	Perth
D. P. Poppi	2006–08	Brisbane
R. M. Herd	2008–10	Armidale
R. D. Bush	2010–12	Sydney
R. D. Bush	2012–14	Sydney

## Fellows of the Australian Society of Animal Production

Fellows shall be Members who, in the opinion of the Council of the Society, have rendered eminent service to animal production in general or within Australia.

1956	Charles Euston Young	1990	Alan Axelsen James Philip Hogan Trevor William Scott Robert Humphrey Weston
1962	Mervin Clarence Franklin Hedley Ralph Marston		
1964	Phillip Gurner Schinckel	1992	Michael Freer Hugh McLeod Gordon John Ryves Hawker David Roy Lindsay Mary Esther Rose
1966	Helen Newton Tumer		
1968	Keith Valentine Leighton Kesteven Archibald James Vasey Rodger Henry Watson	1994	Russel William Moubray Hodge Keith Johnston Hutchinson James Patrick Langlands Douglas Barrie Purser John Edward Vercoe
1970	Eric John Underwood David Sutcliffe Wishart		
1972	Hector John Lee George Russell Moule	1996	Ronald Alfred Leng John Clive Ratcliffe Frank William Nicholas
1974	Frederick Harold William Morley		
1976	Alan Charles Hassall Lancelot Harnilton Lines Ian Wilbur McDonald Patrick Reginald McMahon	1998	Robert Thomas Cowan David James Farrell Justin Joseph Lynch John Lionel Wheeler
1978	Albert Henry Bishop Victor Gordon Cole Leslie Alfred Downey Reginald John Moir Robert Lovell Reid Wallace Carl Skelsey Percival James Skerman Dudley Martin Smith Neil Tolmie McRae Yeates	2000	Bernard Michael Bindon Barrie John Restall Geoffrey Edward Robards
1980	Graham Ian Alexander Gordon Lee McClymont Terence James Robinson Derek Edward Tribe	2002	Frank Annison John Nolan Barry Norton
1982	Sydney John Miller Norman McCall Tulloh Henry Greig Turner William Maxwell Willoughby	2004	Keith William Entwistle Neil Patrick McMeniman William Anthony Pattie
1984	William George Alden Robert Henry Hayman James Irwin Faithfull Maple-Brown Jim Harcourt Shepherd	2006	Norman Adams Heather Burrow Graham Faichney David Masters David Pethick
1986	George Alexander Charles Hoani Scott Dolling Ian Lind Johnstone Dennis John Minson William Henry Southcott	2008	David Blair Coates Hugh Dove Peter Thomas Doyle Adrian Roderic Egan Christopher Morris Oldham
1988	John Lovick Corbett Haydn Lloyd Davies Peter Everard Geytenbeek Geoffrey Roger Pearce Laurence Cecil Snook	2010	Laurie Robert Piper Philip Ian Hynd Dennis Paul Poppi Cyril Richard Stockdale Peter Charles Wynn
		2012	Wayne Leslie Bryden Geoff Norman Hinch Stuart Ross McLennan Victor Hutton Oddy
		2014	Frank Rowland Dunshea Robert Maxwell Herd

**Honorary Members of the Australian Society of Animal Production**

Honorary Members shall be those who, in the opinion of the Council, have rendered eminent service to the Society.

1976	Joseph Phillip Kahler
1980	Clarence James Daley
1982	Ian Neville Southey
1986	John Murray George Andley George Ward
1988	Edward Ben Byers John Terrell Williams
1990	Barry Graham Lukins
1994	Christopher John Thwaites Edmund Wyndham
1996	Eric John Hilder
1998	Narelle Yvonne Morse Evan Hollinworth Macdonald Barnet
2000	Gordon Terrell Williams
2002	David Macfie Richard Moss
2004	David Hennessey
2006	Anthony (Tony) Schlink
2010	Michael Leo Tierney

### The Underwood Lecture

In honour of **Professor E. J. (Eric) Underwood**, AO, CBE, BSc(Agric)(Hons)(WA), PhD(Cantab), Hon. DRurSc(UNE), Hon. DSc(Wis), Hon. DSc(Agric)(WA), Hon. DSc(Melb), FRS, FAA, FFA, FAIAS, FASAP, Hon. FACVS. Agricultural Scientist 1905 to 1980.

The Lecturers have been:

1984	R. J. Moir
1986	H. J. Lee
1988	I. W. McDonald
1990	A. D. Robinson
1992	J. Stocker
1994	K. W. Entwistle
1996	D. E. Beever
1998	H. Dove
2000	N. F. Suttle
2002	J. E. Vercoe
2004	Professor J. C. MacRea
2006	D. Lindsay and B. Paganoni
2008	G. Atwood
2010	D. Poppi
2012	R. Hegarty

The 2014 Underwood Lecturer is **Dr Joe Jacobs**

### The McClymont Lecture

The 22nd Federal Council introduced this lecture to honour **Professor G. L. (Bill) McClymont**, AO, BVSc(Syd), PhD(Cantab), Hon. DRurSc(UNE), FAIAS, FASAP, Foundation Professor (1955 to 1976) of Rural Science at the University of New England, and a pioneer in the development and application of ecological principles to the teaching and practice of agriculture.

The Lecturers have been:

1998	B. E. Norton
2000	A. R. Sykes
2002	G. Grigg
2004	Professor T. Reeves
2006	J. Scott, T. Coventry and H. Sutherland
2008	W. Winter and P. Doyle
2010	P. Morris
2012	W. Bryden

The 2014 McClymont Lecturer is **Dr Paul Greenwood**

### The Harry Stobbs Lecture

The 27th Council presented a lecture to honour **Professor H. (Harry) Stobbs**, BSc(Agric), Ph.D. Harry was recognised nationally and internationally for his contributions to our understanding of the plant/animal interaction, particularly his work on understanding grazing behaviour on different sward types in the tropical environment.

The Lecturers have been:

2008	G. Edwards
2010	D. Swain
2012	P. Gregorini

The 2014 Harry Stobbs Lecturer is **Dr David Pacheco**

### The John Barnett Lecture

The 28th Federal Council inaugurated this lecture on animal welfare to honour **Associate Professor J. L. (John) Barnett** (1949–2009), BSc (Zool)(Hons)(Sheffield), PhD (Monash). John was nationally and internationally recognised for his outstanding contributions to stress physiology and stress-related problems of animal welfare. Over 30 years, his research provided a timely balance on discussions within science on the scientific assessment of animal welfare and its interpretations.

The Lecturers have been:

2010	P. Hemsworth
2012	G. Cronin

The 2014 John Barnett Lecturer is **Dr Isabelle Veissier**

**Robert Maxwell Herd**

BSc (University of NSW), MSc (University of NSW), PhD (Carleton University, Canada)

Robert Herd completed a Bachelor of Science Honours degree in 1976 and a Master of Science in 1981 at the University of New South Wales, and went to Canada to undertake a PhD at the Carleton University, which he completed in 1983. He subsequently took up a position as Livestock Research Officer (Nutrition) at the Trangie Agricultural Research Centre of the then NSW Department of Agriculture (now NSW Department of Primary Industries; NSW DPI). He has gone through several promotions and is currently Principal Research Scientist at the NSW DPI's Beef Industry Centre located at the University of New England (UNE) Armidale campus. He is also an Adjunct Professor at UNE. He has also had sabbatical leave and collaboration with scientists at the Roslin Institute, Ohio State University and the University of Idaho, USA. He played a significant science management role, as Project Leader in both of the last two Beef Cooperative Research Centres (1999–2006, and 2005–2012).

Robert is recognised internationally as an expert in the efficiency of feed utilisation by beef cattle. His comprehensive research on genetic improvement of feed efficiency led to the adoption of Net (or Residual) Feed Intake (NFI) as a trait in the national genetic improvement scheme for beef cattle – BREEDPLAN. His keen research interest in understanding the biological mechanisms contributing to the genetic variation has resulted in the publication of key review papers in this area. His research provided the first empirical data for the link between feed efficiency and reduced methane emissions in cattle. His current research is trying to push the boundaries even further by investigating the feasibility of breeding cattle for reduced methane per unit feed intake. The research has already provided the first ever genetic parameters for this trait in cattle, and the

results look promising. As part of his research he has been a member of the supervisory committee of many postgraduate and honours students. He has been examiner for PhD theses and regularly referees manuscripts for several international scientific journals and national scientific conferences. In recognition for the scientific excellence of his work he was acknowledged at the 2013 Australian Museum Eureka Prizes by his 'Cattle Methane Team' being selected as one of three finalists for the Caring for our Country Landcare Eureka Prize for Sustainable Agriculture.

Robert is the author of over 200 scientific publications, which include three book chapters and over 100 peer-reviewed papers. He also served as Guest Editor of the Australian Journal of Experimental Agriculture to produce a special issue on feed efficiency in 2004. Of special mention is his 2001 co-authored paper of the most comprehensive set of genetic parameters for feed efficiency in beef cattle. This paper made the Top 50 most-frequently cited paper ever published by the prestigious Journal of Animal Science. It is currently ranked 2nd on the all-time list.

Robert has been active as a member of the Australian Society of Animal Production (ASAP) since 1990. He has provided consistent long term service to ASAP at the federal and branch levels. He served on the Federal Council as National President from 2008–2010, and is currently a committee member of the New England Branch as its Secretary (2010 – present). He has also participated in numerous conferences by national and international animal science associations as invited speaker and session chair. For his distinguished contribution to ASAP and to animal production in Australia in research and development, the Australian Society of Animal Production is pleased to enrol him as a Fellow of the Society.





### Frank Rowland Dunshea

BAgricSc (La Trobe University), PhD (La Trobe University)

Frank Dunshea studied Agricultural Science, graduating in 1983 from La Trobe University where he also completed a PhD in 1987. He then spent three years as a Post-Doctoral Fellow at Cornell University before returning to Victoria as a research scientist with the Department of Primary Industries at Werribee. While working in the Department, Frank successfully undertook various leadership roles before accepting his current position as Professor of Agriculture in the Faculty of Land and Food Resources at the University of Melbourne in 2006.

Professor Dunshea's expertise covers aspects of both animal science and biomedical research using farm animal models. His major contributions have been in growth physiology and nutrition and delineating the interactions between the animal and the animal environment. His research has an impressive breadth and quality and he has published some 600 journal, conference, book or technical articles. His research has had a high scientific impact and he is currently in the top 1% of scientists for individual impact in Agricultural Science and in all scientific fields in the worldwide 'Web of Science' ISI ranking. This is a clear indication of his international stature. In addition, the results of much of his research have been rapidly adopted by industry. Throughout his career Frank has maintained a balanced approach to research, combining both fundamental with applied aspects that have provided commercial and public good outcomes.

As an example of delivery to the animal industries, Professor Dunshea was instrumental in developing and commercializing an immunocastration technology that is now approved for pigs and other species in about 70 countries. In 2010, he chaired an international panel of pig nutritionists that developed the nutrient requirements for immunocastrated boars and he has disseminated these findings at a number of international meetings. Frank also sits on a similar panel investigating the effects of immunocastration on meat quality. He has contributed substantially to knowledge of modes of action of metabolic modifiers and their impact on nutrient requirements in pigs and cattle and continues to work extensively with these and other technologies to maximise benefits for farmers, meat producers and consumers. He has also worked with the Australian and international dairy, beef and sheep industries; more recently investigating the nutritional means to alleviate heat stress. This work has focused on dietary insulin-mimics, anti-oxidants, anti-diabetogenic compounds and osmolytes to reduce the impact of heat stress.

Professor Dunshea has made a significant and ongoing impact on Australian animal agriculture through research leadership in the pork and other animal industry Co-operative Research Centres (CRC). He was involved for the duration (from 2005–2011) of the first Pork CRC as program leader for the whole herd feed efficiency program. The original Pork CRC consisted of researchers from 30 organizations and companies and together with Federal Funding represented an \$81 million investment over 7 years. The research program that he led was comprised of 7 sub-programs, and accounted for over 60% of the Pork CRC budget. The nutrition and other research outputs from the initial CRC helped reposition the Australian Pork industry to be internationally competitive and re-established a strong pig and collaborative research capability in Australia. In November 2010, Professor Dunshea was a member of the successful re-bid team that secured an additional \$130 million investment for the CRC for High Integrity Pork over 8 years from July 2011. Frank has also played active research and outreach roles in the Beef and Sheep CRCs and is a keen and active participant in the annual combined animal industries student workshops. This reflects the importance he places on mentoring of postgraduate students.

Frank Dunshea is held in high esteem internationally and is regularly invited to prepare reviews and make plenary presentations on nutrition and metabolism. His standing is also reflected in his membership of the Editorial Boards of four international journals. In December 2007 he was made a Fellow of the Nutrition Society of Australia in recognition of his contribution to nutritional science and, in January 2009, was appointed to the National Nutrition Committee of the Australian Academy of Science and will Chair this committee from 2014. In 2009 Frank was awarded the American Society of Animal Science (ASAS) Growth and Development award and in 2013 was awarded the ASAS non-ruminant nutrition award. He was made a Fellow of the Australasian Pig Science Association in November 2013. In all of these Associations, including ASAP, he has played an active role both as an office bearer and member in furthering each group's aims and activities.

In recognition of Frank Dunshea's contribution to the animal industries in Australia through research leadership and education, the Australian Society of Animal Production is pleased to enrol him as a Fellow of the Society.