



ANIMAL WELFARE
SCIENCE CENTRE

THE ANIMAL WELFARE SCIENCE CENTRE REVIEW

2015-2019

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Background

The Animal Welfare Science Centre (AWSC) has two current partner organisations:

- Victorian Department of Jobs, Precincts and Regions. Agriculture Victoria Research Division (AgVic).
- The University of Melbourne, Faculty of Veterinary and Agricultural Sciences (UoM).

In 2015 the South Australian Research and Development Institute and the School of Agricultural and Veterinary Science, University of Adelaide joined the AWSC as formal partners. The South Australian partner organisations formally retired from the AWSC in February 2019.

In 2019, the AWSC entered into collaborative agreements with:

- The Ohio State University, Departments of Animal Sciences and Veterinary Preventive Medicine (OSU).
- United States Department of Agriculture - Livestock Behavior Research Unit (USDA).

Across partner organisations, the AWSC has capability across a wide range of research disciplines: Animal Science, Applied Ethology, Biometrics, Immunology, Neurophysiology, Neuroendocrinology, Psychology, Sociology, Stress Physiology and Veterinary Science.

Research is conducted across a range of animal sectors including pork, dairy, eggs, meat chicken, beef, sheep meat, wool, companion animals and zoo animals.

Scientists also provide technical and advisory functions on Government, industry and scientific committees including the National Primary Industries Animal Welfare R, D&E Strategy and the OIE Collaborating Centre for Animal Welfare Science and Bioethical Analysis Management Committee.

The AWSC has built upon its key discipline in studying human/animal interactions, animal housing and husbandry and the effects of community attitudes and behaviour upon animal welfare.

The AWSC has collaborations in novel disciplines which are used in Animal Welfare Science, some examples are:

- With Peter Sandoe (Professor of Philosophy, Copenhagen) in the area of zoo animal welfare and ethics (Paul Hemsworth)
- With Sigfredo Fuentes (UoM) and also CQU in remote sensor-based measurement of animal welfare (Ellen Jongman)
- With Alan Tilbrook (UQ) in the use of neuropeptides in the measurement of animal welfare (Paul Hemsworth)
- With Craig Johnston (Massey) in the use of EEG assessment of animal pain (Andrew Fisher)
- With Jeremy Marchant-Forde (USDA) and Roger Rassool (UoM, Physics) in the development and use of remote monitoring technology to assess indicators of animal welfare (Paul Hemsworth)

Operating Environment

Animal welfare awareness continues to increase in society, strongly influencing views on animal use and the acceptability of various animal management practices. Stakeholders in the animal welfare domain include the public, generally as consumers, owners or concerned observers, special interest groups, businesses based on the commercial supply of animals and animal products and those developing, implementing or auditing compliance with relevant policy at

government or community level. Thus, consumer and public attitudes to animal welfare have the potential to dramatically affect the use of animals in society, influencing the operations of livestock industries, medical research, the management of feral and wild animals and the care of recreational and companion animals.

While consumer and public attitudes to animal welfare ultimately determine society's use and care of domestic animals, science has a critical role in underpinning society's decisions on animal use and the attendant conditions and compromises. Lack of awareness of factual information means that many people are unaware of the conditions under which domestic animals live, how they are treated and their species-specific requirements.

Thus, there are basically four key areas of activity necessary to rationally address animal welfare:

- animal welfare science
- understanding public and consumer attitudes to animal welfare
- public education and
- industry education

It is expected that certain animal production and management practices will be highlighted from time to time by community groups and that their viewpoints will be promoted to the community. It is important that the community is well informed, including the scientific perspective.

While research can be utilised to underpin the establishment, amendment or validation of industry welfare standards and practices, it is critical to deliver industry education, through staff selection and training strategies, and modify legislation, codes of practice and/or welfare QA programs to achieve these welfare standards.

The Centre is represented on the National Primary Industries Animal Welfare Research Development and Extension Strategy which brings together the core providers of farm animal welfare research with the major funding organisations and Governments to deliver targeted cross-sectoral research, development and extension within Australia's livestock industry sector.

The Centre, CSIRO and the University of Queensland (Centre for Animal Welfare and Ethics) are the Australian partners in the OIE Collaborating Centre for Animal Welfare which was formed in 2009 with the Animal Welfare Science and Bioethics Centre of Massey University, the Animal Behaviour and Welfare Research Centre of AgResearch and the Ministry for Primary Industries in New Zealand. The OIE Centre (now re-named as the Centre for Animal Welfare Science and Bioethical Analysis; the David Bayvel Consortium) supports the OIE region for Asia, the Far East and Oceania by, for example, building regional capacity through "twinning" programs and developing an animal welfare training course.

Animal Welfare Science Centre activities

The Centre conducts research in three program areas:

- 1. Welfare methodology or the development and validation of methods to assess animal welfare.**
- 2. Housing and husbandry effects on animal welfare.**
- 3. Attitudinal effects:**
 - 3.1.** The effects of the attitudes of stockpeople, animal handlers and animal owners on the welfare of their animals.
 - 3.2.** The effects of attitudes to animal welfare on consumer and community behaviour.

These programs support the fourth program area:

4. Tertiary, post-graduate and industry education and training.

Through these programs, the Centre aims to:

- Develop scientifically defensible welfare methodology.
- Use scientifically defensible methodology to establish, amend or validate animal welfare standards and practices.
- Develop and support industry education and training strategies and provide scientific advice to support the development or revision of animal welfare standards and guidelines and codes of practice, and the development of quality assurance programs to introduce scientifically defensible welfare standards in the animal industries.
- Understand public and consumer attitudes to animal welfare to assist Governments and industry in:
 - Developing animal welfare policy
 - assuring local and international consumers, public and other governments of the welfare standards for Australian domestic animals.
- Ensure tertiary students entering the animal industries are better prepared to provide sound, science-based advice on animal welfare practices to industry, interest groups and the public.
- Provide high quality postgraduate and postdoctoral training for the next generation of researchers and teachers in animal welfare science.

The Centre's activities are guided by our vision and mission:

Our Vision

“Animal welfare and its constant improvement are societal and cultural norms”

Our Mission

“To contribute to improved animal welfare as a world leading provider of expert information, advice and education underpinned by rigorous research”

The top 10 projects (by funding amount) in the period 2015 – 19 were:-

1. Identifying public and producer attitudes to sheep and cattle animal welfare to inform education strategies - Strategic Partnership for Animal Welfare RD&A /Meat and Livestock Australia/University of Melbourne
2. Animal Welfare Science Centre - Victorian Department of Jobs, Precincts and Regions (Agriculture Victoria Research Division) and The University of Melbourne
3. AgVic Dairy welfare (3 projects)
4. AgVic Sheep/Lamb welfare (2 projects)
5. Enhancing small ruminant production to benefit farming families in Sindh and Punjab, Pakistan - Australian Centre for International Agricultural Research
6. Human-animal relationships in zoos: Optimising animal and visitor experiences – Australian Research Council (Linkage Program), Taronga Conservation Society, Zoos Victoria, Detect Australia
7. Assessing and Addressing On-Farm Sheep Welfare - Meat and Livestock Australia
8. What causes smothering in commercial free-range laying hens - Australian Eggs Ltd
9. Carbon dioxide stunning of pigs - Australian Pork Limited

10. Early stress experiences and stress resilience in pigs - Australian Research Council – Linkage Program, Sunpork P/L, Rivalea P/L, Australasian Pork Research Institute Ltd

If one considers the AWSC Vision and Mission, all these projects are aligned with generating and communicating new knowledge to industry and Governments in order to improve the welfare of animals across sectors through changes to housing and husbandry and through an improved understanding of animal use by the community.

AWSC Personnel

Staff of the Centre

[See appendix 1.](#)

The Centre's research and teaching capacity is considerable with scientific expertise and experience in the key disciplines of animal behaviour, psychology, stress physiology and veterinary medicine.

Principal investigators

Prof. Andrew Fisher (Faculty of Veterinary & Agricultural Sciences, The University of Melbourne) – Director of the Centre. Chair of Cattle and Sheep Production Medicine. Andrew has significant experience in animal welfare, with a particular focus on production animal management and transport. Research interests include welfare aspects of dairy cow and calf management.

Prof. Grahame Coleman (Faculty of Veterinary and Agricultural Sciences, The University of Melbourne) – Grahame has followed a research career in aspects of human and animal behaviour associated with biological rhythmicity and sleep and changes in stress-related and reproductive hormones. Current research interests focus primarily on human-animal interactions in farm and companion animals and public attitudes to animal welfare.

Dr. Rebecca Doyle (Faculty of Veterinary & Agricultural Sciences, The University of Melbourne) – Rebecca's research projects have included animal cognition and cognitive bias; correlating stress physiology with behavioural and cognitive welfare measures; and how to make practical animal welfare improvements locally and in developing countries. Her position with Centre focuses on welfare improvements in the sheep and beef industries.

Dr. Lauren Hemsworth (Faculty of Veterinary & Agricultural Sciences, The University of Melbourne) - Research interests include the human-animal relationship and its influence on animal welfare and productivity, field welfare assessment in farm and companion animals and developing education programs for recreational horse owners.

Prof. Paul Hemsworth (Faculty of Veterinary and Agricultural Sciences, The University of Melbourne) –Director of the Centre: A research career studying the behaviour and welfare of farm and companion animals, particularly examining the influence of the social and physical environment on farm animal behaviour and welfare and the influence of human-animal interactions on animal welfare and productivity.

Dr. Ellen Jongman (Faculty of Veterinary & Agricultural Sciences, The University of Melbourne) - Research interests include the effect of housing, husbandry procedures and management on the welfare of sheep and dairy cows.

**Dr. Jean-Loup Rault (University of Veterinary Medicine, Vienna – Austria) - *Jean-Loup resigned from the University of Melbourne in August 2017 but his AWSC-related publications and projects are included in this report. Jean-Loup focused his research on pigs and poultry, specifically social behaviour and oxytocin, free-range systems in poultry, and euthanasia and slaughter.*

Post-doctoral research fellows

Dr. Lauren Edwards (Faculty of Veterinary & Agricultural Sciences, The University of Melbourne) – Research interests include the behaviour and welfare of farmed species (particularly poultry), exploring novel methods of assessing animal welfare, the human-animal relationship in farmed species, cognitive bias and its impact on animal behaviour, and assessing affective experiences in animals.

Dr. Carolina Muñoz (Faculty of Veterinary & Agricultural Sciences, The University of Melbourne) – Carolina is working within the MLA project examining Mulesing in prime lamb systems. Research interests include human-animal interactions in farm animals and farmer and community attitudes to animal welfare.

Supporting scientists

Dr. David Beggs (Faculty of Veterinary and Agricultural Sciences, The University of Melbourne) – Senior Lecturer in Cattle Medicine. David is interested in managing the effects of increasing dairy herd size and intensification to preserve and optimise animal welfare.

Dr. Ian Bland (Faculty of Veterinary and Agricultural Sciences, The University of Melbourne) – Lecturer in Animal Science and Management. Ian is interested in the behaviour and welfare of neonatal/weaned pigs and zoo animals.

Mr. Kym Butler (Agriculture Research, AGVIC, Hamilton and Faculty of Veterinary and Agricultural Sciences, The University of Melbourne) – Kym works within the Biometrics Unit, Agriculture Research and applies biometric analysis to the Centre's research projects.

Dr. Angus Campbell (Faculty of Veterinary and Agricultural Sciences, The University of Melbourne) – Senior Veterinary Consultant and Lecturer in Ruminant Medicine & Production. Involved in research into herd and flock health on sheep, goat and cattle farms in south-eastern Australia, and consults internationally on agricultural development.

Dr Sarah Chaplin (Agriculture Victoria, Department of Economic Development, Jobs, Transport and Resources) – Sarah has expertise in biosecurity, animal behaviour and welfare, social license, risk management and regulation.

Dr. Joe Jacobs (Agriculture Victoria Research, Department of Economic Development, Jobs, Transport and Resources) – Joe is internationally recognised as an expert in agronomy, grazing management and the interactions between pastures, supplements and ruminants. He has over 25 years' experience in applied dairy and livestock production research.

Dr. Jeremy Marchant-Forde (United States Department of Agriculture - Agricultural Research Service) - Works at the Livestock Behavior Research Unit, based in West Lafayette, Indiana. Expertise is applied animal behavior (applied ethology) and stress physiology with a research focus on welfare issues surrounding housing and management of pigs and dairy cattle.

Prof. Steve Moeller (Dept. of Animal Sciences, The Ohio State University) - Activities include teaching, extension, and research directed toward the swine industry with involvement in collaborative research and extension efforts across food animal species and youth and adult audiences.

Dr. Rebecca Morrison (Rivalea Australia) - Research Scientist, she conducted her PhD (Behaviour and welfare of pigs in deep-bedded, group housing systems) with Prof. Paul Hemsworth at the University of Melbourne. Rebecca has worked at the University of Minnesota as the Sustainable Swine Production Systems Scientist, working and researching a range of non-crated farrowing systems.

Dr. Sally Sherwen (Zoos Victoria) - Director Wildlife Conservation and Science, Sally completed her PhD (Impact of visitors on the behaviour and welfare of zoo animals) with Prof. Paul Hemsworth at the University of Melbourne.

Dr. Bill Wales (Agriculture Victoria Research, Department of Economic Development, Jobs, Transport and Resources) - Bill is internationally recognised as an expert in the interactions between pastures, supplements and grazing dairy cows. He is an experienced applied research scientist and has skills in farming systems research and biological processes influencing milk fat synthesis.

Administration and technical staff

Rutu Y. Acharya, Research Assistant, The University of Melbourne

Maxine Rice, Research Assistant, The University of Melbourne

Jess Taylor, Casual Research Assistant, The University of Melbourne.

Jeremy Skuse, Executive Officer, Program Leader - Industry Education & Training, The University of Melbourne

Will Coombs, Casual Technical Officer, The University of Melbourne

PhD candidates

Leigh Atkinson (UOM) – Investigating ways to improve the coping ability of sheep.

Katrina Anderson (UOM) – Validating a panel of behavioural indicators of racehorse stress.

Samantha Chiew (UOM) - The effects of zoo visitor-zoo animal interactions at display enclosures on both the animal and the visitor.

Prabal Chowdhury (UOM) - Investigating causes and risk factors of smothering in free range layer poultry.

Samantha Cramer (UOM) - Investigating options that add value to bobby calves and improve their welfare.

Laura Field (UOM) - researching farmer attitudes and management practices and their relations to welfare outcomes in large dairy herds.

Carmen Glanville (UOM) - Investigating the drivers of companion animal owner behaviour related to neglect and the concept of 'duty of care'.

Belinda Hall (UOM) - The use and effectiveness of cognitive enrichments in zoo animals.

Megan Hayes (UOM) - Human enrichment in pigs.

Sally Haynes (UOM) - The relationship between the attitudes and behaviours of human handlers and the behaviour and welfare of shelter dogs.

Maria Jorquera (UOM) - Novel measures of remote monitoring applicable to welfare assessment.

Sarah Kuyken (UOM) - Development and trial of a horse welfare assessment tool.

Mark Learmonth (UOM) - Human interaction as enrichment for zoo-housed animals: Opportunity for positive affective experiences?

Gabriela Marquette (UOM) - Welfare of calves in relation to disbudding and castration.

Maxine Rice (UOM) - Researching smothering in free range and barn layer systems.

Lydia Rehnberg (UOM) - Human-animal relationships in zoos: Optimising animal and visitor experiences.

Natalie Roadknight (UOM) - Researching calf welfare, in particular the welfare of male calves.

Bronwyn Stevens (UOM) - Does restricting an animal's access to a highly preferred resource result in altered biological function?

Madeleine Woodruff (UOM) - farmer behaviour, attitudes and intervention strategies.

Past PhD students

[See appendix 2.](#)

Josh Aleri (Melbourne)	Jacqui Ley (Monash)
Adele Arnold (Melbourne)	Linda Marston (Monash)
David Beggs (Melbourne)	Andrew McLean (Melbourne)
Naomi Botheras (Melbourne)	Kate Mornement (Monash)
Kate Breuer (Monash)	Carolina Munoz (Melbourne)
Mia Cobb (Monash)	Monoar Sayeed Pallab (Melbourne)
Sara Crawford (Ohio)	Jessica Pempek (Ohio)
Jo Coombe (Melbourne)	Bree Pierce (Monash)
Anoma Dilrukshi (Melbourne)	Cameron Ralph (Melbourne)
Fleur Dwyer (Monash)	Lydia Rehnberg (Melbourne)
Lauren Edwards (Melbourne)	Vanessa Rohlf (Monash)
Joanna Engel (Melbourne)	Lauren Roberts (Melbourne)
Lauren Hemsworth (Monash)	Sabine Roussel (Melbourne)
Tiffani Howell (Monash)	Rebecca Sargent (Melbourne)
Keven Kerswell (Melbourne)	Sally Sherwen (Melbourne)
Tammie King (Monash)	Peta Taylor (Melbourne)
Amanda Kobelt (Melbourne)	Anne Turner (Monash)
Sonja Laine (Melbourne)	Megan Verdon (Melbourne)
Hannah Larsen (Melbourne)	Dennis Wormald (Melbourne)
Mariko Lauber (Melbourne)	

Board of Management

Ms. Lucinda Corrigan - Independent Chair.

Dr. Joe Jacobs - Research Director, Animal Production Sciences, Department of Jobs, Precincts and Regions.

Prof. Brian Leury - Deputy Dean, Faculty of Veterinary and Agricultural Sciences, The University of Melbourne.

Prof. Andrew Fisher - Director AWSC, Faculty of Veterinary and Agricultural Sciences, The University of Melbourne.

AWSC Representation on committees in a technical/advisory capacity

Animal Welfare Advisory Committee	Rebecca Doyle David Beggs
AGVIC Livestock Industries Consultative Committee	Andrew Fisher
AGVIC Agriculture Research and Extension Animal Ethics Committee	Andrew Fisher
Dairy Moving Forward Animal Husbandry Steering Group	Andrew Fisher
Dairy Moving Forward Safe Stock Handling Steering Group	Paul Hemsworth Sarah Chaplin
Dept of Agriculture and Water Resources Live Export Heat Stress Risk Assessment Technical Review Panel	Andrew Fisher
Dept of Agriculture and Water Resources Live Export Live Export Animal Welfare Advisory Group	Andrew Fisher
Global Agenda for Sustainable Livestock - Animal Welfare Action Network	Rebecca Doyle
Greyhound Racing Victoria Welfare Committee	Grahame Coleman
RSPCA Victoria Animal Welfare Policy Committee	Ellen Jongman
National Primary Industries Animal Welfare Strategy Steering Committee	Andrew Fisher
National Stakeholder Advisory Group member for the Poultry Standards and Guidelines	Paul Hemsworth
OIE ad hoc Group on Animal Welfare and Pig Production Systems	Paul Hemsworth
OIE ad hoc Group on Animal Welfare and Poultry Production Systems	Paul Hemsworth Jean-Loup Rault
OIE Collaborating Centre for Animal Welfare Science and Bioethical Analysis Management Committee	Andrew Fisher
Pork Industry Advisory Group for Standards and Guidelines	Paul Hemsworth
Virtual Herding Project (Rural R&D for Profit programme) Steering Group	Paul Hemsworth
Zoos Victoria Animal Welfare Peer Review Committee	Paul Hemsworth

FUNDING FOR AWSC RD&E PROJECTS

(2015 – 2019)

For summaries see [appendix 3.](#)

For funding breakdown, see [Appendix 5.](#)

Agriculture and Food Development Authority of Eire (TEAGASC,)
\$ 70,000

Australian Centre for International Agricultural Research (ACIAR)
\$ 409,932

CRC for High Integrity Australian Pork (Pork CRC)
\$ 538,475

Australian Eggs Limited (AEL – formerly Australian Egg Corporation Ltd)
\$ 460,829

Australian Meat Processor Corporation (AMPC)
\$ 115,748

Australian Pork Limited (APL)
\$ 277,358

Australasian Pork Research Institute Ltd (APRIL)
\$ 49,143

Australian Research Council (ARC)
\$ 467,478

Dairy Australia (DA)
\$ 83,509

Department of Agriculture
\$ 19,956

Greyhound Racing Victoria (GRV)
\$ 49,960

Meat and Livestock Australia (MLA)
\$ 671,238

National Primary Industries RD&E Strategy (NAWRDES)
\$ 418,050

Parks Victoria
\$ 84,344

Rural Industries Research and Development Corporation (RIRDC Chicken meat)
\$ 39,790

Strategic Partnership for Animal Welfare RD&A (inc MDC, UoM and MLA contributions)
\$ 1,121,124

University of Melbourne (UOM)
\$ 474,464

Victorian Department of Jobs, Precincts and Regions (formerly Department of Economic Development, Jobs, Transport and Resources)
\$ 1,415,918

TOTAL RD&E FUNDING FROM 2015–2019 - \$ 6,766,866

AWSC RD&E PROJECTS

2015-2019

[See appendix 3.](#)

Only those projects where AWSC is the lead organisation are included. The AWSC participates in many collaborative projects led by other organisations.

1. Dairy industry

- 1.1. Characterisation of the welfare and performance responses of calves to disbudding and castration procedures - *University of Melbourne/TEAGASC, Agriculture and Food Development Authority of Eire*
- 1.2. The welfare of bobby calves in the meat supply chain - *Strategic Partnership for Animal Welfare RD&A / Parmalat / Meat and Livestock Australia/University of Melbourne*
- 1.3. Scale of production, attitudes of dairy farmers and stockpeople and the welfare of dairy cows - *Dairy Australia*
- 1.4. Differences between heat tolerant and heat susceptible cows in standing, walking and lying time defined - *Department of Economic Development, Jobs, Transport and Resources*
- 1.5. Milking order and animal welfare in large herds - *Department of Economic Development, Jobs, Transport and Resources*
- 1.6. Ensuring dairy cow welfare with increasing scale of production – *Dairy Australia*
- 1.7. Dairy welfare - *Department of Economic Development, Jobs, Transport and Resources*

2. Pork industry

- 2.1. Early stress experiences and stress resilience in pigs - *Australian Research Council – Linkage Program, Sunpork P/L, Rivalea P/L, Australasian Pork Research Institute Ltd*
- 2.2. Developing remote monitoring methods for early detection of respiratory disease in pigs - *Australasian Pork Research Institute Ltd*
- 2.3. Human enrichment program for breeding sows: proof of concept - *CRC for High Integrity Australian Pork*
- 2.4. Review of the scientific literature and the international pig welfare codes and standards to underpin the future Standards and Guidelines for Pigs - *Australian Pork Limited*
- 2.5. Sham-chewing and sow welfare and productivity - *CRC for High Integrity Australian Pork*
- 2.6. Development of commercially-viable enrichment programs for group-housed sows - *CRC for High Integrity Australian Pork*
- 2.7. Brain-derived neurotrophic factor as an indicator of environmental enrichment effectiveness - *CRC for High Integrity Australian Pork*
- 2.8. Increased light intensity and mat temperature attract piglets to creep areas in farrowing pens - *CRC for High Integrity Australian Pork*
- 2.9. Conditioned feeding to increase feed intake in the mature gilt model – *Commonwealth, sponsored by Australian Pork Limited*
- 2.10. The feeding behaviour of sows and its relationship to sow welfare and reproduction - *CRC for High Integrity Australian Pork*

- 2.11. Welfare implications of group lactation at various ages - *CRC for High Integrity Australian Pork*
- 2.12. Carbon dioxide stunning of pigs - *Australian Pork Limited*
- 2.13. Developing ways to measure and increase sow contentment - *CRC for High Integrity Australian Pork*
- 2.14. ProHand® Pigs technical support - *Australian Pork Limited*

3. Poultry

- 3.1. What causes smothering in commercial free-range laying hens - *Australian Eggs Ltd*
- 3.2. Animal welfare and values - *Australian Eggs Ltd*
- 3.3. Hen welfare literature review - *Australian Eggs Ltd*
- 3.4. Assessment of factors influencing behaviour and welfare of birds in free range systems (broilers) - *Rural Industries Research & Development Corp, (Chicken meat)*
- 3.5. Free-range hen welfare: Characterisation of 'outdoor' and 'indoor' hens and physical features in the range - *Australian Egg Corporation Limited*

4. Beef and sheep industries

- 4.1. Phasing out of mulesing: cost, benefits and opportunities - *Meat and Livestock Australia*
- 4.2. Identifying public and producer attitudes to sheep and cattle animal welfare to inform education strategies - *Strategic Partnership for Animal Welfare RD&A /Meat and Livestock Australia/University of Melbourne*
- 4.3. Beat the heat – reducing impacts of hotter summers to grazing sheep - *Department of Economic Development, Jobs, Transport and Resources*
- 4.4. Developing the basis for an attitude-behaviour training program for stockpeople in the sheep transport and abattoir sectors - *Meat and Livestock Australia*
- 4.5. Methods of field euthanasia for livestock that preserve brain material - *Meat and Livestock Australia*
- 4.6. Assessing and Addressing On-Farm Sheep Welfare - *Meat and Livestock Australia*
- 4.7. Quantifying welfare improvements in the live export industry - *Meat and Livestock Australia*
- 4.8. Relationships between fear of humans, temperament and handling pre-slaughter and lamb welfare and meat quality - *Australian Meat Processor Corporation*
- 4.9. Lamb welfare - *Department of Economic Development, Jobs, Transport and Resources*
- 4.10. Welfare implications of "NumNuts" - *Meat and Livestock Australia*

5. Companion, zoo and work animals

- 5.1. Socialisation of greyhounds to optimise their racing success and maximise successful rehoming - *Greyhound Racing Victoria*
- 5.2. Human-animal relationships in zoos: Optimising animal and visitor experiences – *Australian Research Council (Linkage Program), Taronga Conservation Society, Zoos Victoria, Detect Australia*

6. General/Other

- 6.1. Monitoring public attitudes to livestock industries and livestock welfare – facilitated by *National Primary Industries Animal Welfare RD&E Strategy (NAWRDES)* and funded by *AgriFutures, Australian Pork Limited, Australian Meat Processor Corporation, Livecorp and Meat and Livestock Australia*
- 6.2. Enhancing small ruminant production to benefit farming families in Sindh and Punjab, Pakistan - *Australian Centre for International Agricultural Research*
- 6.3. Evaluation of the welfare risks and impacts of roping - *Parks Victoria*
- 6.4. Animal Welfare Science Centre - *Victorian Department of Jobs, Precincts and Regions (Agriculture Victoria Research Division) and The University of Melbourne*
- 6.5. Australian Animal Welfare Views – facilitated by *NAWRDES* and funded by *Commonwealth Department of Agriculture, Australian Egg Corporation, Australian Pork, Rural Industries R&D Corporation, Meat and Livestock Australia, Dairy Australia and Livecorp*
- 6.6. Executive Support, National Primary Industries Animal Welfare RD&E Strategy (NAWRDES) - *NAWRDES*

AWSC RD&E COMMUNICATIONS

Books and chapters

(n = 13)

1. Skuse, J.M, Hemsworth, P.H. and Rault, J-L. (2019). Improving human-animal interactions in "Animal Welfare in Practice", Ed Rault, J-L. 5MPublishing, UK. Chapter 4.1, pp. 89-94 (IN PRESS)
2. Hemsworth, P.H. (2018). Defining and ensuring animal welfare in pig production: an overview. In "Achieving Sustainable Production of Pig Meat. Volume 3: Animal Health and Welfare", Ed Wiseman, J. Burleigh Dodds Scientific Publishing, Cambridge UK, Chapter 6, pp. 125-150.
3. Hemsworth, P.H., Sherwen, S.I. and Coleman, G.J. (2018). Human Contact. In Appleby, M.C., Olsson, I.A.S. and Galindo, F. Animal Welfare 3rd Edition. CABI. Oxfordshire. 294-314. ISBN: 9781786390202
4. Verdon, M and Rault, J-L. (2018). Aggression in group housed sows and fattening pigs. In: Advances in pig welfare, Ed Špinka, M. pp 235-260. ISBN 97800-08-101012-9. <https://doi.org/10.1016/B978-0-08-101012-9.00018-6> .Hemsworth, P.H. and Coleman, G.J. (2011) Human-Livestock Interactions: The Stockperson and the Productivity and Welfare of Intensively Farmed Animals, 2nd Edition, CAB International, Oxford, UK.
5. Coleman, G.J. (2017). Consumer and societal expectations for sheep products. In Ferguson, D., Lee, C. and Fisher, A. eds. Advances in sheep welfare. Woodhead Publishing. Accepted May 2017. In press.
6. Doyle, R. E. (2017). Sheep cognition and implications for welfare. In Ferguson, D., Lee, C. and Fisher, A. eds. Advances in sheep welfare. Woodhead Publishing. 55-68. ISBN 978-0-08-100718-1
7. Ferguson, D.M., Fisher, A.D., Colditz, I.G. and Lee, C. (2017). Future challenges and opportunities in sheep welfare. In Ferguson, D., Lee, C. and Fisher, A. eds. Advances in sheep welfare. Woodhead Publishing. 285-292. ISBN 978-0-08-100718-1
8. Ferguson, D., Lee, C. and Fisher, A.D. (2017). eds. Advances in sheep welfare. Woodhead Publishing. ISBN 978-0-08-100718-1
9. Hemsworth, P.H. and Jongman, E.C. (2017) Humane transport, lairage and slaughter of sheep. In: Achieving sustainable production of sheep. Ed Greyling, J. Burleigh Dodds Scientific Publishing, Cambridge CB22 3HJ UK, pp379-396. ISBN-13: 9781786760845
10. Hemsworth, P.H., Mellor, D.J., Coleman, G.J., Beausoleil, N.J., Fisher, A.D. and Stafford, K.J. (2016). Australian and New Zealand perspectives. In: Brown, J. and Seddon, Y. (Editor), Animals and Us: 50 years and more of Applied Ethology, Wageningen Academic Publishers, pp193-210. ISBN: 978-90-8686-282-5
11. Rault, JL and Doyle, R. E. (2016). Cognitive approaches and new technologies: changing methodologies in applied ethology. In: Brown, J. and Seddon, Y. (Editor), Animals and Us: 50 years and more of Applied Ethology, Wageningen Academic Publishers, pp113-132. ISBN: 978-90-8686-282-5
12. Fisher, A.D. (2016). How can we measure welfare of animals on farms? In: Breeding Focus 2016: Improving Welfare. Eds. S. Hermesch and S. Dominik. AGBU, University of New England, Australia. p 5-15.
13. Moran, J. and Doyle, R.E. (2015). Cow Talk: Understanding dairy cow behaviour to improve their welfare on Asian farms. CSIRO Publishing. ISBN: 9781486301614

Research publications in refereed journals

(n = 133)

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Refereed Conference publications

(n = 96)

1. Atkinson, L., Doyle, R. E., and Jongman, E. (2019). Using humans as early life stressors to improve coping in sheep. International Ethological Conference, Chicago, USA. 2019. Oral presentation.

2. Power-Geary, J., Nolan, H.R.J., Hemsworth, L.M. and Taylor, P.S. (2019). Understanding the perceptions and knowledge of laying hen welfare: industry and community stakeholder focus groups. 30th Australian Poultry Science Symposium. 17-20 Feb 2019. Sydney
3. Doyle, R. E. (2019). Global Animal Welfare: animal welfare and the sustainable development goals. Science Week, Gold Coast, Australia. 2019. Oral presentation.
4. Doyle, R. E. (2019). Welfare in the value chain: practical strategies and benefits of improved pig welfare. Regional symposium on research into smallholder pig production, health and pork safety, Hanoi, Vietnam 27-29th March 2019.
5. Fisher, A.D., van Oostveen, C., Conley, M. and Jongman, E.C. (2019). The relationship between motion score and reproductive behaviour in dairy cows managed in pasture and feedpad environments. 53rd Congress of the International Society for Applied Ethology. 5-9 August, Bergen, Norway.
6. Hall, B.A., Sherwen, S., Franks, R., McGill, D.M. and Doyle, R.E. (2019). Cognitive enrichment for parrots: effects of design and personality. 14th International Conference on Environmental Enrichment. Kyoto, 22-26 June 2019.
7. Hayes, M. Hemsworth, L.M., Morrison, R.S., Rice, M. and Hemsworth, P.H. (2019). Positive human contact reduces avoidance behaviour of gestating sows during routine husbandry procedures. Proceedings of the 17th Biennial Conference of the Australasian Pig Science Association (APSA). 17-20 November, Adelaide. p 43.
8. Hayes, M., Hemsworth, L., Morrison, R., Rice, M. and Hemsworth, P.H. (2019). Daily positive human contact alters the frequency of sow-initiated interactions with a stockperson. International Ethological Conference, Chicago, USA. 2019. Oral presentation.
9. Hemsworth, L., Duke, M., Tilbrook, A.J. and Hemsworth, P.H. (2019). Exploratory behaviour of piglets raised in two farrowing-lactation systems. International Ethological Conference, Chicago, USA. 2019. Oral presentation.
10. Jorquera, M.F., Dunshea, F.R., Fuentes, S. and Jongman, E.C. (2019). A pilot study of early detection of porcine pleuropneumonia using remote sensing and computer vision techniques over thermal infrared and RGB imagery. UFAW Conference June 2019, Brugge, Belgium. Oral presentation.
11. Jorquera-Chavez, M., Fuentes, S., Jongman, E.C., Warner, R.D. and Dunshea, F.R. (2019). Development and implementation of machine vision techniques to measure eye temperature, heart rate and respiratory rate in dairy cattle. Proceedings of the 9th European Conference on Precision Livestock Farming. 26-29 August 2019, Cork, Ireland, 116.
12. Acharya, R., Hemsworth, L.M. and Hemsworth, P.H. (2018). Examining the relationship between feeding behaviour and sham chewing in nulliparous group-housed gestating sows. Proceedings of the 52nd Congress of the International Society for Applied Ethology. 30 July-3 August 2018, Prince Edward Island, Canada. 235.
13. Chiew, S.J., Butler, K.L., Sherwen, S.L., Coleman, G.J., Fanson, K.V. and Hemsworth, P.H. (2018). Effects of manipulating visitor proximity and intensity of visitor behaviours on little penguins (*Eudyptula minor*). Proceedings of the 52nd Congress of the International Society for Applied Ethology. 30 July-3 August 2018, Prince Edward Island, Canada. 205.
14. Coleman, G.J., McLeod, E., Howell, T. and Hemsworth, L.M. (2018). Examining relationships between cat owner attitudes and cat owner reported management behaviour. Proceedings of the 52nd Congress of the International Society for Applied Ethology. 30 July-3 August 2018, Prince Edward Island, Canada. 130.
15. Coleman G.J. (2018). Public perceptions of farm animal welfare and their relevance to livestock welfare. 2018 AVA ANNUAL CONFERENCE. Invited speaker.

16. Doyle, R.E, Wieland, B., Roesel, K. and Grace, D. (2018). Production animal welfare and the sustainable development goals. UFAW: Animal welfare across borders. Hong Kong, October 2018.
17. Fisher, A.D., Van Oostveen, C., Conley, M. and Jongman, E.C. (2018). The effect of concrete feedpad feeding periods on oestrous behaviour in dairy cows in a pasture-based farming system. Proceedings of the 52nd Congress of the International Society for Applied Ethology. 30 July-3 August 2018, Prince Edward Island, Canada. 82.
18. Hemsworth, L.M., Acharya, R. and Hemsworth, P.H. (2018). Sham chewing and sow welfare and productivity in nulliparous group-housed gestating sows. Proceedings of the 52nd Congress of the International Society for Applied Ethology. 30 July-3 August 2018, Prince Edward Island, Canada. 248.
19. Hemsworth, P.H., Rice, M., Jongman, E.C., Hemsworth, L.M. and Coleman, G.J. (2018) Improving our understanding of assessing fear in sheep. Proceedings of the 52nd Congress of the International Society for Applied Ethology. 30 July-3 August 2018, Prince Edward Island, Canada. 223.
20. Munoz, C.A., Hemsworth, P.H., Coleman, G.J, Abrie, L. and Doyle, R.E. (2018). Using qualitative behaviour assessment and flight distance to examine the farmer-ewe relationship in extensive systems. Proceedings of the 52nd Congress of the International Society for Applied Ethology. 30 July-3 August 2018, Prince Edward Island, Canada. 230.
21. Rice, M., Acharya, R., Abrie, L. and Hemsworth, L.M. (2018). A preliminary examination of sham chewing across first and second gestation in group-housed sows. Proceedings of the 52nd Congress of the International Society for Applied Ethology. 30 July-3 August 2018, Prince Edward Island, Canada. 239.
22. Roadknight, N. and Fisher, A.D. (2018). The Australian/New Zealand system for managing non-replacement dairy calves. Teagasc National Dairy Conference, Athlone, Ireland. 14-16.
23. Woodruff, M., Munoz, C.A., Doyle, R.E, Coleman, G.J. and Hemsworth, L.M. (2018). Too short: Understanding farmer knowledge of and attitudes towards appropriate lamb tail length. UFAW: Animal welfare across borders. Hong Kong, October 2018.
24. Coleman, G.J. (2017). The human animal relationship, its implications for pig welfare and productivity and training strategies to safeguard pig welfare. Proceedings of the Manitoba Swine Seminar, Manitoba, Feb. 2017. 49-62. Invited address.
25. Coleman, G.J. (2017). Public attitudes predict community behaviours relevant to the swine industry. Proceedings of the Manitoba Swine Seminar, Manitoba, Feb. 2017. 141-153. Invited address.
26. Doyle, R.E., Hazel, S., Zemitis, J.E., Ralph, C.A., Plush, K., Morrison, R.S., Cronin, G.M. and Lee, C. (2017). Developing a rapidly learnt judgement bias test in a confined environment. UFAW International Animal Welfare symposium. 27-29 June 2017, Surrey, U.K. 92
27. Doyle, R.E., Ralph, C.R., Edwards, L.E., Morrison, R.S, Cronin, G.M. and Plush, K.J. (2017). The reproductive value of enrichment to sows at farrowing. Proceedings of the 16th Biennial Conference of the Australasian Pig Science Association, 19-22 November 2017, Melbourne, Australia, p. 2439
28. Fisher, A.D., Atkinson, L., Houghton, E., Lee, C. and Doyle, R.E. (2017). The use of selective serotonin reuptake inhibitors to try to develop a pharmacological model of positive affect in sheep. Proceedings of the 51st Congress of the International Society for Applied Ethology. 7-10 August 2017, Aarhus, Denmark. 208.
29. Hayes, M. and Hemsworth, L.M. (2017). Assessing the behavioural response of companion dogs to humans in a household environment. Proceedings of the 7th International Conference on the Assessment of Animal Welfare at Farm and Group Level. 5-8 September, Wageningen, Netherlands, 179.

30. Hemsworth, L.M, Acharya, R.Y and Hemsworth, P.H. (2017). A preliminary examination of sham chewing behaviour in group-housed nulliparous sows. Proceedings of the 16th Biennial Conference of the Australasian Pig Science Association, 19-22 November 2017, Melbourne, Australia, p. 2440
31. Hemsworth, L. M. (2017). Behaviour change in horse owners for horse welfare improvement. Proceedings of the 13th Conference of the International Society for Equitation Science, 22-25 November 2017, Wagga Wagga, Australia.
32. Hemsworth, P.H. (2017). Advances in applied animal welfare science: human-animal interactions in zoos, Fourth Symposium, Zoos and Aquariums Moving Forward as Welfare Centers: Ethical Challenges and Global Commitment, World Association of Zoos and Aquariums, Detroit Zoo 4-6 May 2017, Detroit Zoo, Detroit, USA.
33. Kite, R. and Jongman, E.C. (2017). The development of a welfare assessment tool for the Australian Fur Seals at Melbourne Zoo. Proceedings of the 7th International Conference on the Assessment of Animal Welfare at Farm and Group Level. 5-8 September, Wageningen, Netherlands, 191.
34. Kuyken, S.C. and Hemsworth, L.M. (2017). Examining the reliability of a horse hoof condition score. Proceedings of the 7th International Conference on the Assessment of Animal Welfare at Farm and Group Level. 5-8 September, Wageningen, Netherlands, 166.
35. Monk, J., Doyle, R.E., Belson, S, Cronin, G.M. and Lee, C. (2017). Assessing anxious states in sheep: a more practical attention bias test. Proceedings of the 51st Congress of the International Society for Applied Ethology. 7-10 August 2017, Aarhus, Denmark. 199.
36. Morrison, R.S., Kells, N.J., Johnson, C.B. and Hemsworth, P.H. (2017). Strategies to reduce the pain of tail docking in piglets. Proceedings of the 16th Biennial Conference of the Australasian Pig Science Association, 19-22 November 2017, Melbourne, Australia, p. 2448
37. Muñoz, C.A., Campbell, A.J.D., Hemsworth, P.H. and Doyle, R.E. (2017). On-farm ewe welfare and its relationship with farmer management styles. Proceedings of the 7th International Conference on the Assessment of Animal Welfare at Farm and Group Level. 5-8 September, Wageningen, Netherlands, 38.
38. Ralph, C.R., Plush, K.J. and Rault, J-L. (2017). Oxytocin delivered intranasally to gilts immediately after the birth of the first piglet decreased colostrum intake and growth of piglets. Proceedings of the 16th Biennial Conference of the Australasian Pig Science Association, 19-22 November 2017, Melbourne, Australia, p. 2454
39. Ralph, C.R., Plush, K.J., Hazel, S., Zemitis, J. and Doyle, R.E. (2017). The provision of lucerne to sows evoked greater arousal in response to an anticipatory behaviour test. Proceedings of the 16th Biennial Conference of the Australasian Pig Science Association, 19-22 November 2017, Melbourne, Australia, p. 2460
40. Rault, J-L., Howell, T., Rohlf, V. and Coleman G.J. (2017). Exploring stakeholder views towards poultry welfare using online forums. Aust.Poult.Sci.Symp. 28, 109
41. Rault, J-L. (2017). Positive social behaviour: inside out. Proceedings of the 51st Congress of the International Society for Applied Ethology. 7-10 August 2017, Aarhus, Denmark. 47.
42. Verdon, M., Morrison, R.S. and Rault, J-L. (2017). Group-lactation housing from 7 or 14 days post-partum: effects on sow behaviour. Proceedings of the 16th Biennial Conference of the Australasian Pig Science Association, 19-22 November 2017, Melbourne, Australia, p. 2461
43. Verdon, M., Morrison, R.S. and Rault, J-L. (2017). Group-lactation housing from 7 or 14 days post-partum – effects on piglet behaviour. Proceedings of the 16th Biennial Conference of the Australasian Pig Science Association, 19-22 November 2017, Melbourne, Australia, p. 2450

44. Zegarra, N., Hemsworth, P.H. and Verdon, M. (2017). Floor feeding over multiple drops does not increase feeding opportunities for submissive sows. Proceedings of the 51st Congress of the International Society for Applied Ethology. 7-10 August 2017, Aarhus, Denmark. 177
45. Zemitis, J, Plush, K.J., Ralph, C.R., Morrison, R.S., Hazel, S. and Doyle, R.E. (2017). Play behaviour in piglets is infrequent and not altered by enrichment with lucerne when measured by scan sampling. Proceedings of the 16th Biennial Conference of the Australasian Pig Science Association, 19-22 November 2017, Melbourne, Australia, p. 2447
46. Acharya, R. and Rault, J-L. (2016). YouTube to the rescue: factors influencing feather damaging behaviours in parrots. 50th Congress of the International Society for Applied Ethology. 12-16 July, Edinburgh, UK, 390
47. Brown, J., Seddon, Y., Rault, J-L., Doyle, R.E, Jensen, P., Rodenburg, B. and Marchant-Forde, J. (2016). 50th Congress of the International Society for Applied Ethology. 12-16 July, Edinburgh, UK, 112
48. Chavez, M.J. and Jongman, E.C. (2016). The relationship between heat stress tolerance and temperament of dairy cows. 50th Congress of the International Society for Applied Ethology. 12-16 July, Edinburgh, UK, 144
49. Chiew, S., Sherwen, S., Hemsworth, P.H. and Coleman, G.J. (2016). Visitor and keeper beliefs about the effects of visitors on zoo animal. 50th Congress of the International Society for Applied Ethology. 12-16 July, Edinburgh, UK, 314
50. Coleman, G.J. (2016). Human attitudes and their relevance to animal welfare. 50th Congress of the International Society for Applied Ethology. 12-16 July, Edinburgh, UK, 297
51. Coleman, G.J., Rohlf, V., Toukhsati, S. and Blache, D. (2016). Relevance of public attitudes to animal welfare for the pork industry. Animal Production 2016. 4-7 July, Adelaide, Australia, 68
52. Cronin, G.M., Hopcroft, R.L., Groves, P.J. and Hemsworth, P.H. (2016). The impact of a feather-pecking outbreak in an experimental free-range layer flock on growth, egg production. Plumage damage and mortality. Animal Production 2016. 4-7 July, Adelaide, Australia. 59
53. Cronin, G.M., Tran, K.T.N., Hartcher K.M. and Hemsworth, P.H. (2016). Free-ranging by laying hens soon after the pop-holes open. Aust.Poult. Sci.Symp. 27. 72-75
54. Doughty, A.K., Coleman, G.J., Hinch, G.N. and Doyle, R.E. (2016). The welfare of extensively managed sheep: a survey identifying issues and indicators. 50th Congress of the International Society for Applied Ethology. 12-16 July, Edinburgh, UK, 312
55. Fisher, A.D. (2016). Do animals know what's good for them? - Aligning animal preferences and their biological needs in welfare studies. Refereed paper in the Proceedings of the Australian Veterinary Association Annual Conference, Adelaide 22-26 May 2016.
56. Fisher, A.D., Stevens, B., Conley, M., Jongman, E.C., Hides, S. and Mansell, P. (2016). The relationship between standing behaviour in transported calves and subsequent blood glucose and CK concentrations. 50th Congress of the International Society for Applied Ethology. 12-16 July, Edinburgh, UK, 90
57. Hartcher K.M., Hickey K.A., Hemsworth P.H., Cronin G.M., Wilkinson S.J. and Singh M. (2016). Using radio frequency identification (RFID) technology to improve our understanding of the relationships between range access, fearfulness and plumage damage in free-range laying hens. Proceedings of the 6th annual Australian and New Zealand Spatially Enabled Livestock Management (SELM) Symposium. 31 Mar - 1 April 2016, Sydney. 28
58. Hartcher K.M., Hickey K.A., Hemsworth P.H., Cronin G.M., Wilkinson S.J. and Singh M. (2016). Is range use related to fearfulness and plumage damage? Aust.Poult. Sci.Symp. 27. 76
59. Hemsworth, L.M., Powell, C., Rice, M. and Hemsworth, P.H. (2016). A measure of fear of humans in commercial group-housed sows. 50th Congress of the International Society for Applied Ethology. 12-16 July, Edinburgh, UK, 412

60. Hemsworth, P.H., Rice, M., Borg, S., Edwards, L.E., Ponnampalam, E.N. and Coleman, G.J. (2016). Relationship between handling, behaviour and stress in lambs at abattoirs. *Animal Production* 2016. 4-7 July, Adelaide, Australia. 79
61. Larsen, H., Cronin, G.M., Gebhardt-Henrich, S.G., Hemsworth, P.H., Smith, C.L. and Rault, J-L. (2016). Individual tracking of free-range laying hens on an Australian commercial property using Radio Frequency identification. *Proceedings of the 6th annual Australian and New Zealand Spatially Enabled Livestock Management (SELM) Symposium*. 31 Mar - 1 April 2016, Sydney. 8
62. Larsen, H., Cronin, G.M., Smith, C.L., Hemsworth, P.H. and Rault J-L. (2016). Use of different outdoor areas in commercial free-range layers using RFID technology. *Aust.Poult. Sci.Symp.* 27. 77
63. Larsen, H., Cronin, G.M., Hemsworth, P.H., Smith, C.L., Rault, J-L. and Gebhardt-Henrich, S.G. (2016). Fearfulness and access to the outdoor range in commercial free-range laying hens. *50th Congress of the International Society for Applied Ethology*. 12-16 July, Edinburgh, UK, 143
64. Learmonth, M.J., Magrath, M., Sherwen, S. and Hemsworth. P.H. (2016). Effects of zoo visitors on quokka (*Setonix brachyurus*) avoidance behaviour in a walk-through exhibit. *50th Congress of the International Society for Applied Ethology*. 12-16 July, Edinburgh, UK, 115
65. Matthews, L.R. and Rault, J.-L. (2016) A focused review of science-based evidence on the welfare of Australian meat chickens. *Aust.Poult. Sci.Symp.* 27. 47-50.
66. Munoz, C.A., Campbell, A.J.D., Hemsworth, P.H. and Doyle, R.E. (2016). Assessment of human-animal relationship in extensively managed ewes. *50th Congress of the International Society for Applied Ethology*. 12-16 July, Edinburgh, UK, 380
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Research Reports

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2015/16

1. AECL Project 1UM121. Free-range hen welfare: Characterisation of 'outdoor' and 'indoor' hens and physical features in the range. Jean-Loup Rault, Paul Hemsworth and Greg Cronin.
2. APL Project 2013/030. The re-development of ProHand: Training programs for stockpeople in the pig industry. Grahame Coleman, Paul Hemsworth, Jeremy Skuse, Tammie King, Vanessa Rohlf, Tiffani Howell.
3. DEDJTR Project 105527. Lamb Welfare. Paul Hemsworth, Ellen Jongman.
4. DEDJTR Project 105528. Dairy Welfare. Andrew Fisher, Ellen Jongman.
5. MLA Project B.AWW.0249. Assessment of pain responses following castration of lambs using the Elastrator ring with and without midline injections of lignocaine. Ellen Jongman, Paul Hemsworth and Angus Campbell.
6. National Primary Industries Animal Welfare RD&E Strategy Project. Exploring stakeholder views towards animal welfare issues using online forums. Tiffani Howell, Vanessa Rohlf, Grahame Coleman and Jean-Loup Rault.
7. RIRDC Project PRJ-008899. Assessment of factors influencing behavior and welfare of birds in free-range systems. Jean-Loup Rault and Paul Hemsworth.

2016/17

8. AMPC 3000/5091. Relationship between fear of Humans, Temperament and Handling Pre-Slaughter on Lamb Welfare & Meat Quality. P.H. Hemsworth, G.J. Coleman, M. Rice and E.N. Ponnampalam.
9. APL Project 2015/003. The re-development of ProHand: Carbon dioxide stunning of pigs. J-L Rault, E. Jongman.
10. APL Project 2014/155. Euthanasia is a vital part of good welfare. The re-development of ProHand: Carbon dioxide stunning of pigs. T. Holyoake, G. Coleman, J-L Rault.
11. CRC for High Integrity Australian Pork Project 1A-116. Increased light intensity and mat temperature attract piglets to creep areas in farrowing pens. J-L Rault, G. Cronin, J. Marchand-Forde, R. Morrison, G. Morello.
12. CRC for High Integrity Australian Pork Project 1A-115. The feeding behaviour of sows and its relationship to sow welfare and reproduction. M. Verdon, R.S. Morrison and P.H. Hemsworth.
13. Dairy Australia Project C100000614. Ensuring dairy cow welfare with increasing scale of production. D. Beggs, E. Jongman, P.H. Hemsworth and A Fisher.

2017/18

14. MLA Project B.AWW.0237. Assessing and addressing on-farm sheep welfare. R. Doyle.
15. MLA Project B.AWW.0259. Developing the basis for an attitude-behaviour training program for stockpeople in the sheep transport and abattoir sectors. P. Hemsworth.
16. DA project C100002561 - Scale of production, attitudes of dairy farmers and stockpeople and the welfare of dairy cows. P. Hemsworth.
17. DA study tour report 2017 – USA Dairy beef pathways. S. Chaplin. <https://bit.ly/2yKtkoS>
18. GRV project 1718-14 - Socialisation of greyhounds to optimise their racing success and maximise successful rehoming. P. Hemsworth.
19. CRC for High Integrity Australian Pork project 1C-120 - Human enrichment program for breeding sows: proof of concept. P. Hemsworth.
20. CRC for High Integrity Australian Pork project 1Z-1501 - Developing ways to measure and increase sow contentment. R. Doyle.
21. Parks Victoria project - Evaluation of the welfare risks and impacts during roping of feral horses. E. Jongman.

2018/19

22. Australian Research Council. Linkage Project LP140100373. Human-animal relationships in zoos: optimising animal and visitor experiences. Hemsworth, P.H.
23. Australian Pork Ltd. Project 2017/2217. Review of the scientific literature and the international pig welfare codes and standards to underpin the future Standards and Guidelines for Pigs. Hemsworth, L.M.
24. Australian Eggs Ltd. Project 1HS905. Hen welfare literature review. Hemsworth, P.H.
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26. Meat and Livestock Australia. Project B.AWW.0257. Evaluation of different intravenous methods of euthanasia for ruminant livestock to enable the collection of brain samples for disease surveillance. Stanger, K.J., Kells, N.K., Fisher, A.D., Rault, J-L., Jubb, T. and Johnson, C.

PhD Theses

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1. Beggs, D.S. (2018). Ensuring dairy cow welfare with increasing scale of production. The University of Melbourne.
2. Taylor, P.S. The University of Melbourne (2018). Relationships between ranging behaviour and welfare of commercial free-range broiler chickens. The University of Melbourne.
3. Larsen, H. The University of Melbourne (2018). Relationships between range characteristics, ranging behaviour, and welfare of commercial free-range laying hens. The University of Melbourne.
4. Aleri, J. (2016). Immune and stress responsiveness parameters as predictors of dairy heifers coping ability in their production environment. The University of Melbourne.
5. Wormald, D. (2016). Assessment and key features of anxiety traits in dogs. The University of Melbourne.
6. Engel, J. (2016). The importance of rearing environment, space and nests for laying hens (*Gallus domesticus*) in cages. The University of Melbourne.
7. Munoz, C.A. (2019). Assessing and addressing the welfare of extensively managed ewes. The University of Melbourne.

8. Roberts, L.J. (2016). The indicators of stockmanship and their relationships with behavioural observations and supervisor assessments of stockpeople. The University of Melbourne.
9. Sherwen, S.L. (2015). The visitor effect: an investigation into the impact of visitors on the behaviour and welfare of zoo animals. The University of Melbourne.

AWSC SCIENTIFIC SEMINARS

2010-2014

See [appendix 4](#).

2019

4 seminars featuring 17 presentations

2018

3 seminars featuring 7 presentations

2017

1 seminar featuring 4 presentations

2016

3 seminars featuring 4 presentations

2015

4 seminars featuring 4 presentations

Appendix 1 – AWSC Staff

NAME	POSITION	FTE	FUNDING SOURCE	AGE	GENDER	NOTES
Andrew Fisher	Director	1.0	FVAS	50 - 60	M	On-going position
Paul Hemsworth	Prof	0.8	FVAS	>60	M	On-going position
Grahame Coleman	Prof	0.2	Project	>60	M	Current Contract ends 06/20
Lauren Hemsworth	Research Fellow	0.5 Teach 0.5 Res	FVAS Projects	30 - 40	F	On-going position
Ellen Jongman	Research Fellow	0.5 Teach 0.3 Res	FVAS Projects	50 - 60	F	On-going position
Rebecca Doyle	Research Fellow	0.5 Teach 0.5 Res	FVAS Projects	30-40	F	On-going position (from Feb 2020 part-time at 0.65 FTE after return from mat leave)
Carolina Munoz	Post-Doc	0.6	Project	30 - 40	F	Current Contract ends 07/22
Jeremy Skuse	EO/Prog Leader	0.5 EO 0.25 PL 0.25 NAWRDES	FVAS/AgVic FVAS/AgVic NAWRDES	>60	M	Current Contract ends 06/20
Maxine Rice	RA	1.0	Projects	30 – 40	F	Contract ends 01/2023
Rutu Acharya	RA	1.0	Projects	30 - 40	F	Contract ends 05/2022
Will Coombs	Technician	1.0	Projects	<30	M	Casual
Jess Taylor	RA	0.6	Projects	<30	F	Casual

The academic staff profile of the AWSC is not dissimilar to much of the Faculty, whereby the most senior positions (Level E) are occupied by male staff, and the earlier-mid-career positions are held by female staff. Women are under-represented within the Faculty at Levels D & E, particularly at Level E, and although the AWSC has too small a sample size to make conclusions, it is clear that the pattern conforms to the wider Faculty. The University of Melbourne participates in the Athena Swann program, and at a more local level, one AWSC academic is being supported to undertake the Faculty womens' academic leadership development program, and another has been supported to undertake the Homeward Bound women in science leadership experience, as well as being enabled to work with significant flexibility around location and work patterns to enable a family-friendly career structure.

Appendix 2 - Past Students – what did they do/where are they now

Josh Aleri (Melbourne)	Senior Lecturer and researcher in Production Animal Health and Management (Cattle Medicine) at Murdoch University
Adele Arnold (Melbourne)	AgResearch NZ; Animal Welfare Officer, Dairy NZ, (current – unsure)
David Beggs (Melbourne)	Senior Lecturer in Cattle, UoM
Naomi Botheras (Melbourne)	Animal Welfare extension specialist, OSU, (current – unsure)
Kate Breuer (Monash)	Animal Welfare Policy Officer, RSPCA Vic, (current – unsure)
Mia Cobb (Monash)	Casual lecturer, UoM. freelance animal welfare communicator
Sara Crawford (Ohio)	Assistant Vice President of Animal Welfare at National Pork Board
Jo Coombe (Melbourne)	Lead, Animal Health, Welfare and Fertility, Dairy Australia. Dairy industry consultant
Anoma Dilrukshi (Melbourne)	Post Grad Teaching student, UoM, (current – unsure)
Fleur Dwyer (Monash)	Medical student at Uni Qld, (current – unsure)
Lauren Edwards (Melbourne)	Lecturer at Unitec NZ, Post-doc at UoM, Policy Officer at AgVic
Joanna Engel (Melbourne)	Vintage Lab Technician Indevin NZ
Lauren Hemsworth (Monash)	Research Fellow UoM
Tiffani Howell (Monash)	Casual research assistant, La Trobe Uni: Tutor, Monash Univ
Keven Kerswell (Melbourne)	Casual research assistant, UoM, (current – unsure)
Tammie King (Monash)	Senior Behavioural Research Scientist, Waltham Centre for Pet Nutrition, UK
Amanda Kobelt (Melbourne)	Key Project Development Manager, EcoDev, Vic, (current – unsure)
Sonja Laine (Melbourne)	Seeing Eye Dogs Australia
Hannah Larsen (Melbourne)	AW Officer Deakin Uni. Animal Welfare Specialist, Zoos Vic
Mariko Lauber (Melbourne)	Manager Domestic Animals, DEDJTR. Policy, Projects and Research Manager, Greyhound Racing Vic
Jacqui Ley (Monash)	Veterinarian, Animal Behaviour Consultations

Linda Marston (Monash)	Prog Mgr, Centre for service & therapy dogs. Casual lecturer, La Trobe Uni.
Andrew McLean (Melbourne)	Consultant, Australian Equine Behaviour Centre
Kate Mornement (Monash)	Director, Pets Behaving Badly, Working Dog Alliance
Carolina Munoz (Melbourne)	Post-doc Research Fellow, UoM
Monoar Sayeed Pallab (Melbourne)	Veterinarian
Jessica Pempek (Ohio)	Project Manager for the Animal Welfare Community of Practice, OSU.
Bree Pierce (Monash)	Clinical trials manager with a pharmaceutical company, (current – unsure)
Cameron Ralph (Melbourne)	Research Scientist, SARDI. Scientist, Agersens, (current – unsure)
Lydia Rehnberg (Melbourne)	Recently graduated
Vanessa Rohlf (Monash)	Casual research assistant, UoM. Consultant, Therapist and Educator for Animal Caregivers
Lauren Roberts (Melbourne)	Major Investigations Team Inspector, RSPCA Vic.
Sabine Roussel (Melbourne)	Lecturer, INA P-G, Paris, France, (current – unsure)
Rebecca Morrison (nee Sargent (Melbourne)	Animal Welfare research scientist, Rivalea Australia
Sally Sherwen (Melbourne)	Director Wildlife Conservation and Science, Zoos Victoria
Peta Taylor (Melbourne)	Lecturer, UNE
Anne Turner (Monash)	Senior lecturer, Deakin Uni
Megan Verdon (Melbourne)	Research Fellow at the Dairy Centre in the Tasmanian Institute of Agriculture
Dennis Wormald (Melbourne)	Veterinarian. Casual lecturer, UoM. Owner Abadog – developing Automated Behaviour Assessments for Dogs.

Appendix 3 - AWSC RD&E Project Summaries 2015-2019

1. Dairy industry

1.1. Characterisation of the welfare and performance responses of calves to disbudding and castration procedures

Investigators: A. Fisher, K. Stanger, and B. Earley & M. McGee (Teagasc)

Funding: University of Melbourne / TEAGASC, Agriculture and Food Development Authority of Eire.

2019 – €22,000 (A\$ 35,000)

2018 – €22,000 (A\$ 35,000)

Commencement date: 2018

Completion date: 2021

The PhD Fellowship is a joint research project between Teagasc and the University of Melbourne. This research will deliver practical pain management strategies as a part of standard industry practice at the time of disbudding and castration of calves.

1.2. The welfare of bobby calves in the meat supply chain

Investigators: A. Fisher, E. Jongman, P Mansell

Funding: Strategic Partnership for Animal Welfare RD&A / Parmalat / Meat and Livestock Australia/University of Melbourne.

2019 – \$ 22,437

2018 – \$ 22,438

2017 - \$ 16,125

Commencement date: 2017

Completion date: 2020

The goal of this PhD project is to measure the health and welfare status of bobby calves within the supply chain, and to identify variations in calf hydration, glucose levels, and colostral immunity in relation to breed, bodyweight, time off feed and transport distance.

The project will then include research on-farm (and onwards in the supply chain) to validate the optimal calf preparation strategies indicated by the initial research to provide objective data on industry performance, as well as forming the basis of updated advice to farmers on areas of calf preparation on which to focus for ensuring optimal calf welfare.

1.3. Scale of production, attitudes of dairy farmers and stockpeople and the welfare of dairy cows

Investigators: P. Hemsworth

Funding: Dairy Australia

2017 - \$ 5,515

Commencement date: 2017

Completion date: 2018

Understanding the relationships between herd size and work-related attributes of farmers and stockpeople may provide the opportunity through education and training and herd management practices to safeguard cow productivity, health and welfare in situations where increasing herd size is a risk factor.

1.4. Differences between heat tolerant and heat susceptible cows in standing, walking and lying time defined

Investigators: E. Jongman, P. Hemsworth, A. Fisher
Funding: Department of Economic Development, Jobs, Transport and Resources
2017 - \$ 70,000
2016 - \$ 70,000
Commencement date: 2015
Completion date: 2017

This project aligned with a larger DEDJTR project (Nutritional and genetic strategies to mitigate the influence of heat events on milk production) to provide new insights into feeding strategies and management options for cows during periods of heat stress that inform further research and development activities to improve on-farm management.

1.5. Milking order and animal welfare in large herds

Investigators: E. Jongman, P. Hemsworth, A. Fisher
Funding: Department of Economic Development, Jobs, Transport and Resources
2017 - \$ 70,000
2016 - \$ 70,000
Commencement date: 2016
Completion date: 2017

This 1-year project determined the effects of management practices, herd size and relative place in the milking order on animal welfare outcomes in order to enable dairy farmers to be informed on best management practices of large herds.

1.6. Ensuring dairy cow welfare with increasing scale of production

Investigators: A.Fisher
Funding: Dairy Australia
2017 - \$ 13,854
2016 - \$ 30,440
2015 - \$ 33,250
Commencement date: 2013
Completion date: 2017

This 3-year project supported a PhD student who undertook on-farm studies to determine relationships between farm characteristics and practices associated with scale of production and animal welfare measures.

1.7. Dairy welfare

Investigators: A. Fisher, P. Hemsworth, E. Jongman, G. Coleman

Funding: Department of Economic Development, Jobs,
Transport and Resources

2015 - \$ 225,000

Commencement date: 2012

Completion date: 2015

This 3-year project provided further information in the areas of cow lameness and bobby calf management that will ensure animal welfare concerns will be addressed in a fashion to ensure community acceptance of increased intensification in the dairy industry.

The project identified calf feeding and management strategies to enhance fitness for travel and determined the prevalence of lameness in Victorian dairy cows and develop management guidelines based on the foot problems that are recorded. The project also contributed to optimising feeding and management practices and fertility of cows.

2. Pork industry

2.1. Early stress experiences and stress resilience in pigs

Investigators: P. Hemsworth, R. Rassool, A. Tilbrook (UQ), J. Marchant- Forde (USDA) and J-L. Rault (UV)

Funding: Australian Research Council – Linkage Program, Sunpork P/L,
Rivalea P/L, Australasian Pork Research Institute Ltd

2019 - \$ 175,483 - ARC

Commencement date: 2019

Completion date: 2022

This Australian Research Council Linkage Project aims to examine stress resilience in pigs. Working with collaborators from the University of Queensland (UQ), the University of Vienna (UV) and the United States Department of Agriculture (USDA) and industry partners Australasian Pork Research Institute, Rivalea Australia and Sunpork Farms this project will be contracted in June 2019 and conclude in 2022.

2.2. Developing remote monitoring methods for early detection of respiratory disease in pigs

Investigators: E. Jongman, S.Fuentes, F. Dunshea, R.Rajasekharan and T.Poblete

Funding: Australasian Pork Research Institute Ltd

2018 - \$ 49,143

Commencement date: 2012

Completion date: 2018

This project (working with UoM Engineering) and funded by APRIL, will identify and extract the relevant video footage for analysis of behavioural and physiological measures indicative of early signs of respiratory disease. This project will provide proof of concept that remote monitoring using video imaging can be developed for a whole farm monitoring system for health and welfare of pigs.

2.3. Human enrichment program for breeding sows: proof of concept

Investigators: P. Hemsworth, L. Hemsworth, R. Morrison

Funding: CRC for High Integrity Australian Pork

2018 - \$ 89,979

Commencement date: 2017

Completion date: 2018

This experiment is a proof of concept to examine whether regular positive human contact is enriching for sows (i.e., leads to a positive affective state) and facilitates stress resilience).

2.4. Review of the scientific literature and the international pig welfare codes and standards to underpin the future Standards and Guidelines for Pigs

Investigators: P. Hemsworth, L. Hemsworth, R. Acharya, J. Skuse

Funding: Australian Pork Limited

2018 - \$ 7,129

2017 - \$ 18,514

Commencement date: 2017

Completion date: 2018

This project reviewed the scientific literature and examine international codes and standards for the welfare of the pig to inform the review of the current Australian Model Code of Practice for the Welfare of Animals – Pigs.

2.5. Sham-chewing and sow welfare and productivity

Investigators: L. Hemsworth, P. Hemsworth, J-L Rault

Funding: CRC for High Integrity Australian Pork

2017 - \$ 12,852

2016 - \$ 12,852

Commencement date: 2016

Completion date: 2017

The project determined the relationships between sham-chewing, a commonly observed stereotypy in pigs, and the welfare and productivity of group-housed gestating sows. Clarifying whether this stereotypy is a sow welfare and/or productivity problem or not, is a necessary first step if we are to assess means to alleviate the problem through interventions such as altering feed levels, housing system, providing environmental enrichment, or other means.

2.6. Development of commercially-viable enrichment programs for group-housed sows

Investigators: E. Jongman, R. Morrison, P. Hemsworth, R. Parkes

Funding: CRC for High Integrity Australian Pork
2017 - \$ 76,143

Commencement date: 2016

Completion date: 2017

The aim of this project was to determine the effects of environmental enrichment in the form of i) straw, (ii) a 'Ridley block', (iii) Lucerne hay, (iv) a wooden block and (v) 1 kg of corn silage in comparison to (vi) a control treatment of no environmental enrichment on sow aggression, injuries, foraging behaviour and reproductive performance. The commercial viability of each enrichment sources was assessed including cost, practicality and effluent management.

2.7. Brain-derived neurotrophic factor as an indicator of environmental enrichment effectiveness

Investigators: J-L Rault, C. Ralph, A. Lawrence

Funding: CRC for High Integrity Australian Pork
2017 - \$ 12,980

Commencement date: 2017

Completion date: 2017

This study investigated whether BDNF concentration differ between piglets housed in different systems during lactation (enriched vs. barren) and/or after weaning (enriched vs. barren).

2.8. Increased light intensity and mat temperature attract piglets to creep areas in farrowing pens

Investigators: J-L Rault, G. Cronin, J. Marchand-Forde, R. Morrison, G. Morello

Funding: CRC for High Integrity Australian Pork
2016 - \$ 26,825

Commencement date: 2016

Completion date: 2016

Pen farrowing systems have been considered as alternatives to crates to enhance sow welfare. A major concern with pen systems is the higher piglet pre-wean mortality due to crushing by the sow. This project tested the hypothesis that an optimized management of light and mat surface temperature can promote greater piglet use of the creep, which has been associated with reduced piglet crushing.

2.9. Conditioned feeding to increase feed intake in the mature gilt model

Investigators: L.M. Hemsworth

Funding: Commonwealth/Australian Pork Limited
2016 - \$ 19,956

Commencement date: 2016

Completion date: 2016

2016 Science and Innovation Awards (APL sponsored): This project provided proof of concept in the use of conditioning to facilitating meal initiation and increasing feed intake in mature gilts as a model for lactating sows. The project will be conducted over 3 replicates.

2.10. The feeding behaviour of sows and its relationship to sow welfare and reproduction

Investigators: M. Verdon, R. Morrison, P. Hemsworth

Funding: CRC for High Integrity Australian Pork
2016 - \$ 14,280

Commencement date: 2016

Completion date: 2016

This project contributed to an understanding of the relationships between sow feeding behaviour, welfare and productivity when sows are fed over multiple feed drops per day.

2.11. Welfare implications of group lactation at various ages

Investigators: J-L. Rault, R. Morrison, M. Verdon

Funding: CRC for High Integrity Australian Pork
2016 - \$ 33,434
2015 - \$ 91,454

Commencement date: 2015

Completion date: 2016

This project examined the implications of grouping sows during lactation on sow and piglet welfare and productivity and compared grouping at 7 and 14 days after farrowing in a commercial setting. A two-stage lactation system may bring immediate benefits in terms of sow welfare, and possibly long-term benefits for the development of pigs' social skills in later life.

2.12. Carbon dioxide stunning of pigs

Investigators: J-L. Rault, E.C. Jongman

Funding: Australian Pork Limited
2016 - \$ 75,840
2015 - \$ 133,561

Commencement date: 2015

Completion date: 2016

This 2-year project conducted a systematic, critical literature review on gas stunning methods for pigs, assessed the effects of various factors on the reaction of pigs to CO2 stunning and identified practical indicators and develop minimum operating standards on CO2 stunning systems.

2.13. Developing ways to measure and increase sow contentment

Investigators: R.Doyle, K. Plush, R. Morrison, C. Ralph, G. Cronin,C. Lee, S. Hazel

Funding: CRC for High Integrity Australian Pork

2016 - \$ 85,177

2015 - \$ 81,999

Commencement date: 2015

Completion date: 2016

This 2-year project assessed the contentment of sows during lactation by using scientific indicators of positive welfare and then developing practical measures for use on farm. This study also assessed the effect enrichment has on the welfare of lactating sows, with the hypothesis being that enrichment will increase the level of contentment a sow experiences during lactation.

2.14. ProHand® Pigs technical support

Investigators: J. Skuse and G. Coleman

Funding: Australian Pork Limited

2018 - \$ 6,438

2017 - \$ 12,876

2016 - \$ 11,500

2015 - \$ 11,500

Commencement date: 2012

Completion date: 2018

This project provides technical support to ProHand® Pigs facilitators and make recommendations on program improvements.

3. Poultry and egg industries

3.1. What causes smothering in commercial free-range laying hens

Investigators: P. Hemsworth, A. Fisher, M.Stevenson and P. Taylor (UNE).

Funding: Australian Eggs Ltd

2019 - \$ 118,186

2018 - \$ 92,615

Commencement date: 2018

Completion date: 2020

There are limited overseas reports on the incidence of smothering in free-range laying flocks which suggest that smothering may account for a substantial proportion of overall mortality.

While a wide range of potential variables have been implicated, there have been few systematic studies on smothering because outbreaks are sporadic and unpredictable, and detection is normally after the incident. Anecdotal reports in the Australian free-range industry suggest that up to 30-40% of mortality of adult birds may be due to smothering.

An understanding of the relationships between environmental characteristics and flock characteristics (e.g. such as physical conditions and behavioural characteristics such as fear and exploration during rearing and in adulthood) and smothering events is likely to lead to benefits for both hen welfare and farm productivity.

Working with the University of New England (UNE), this project will conclude in 2020.

3.2. Animal welfare and values

Investigators: A. Fisher, P. Hemsworth, R. Ankeny (UA), H. Bray (UWA) and Hugh Millar

Funding: Australian Eggs Ltd
2019 - \$ 19,916
2018 - \$ 79,663

Commencement date: 2018

Completion date: 2019

This project involved a panel of experts in animal welfare science, veterinary science and social science to identify and describe values-based elements that arise in the context of the available frameworks for animal welfare, allowing for rational assessment and productive engagement on hen welfare issues.

Working with collaborators from the University of Adelaide (UA), the University of Western Australia (UWA) and a private consultant, this project concluded in 2019.

3.3. Hen welfare literature review

Investigators: P. Hemsworth, A. Fisher, E. Jongman, L. Edwards and A. Noormohammadi

Funding: Australian Eggs Ltd
2019 - \$ 62,000
2018 - \$ 40,000

Commencement date: 2018

Completion date: 2019

This project conducted a review of the scientific literature of laying hen welfare with an emphasis on the relevance of the literature in relation to Australian conditions since this review will be used to inform current welfare discussions and future investment in welfare research and development by Australian Eggs Limited. This review will focus on the main housing, management (at both the farm and stockperson levels) and husbandry practices that have implications for hen welfare.

This Australian Eggs Limited funded project will conclude in 2019 and involved major collaboration from prominent Australian poultry researchers and veterinarians.

3.4. Assessment of factors influencing behaviour and welfare of birds in free range systems (broilers)

Investigators: J-L. Rault, P. Hemsworth

Funding: Rural Industries Research & Development Corp.
(Chicken meat)

2015 - \$39,790

Commencement date: 2013

Completion date: 2015

This 3-year project increased our understanding of both the physical attributes of the environments and the attributes of the meat chicken and how they affect the utilisation of the outdoor environment in free range systems.

3.5. Free-range hen welfare: Characterisation of 'outdoor' and 'indoor' hens and physical features in the range

Investigator: J-L. Rault, P. Hemsworth, G. Cronin

Funding: Australian Egg Corporation Limited

2015 - \$ 48,449

Commencement date: 2012

Completion date: 2015

This 3-year project increased our understanding of both the physical attributes of the environments and the attributes of the laying hen and how they affect the utilisation of the outdoor environment in free range systems. The first experiment investigated behaviour performed in various areas in the range. The second experiment investigated the effects of artificial structures placed in the range to attract hens (vertical vs. horizontal, tall vs. short, and 3 different density of cover). The third experiment used RFID tags to track hens and correlate use of the range with behaviour and physiology.

4. Beef and sheep industries

4.1. Phasing out of mulesing: cost, benefits and opportunities

Investigators: A. Fisher, C. Munoz

Funding: Meat and Livestock Australia

2019 - \$ 81,779

Commencement date: 2019

Completion date: 2022

This project will examine the benefits and costs of ceasing mulesing in prime lamb systems, while also examining the key drivers for farmer behaviour towards continuation of mulesing prime lambs' dams, and possible barriers for behavioural change towards mulesing-free systems. These outcomes will inform future extension programs on appropriate approaches to encourage phasing out mulesing in prime lamb enterprises.

4.2. Identifying public and producer attitudes to sheep and cattle animal welfare to inform education strategies

Investigators: G. Coleman, P. Hemsworth, L. Hemsworth

Funding: Strategic Partnership for Animal Welfare RD&A/Meat and Livestock Australia/University of Melbourne

2019 - \$ 396,216 (UOM - \$108k, MLA - \$167k, MDC - \$121k)

2018 - \$ 300,073 (UOM - \$137k, MLA - \$94k, MDC - \$68k)

2017 - \$ 363,835 (UOM - \$43k, MLA - \$186k, MDC - \$134k)

Commencement date: 2017

Completion date: 2021

This project will provide the tools for the red meat industry to firstly assess public and producer attitudes to animal welfare issues, their knowledge of the issues and their key opinion leaders and secondly to utilise validated education strategies to address misinformation on practices and disseminate research results on best-animal welfare practice addressing the specific contentious welfare issue in question.

4.3. Beat the heat – reducing impacts of hotter summers to grazing sheep

Investigators: E. Jongman, R. Doyle, A. Fisher

Funding: Department of Economic Development, Jobs,
Transport and Resources

2017 - \$ 106,227

2016 - \$ 106,227

Commencement date: 2016

Completion date: 2017

This 1-year project determined the effect of providing shade to growing lambs in hot periods in northern Victoria on animal behaviour, physical and physiological responses to heat and metabolism and examined the relationship between temperament, use of shade and water, physical and physiological response to heat, metabolism and growth on individual sheep.

4.4. Developing the basis for an attitude-behaviour training program for stockpeople in the sheep transport and abattoir sectors

Investigators: P. Hemsforth, G. Coleman, J. Skuse

Funding: Meat and Livestock Australia

2018 - \$ 17,337

2017 - \$ 27,787

Commencement date: 2017

Completion date: 2018

The objective of the project was to collaborate with key sheep-meat stakeholders to review the general content of a cognitive-behavioural training program for sheep abattoir stockpeople, decide on the platform for the program and its delivery method(s) and identify potential funders and sheep-meat industry collaborators.

4.5. Methods of field euthanasia for livestock that preserve brain material

Investigators: K. Stanger, T. Jubb, C. Johnson, A. Fisher

Funding: Meat and Livestock Australia

2018 - \$ 14,400

2017 - \$ 39,900

Commencement date: 2017

Completion date: 2018

The objective of the project was to identify a more suitable agent for the euthanasia of livestock for transmissible spongiform encephalopathies (TSE) surveillance in Australia; compare the efficacy and animal welfare responses of sheep euthanased with either an injectable barbiturate (gold standard) and saturated salt solution (KCl and MgSO₄) and generate objective, scientific data to support the use of the most appropriate method of euthanasia that facilitates the collection of intact brain samples for TSE surveillance.

4.6. Assessing and Addressing On-Farm Sheep Welfare

Investigators: R. Doyle, P. Hemsworth, G. Coleman, J. Webb-Ware, A. Fisher, L. Kubeil

Funding: Meat and Livestock Australia

2017 - \$ 121,875

2016 - \$ 78,812

2015 - \$ 78,812

Commencement date: 2014

Completion date: 2017

The welfare and survival of sheep are vital to both farming profits and community acceptance of products. This project examined the relationships between farmer attitudes, other job-related characteristics, farm management, profits and animal welfare. This project also assessed the efficacy of an intervention method on improving management and welfare on farm in an effort to encourage practice change, reduce mortalities and improve farm production and profitability.

4.7. Quantifying welfare improvements in the live export industry

Investigators: R. Doyle, P. Hemsworth, G. Coleman

Funding: Meat and Livestock Australia

2016 - \$ 30,727

2015 - \$ 92,300

Commencement date: 2014

Completion date: 2016

The way workers handle animals presents the greatest risk to an animal's welfare. MLA provides extensive support in live export markets to educate workers on the best and safest ways to handle animals and improve animal welfare. This project gathered objective data on the changes in animal handling following the delivery of MLA's Live Export Training Program to workers. To do this, data on the behaviour and physiology of animals during handling, the behaviour of workers and their understanding of good animal welfare was collected before and after training.

4.8. Relationships between fear of humans, temperament and handling pre-slaughter and lamb welfare and meat quality

Investigators: P. Hemsworth, G. Coleman, E. Ponnampalam

Funding: Australian Meat Processor Corporation

2016 - \$ 65,262
2015 - \$ 50,486
Commencement date: 2013
Completion date: 2016

The objectives of this project were to determine the relationships between key animal characteristics and handling pre-slaughter on lamb welfare (on the basis of stress and behaviour) and meat quality and behavioural measures pre-slaughter and stress pre-slaughter and consequently poor welfare and meat quality.

4.9. Lamb welfare

Investigators: P. Hemsworth, E. Jongman, R. Doyle, G. Coleman
Funding: Department of Economic Development, Jobs,
Transport and Resources
2016 - \$ 112,000
2015 - \$ 112,000
Commencement date: 2015
Completion date: 2016

This 1-year project determined the relationships between stockperson characteristics, lamb behaviour pre-slaughter, and measures of stress, metabolic state, hydration, and muscular exhaustion and bruising post-slaughter. It also investigated the stockperson attitude-stockperson behaviour-animal stress relationships at abattoirs.

4.10. Welfare implications of "NumNuts"

Investigators: E. Jongman
Funding: Meat and Livestock Australia
2016 - \$ 27,509
2015 - \$ 60,000
Commencement date: 2015
Completion date: 2016

This project assessed pain responses following castration of lambs using an Elastrator ring with and without midline injections of lignocaine.

5. Companion, zoo, work animals

5.1. Socialisation of greyhounds to optimise their racing success and maximise successful rehoming

Investigators: P. Hemsworth, L. Hemsworth, E. Jongman and G. Coleman
Funding: Greyhound Racing Victoria
2018 - \$ 29,622
2017 - \$ 20,338
Commencement date: 2017

Completion date: 2018

The project determined socialisation practices from birth to the end of the greyhounds' racing career to optimise their racing (and rehoming) success. The project reviewed the current scientific literature on effects of socialisation and used focus groups to develop an understanding of industry knowledge of and attitudes towards the role of socialisation and current practices in influencing racing success.

5.2. Human-animal relationships in zoos: Optimising animal and visitor experiences

Investigators: P. Hemsworth, G. Coleman, R. Rassool, K. Fanson, K. Butler, M. Magrath, V. Melfi, D. Peake, W. Shaw

Funding: ARC Linkage, Taronga Conservation Society, Zoos Victoria, Detect Australia

2017 - \$ 57,872 - ARC

2016 - \$ 115,288 - ARC

2015 - \$ 118,835 - ARC

Commencement date: 2014

Completion date: 2017

Extensive research on human-animal relationships in agricultural and domestic settings shows that human-animal interaction affects animal behaviour and welfare, which in turn affect human attitudes to animals. As conservation and welfare organisations, zoos aim to provide visitors with opportunities to closely interact with animals to improve visitor experience and conservation outcomes, whilst maintaining good animal welfare. Some visitor interactions may be stressful for some animals creating conflict between animal welfare and visitor experience. By determining visitor effects, this project provided zoos with practical animal management and educational strategies to optimise both animal welfare and visitor experience.

6. General/Other

6.1. Monitoring public attitudes to livestock industries and livestock welfare

Investigators: G. Coleman, L. Hemsworth and P. Hemsworth

Funding: National Primary Industries Animal Welfare RD&E Strategy

2019 - \$ 94,665

2018 - \$ 10,000

Commencement date: 2018

Completion date: 2019

This project, facilitated by the National Primary Industries Animal Welfare RD&E Strategy and funded by AgriFutures, Australian Pork Limited, Australian Meat Processor Corporation, Livecorp and Meat and Livestock Australia further developed and refined a tool to monitor public perceptions and sources of knowledge in relation to the livestock industries and livestock welfare over time.

6.2. Enhancing small ruminant production to benefit farming families in Sindh and Punjab, Pakistan

Investigators: R. Doyle and A. Campbell
Funding: Australian Centre for International Agricultural Research
2019 - \$ 146,315
2018 - \$ 94,005
2017 - \$ 70,506
2016 - \$ 99,106
Commencement date: 2016
Completion date: 2022

This project, funded by the Australian Centre for International Agricultural Research and concluding in 2022, is examining the goat value chains in Pakistan, including developing an understanding of the role of women small holder farmers on the management and care of animals. Its aim is to optimise small-holder productivity and profitability

6.3. Evaluation of the welfare risks and impacts of roping

Investigators: E. Jongman, L. Hemsworth
Funding: Parks Victoria
2018 - \$ 74,344
2017 - \$ 10,000
Commencement date: 2017
Completion date: 2018

This project developed and reported on the outcomes of a framework and protocol for assessing the animal welfare issues, risks and impacts of roping as a management technique for feral horses in the Eastern Alps.

6.4. Animal Welfare Science Centre

Investigators: J. Skuse, and P. Hemsworth/A. Fisher
Funding: Victorian Department of Jobs, Precincts and Regions (Agriculture Victoria Research Division) and The University of Melbourne
2019 - \$ 160,138
2018 - \$ 194,648
2017 - \$ 189,184
2016 - \$ 360,958
2015 - \$ 44,000
Commencement date: 2006
Completion date: 2020

This project supports the activities of the AWSC including 0.75 FTE Exec Officer/Program Leader position, 0.1FTE Director position and operational expenses. Costs are shared equally between the State and The University of Melbourne

6.5. Australian Animal Welfare Views

Investigators: J-L Rault, V. Rohlf, T. Howell, G. Coleman
Funding: National Primary Industries Animal Welfare RD&E Strategy
and Department of Agriculture
2016 - \$ 13,407
2015 - \$ 13,407
Commencement date: 2015
Completion date: 2016

Developed a Web-based forum for social engagement on key topics relating to animal welfare. Funded by Commonwealth Department of Agriculture, Australian Egg Corporation, Australian Pork, Rural Industries R&D Corporation, Meat and Livestock Australia, Dairy Australia and Livecorp.

6.6. Executive Support, National Primary Industries Animal Welfare RD&E Strategy (NAWRDES)

Investigators: J. Skuse
Funding: NAWRDES
2019 - \$ 59,878
2018 - \$ 58,212
2017 - \$ 56,336
2016 - \$ 54,502
2015 - \$ 57,643
Commencement date: 2012
Completion date: 2020

This project supports the Executive function (0.25FTE) for the NAWRDES and includes operating and provision of the Annual NAWRDES Forum, the ninth of which was held in Melbourne in November 2019.

Significant collaboration

Gap evaluation of pain alleviation research

Investigators: A. Small (CSIRO), I. Colditz (CSIRO), **A. Fisher.**
Funding: Australian Wool Innovation
Commencement date: 2019
Completion date: 2019

This project will provide a stocktake of published research into the welfare impacts of castration, tail docking and mulesing; alternatives to these procedures; and potential pain relief strategies.

The report will include a gap analysis and recommendations as to future research directions.

Development of an interactive training app for timely and humane on-farm euthanasia in pre-weaned piglets

Investigators: M. Pairis-Garcia, **J.-L. Rault**, **G. Coleman**, A. Johnson, S. Millman, R. Anthony, K. George

Funding: National Pork Board

Commencement date: 2015

Completion date: 2017

This project developed an app to assist stockpeople in the pork industry make the appropriate decisions with regard to the euthanasia of piglets. The app will reinforce the attitudes of stock people that timely, appropriate euthanasia of piglets is essential to minimize poor welfare outcomes.

Informing future sheep extension strategies to improve reproduction and related welfare outcomes

Investigators: J. Trompf, L. Kubeil, C. Hollier, C. Arnot, J. Young, G. Kearney, **G. Coleman**

Funding: Meat and Livestock Australia

Commencement date: June 2014

Completion date: June 2017

This project informed future extension strategy by improving industry understanding of how to influence producer attitudes and behaviours towards sheep reproduction and related welfare outcomes, particularly lamb survival. The ultimate aim of this project was to change on farm behaviour increasing the rate of adoption of industry best practice reproduction and welfare management.

Can oxytocin nasal spray improve gilt behaviour during the peri-partum period and increase the weaning weight of piglets?

Investigators: C. Ralph, **J-L Rault**, K. Plush

Funding: CRC for High Integrity Australian Pork

Commencement date: 2016

Completion date: 2018

Stress during farrowing causes the production of opioids, which inhibit oxytocin release. This study assessed the effectiveness of nasal administration of oxytocin on improving maternal behaviour.

Intra-specific behavioural contagion of the human-animal relationship in pigs

Investigators: C. Tallet, M.C. Meunier-Salaun, **J-L Rault**

Funding: INRA

Commencement date: 2016

Completion date: 2016

Collaborative research project with INRA (St Gilles, France; pork behaviour and physiology team), Jean-Loup co-supervision of a Master student: Oceane Leribillard (University of

Rennes 1, France), in collaboration with Celine Tallet and Marie-Christine Meunier-Salaun on the topic: “Intra-specific behavioural contagion of the human-animal relationship in pigs”.

Attitudes to piglet euthanasia

Investigators: P. Holyoake, **J-L Rault**, **G.J. Coleman**

Funding: Australian Pork Limited

Commencement date: 2014

Completion date: 2016

The objective of this project was to develop flexible protocols backed up by training resources to identify, assess and euthanize compromised pigs based on sound decision-making. These resources will be developed following consultation of stockpersons to determine their attitudes and knowledge of euthanasia.

A novel two-step gas system to allow for humane on-farm euthanasia of piglets

Investigators: D. Lay, **J-L Rault**, R. Gates

Funding: National Pork Board (US)

Commencement date: 2015

Completion date: 2017

This project formed part of a large USDA/ NIFA project. Part 1, aimed to measure a piglet's aversion to a gas chamber following a previous exposure to a gas treatment in the chamber and part 2 aimed to validate telemetric EEG recording in freely moving pigs in order to assess the welfare implications of inhaling nitrous oxide.

Effect of perch height on meat chicken behaviour

Investigators: R. Poletto, **J-L Rault**

Funding: Instituto Federal do Rio Grande do Sul, Brazil

Commencement date: 2016

Completion date: 2017

This project examined the effect of perch height on the perching behavior of meat chickens. The experiments were carried out in facilities of the Câmpus Sertão, Instituto Federal do Rio Grande do Sul, Brazil.

Appendix 4 – AWSC Seminars

Reported on [Website](#)

2019

October

"AWSC Students Research Showcase"

Samantha J. Chiew - Visitor effects on little penguins (*Eudyptula minor*) differ between zoos [video presentation](#)

Natalie Roadknight - Is early cow and calf separation in the dairy industry beneficial or detrimental to animal welfare? [video presentation](#)

Maxine Rice - Piling into the ruck: an investigation into the behavioural motivation behind piling behaviour in laying hens [video presentation](#)

Madeleine Woodruff - Knowledge and attitudes are important factors in farmers' choice of lamb tail docking length [video presentation](#)

Belinda Hall - Individual variation in behaviour, personality and enrichment use in parrots [video presentation](#)

Megan Hayes - Regular patting by stockpeople reduces pigs' fear towards routine husbandry procedures [video presentation](#)

Carmen Glanville- Animal cruelty and neglect: prevalence and community actions in Victoria [video presentation](#)

Maria Jorquera-Chavez- Computer vision techniques as non-invasive tools to monitor production, performance and well-being in cattle and pigs [video presentation](#)

Madeleine Holmes: We owe it to fish - the rationale for studying fish welfare [video presentation](#)

Leigh Atkinson - Regular time spent in close proximity to humans improves coping in sheep, but this differs between sexes [video presentation](#)

Jessalyn Taylor - Relationships between zoo visitor behaviour and the behaviour of a captive long-nosed fur seal [video presentation](#)

Mark James Learmonth - Sentience in tortoises, and what this means for their welfare [video presentation](#)

May

Mike Mendl, Professor of Animal Behaviour and Welfare, University of Bristol, UK.

"Assessing animal affect" [pdf](#) [video presentation](#)

February

AWSC/RSPCA Public Seminar

"Advanced biotechnologies to improve the welfare of farm animals"

Tad Sonstegard, Chief Scientific Officer, Acceligen. [pdf](#) [video presentation](#)

Laercio Porto-Neto, Research Scientist, CSIRO.

Anne Marie de Passille, Adjunct Professor, University of British Columbia
"Why keep calves in groups? Behavioural and welfare aspects" [pdf](#) [video presentation](#)

Jeff Rushen, Adjunct Professor, University of British Columbia
"Play behaviour and welfare of dairy calves" [pdf](#) [video presentation](#)

2018

December

Dan Weary, University of British Columbia

"Disentangling separation: bringing new data to the old problem of cow-calf separation" [pdf](#) [video presentation](#)

David Beggs, AWSC, The University of Melbourne

"The welfare of cows in large herds" [pdf](#) [video presentation](#)

Natalie Roadknight, PhD candidate, AWSC, The University of Melbourne

"The welfare of bobby calves in the Australian dairy industry"

October

Ben Pearson, World Animal Protection

"Don't get taken for a ride (Animal welfare issues associated with wildlife entertainment)" [pdf](#)

April

Lauren Hemsworth, AWSC, The University of Melbourne

"The human contribution to animal welfare" [pdf](#) [video presentation](#)

Susan Hazel, The University of Adelaide

"In sickness and in health: Why do people keep or give up their pets?" [pdf](#) [video presentation](#)

Cameron Ralph, South Australian Research and Development Institute

"Novel Biomarkers of Animal Welfare" [pdf](#) [video presentation](#)

2017

August

David Mellor, Massey University

"Using the 5 domains model to understand and improve zoo animal welfare" [pdf](#)

Samantha Chiew, PhD candidate, AWSC, The University of Melbourne

"Zoo visitor-penguin interactions: effects on both penguins and visitors" [pdf](#)

Lydia Rehnberg, PhD candidate, AWSC, The University of Melbourne

"Effects of interactive visitor encounters on the behaviour and welfare of animals commonly housed in Australian zoos" [pdf](#)

Mark Learmonth, PhD candidate, AWSC, The University of Melbourne

"Human interaction as enrichment for zoo-housed animals: opportunity for positive affective experiences?" [pdf](#)

2016

November

Cameron Clark and Sabrina Lomax, The University of Sydney

"Remote monitoring of dairy cattle: opportunities for improved welfare across all species" [pdf](#)

Assoc Prof Roger Rassool and Dr David Peake*, The University of Melbourne and *DETECT Australia

"Physicists might be useful!" [pdf](#)

June

Tina Widowski, The University of Guelph

"Marketing vs science – who's really winning in the free range egg debate?" [pdf](#) [video presentation](#) [narrated presentation](#)

February

Jo Edgar, The University of Bristol

"Empathy in animals" [pdf](#) [video presentation](#)

2015

December

John Webster, The University of Bristol

"Animal Welfare: Science, Values and Action" [pdf](#) [video presentation](#)

October

Peter Sandøe, The University of Copenhagen

"Love hurts - the dark side of human attachment to companion animals" [pdf](#) [video presentation](#)

September

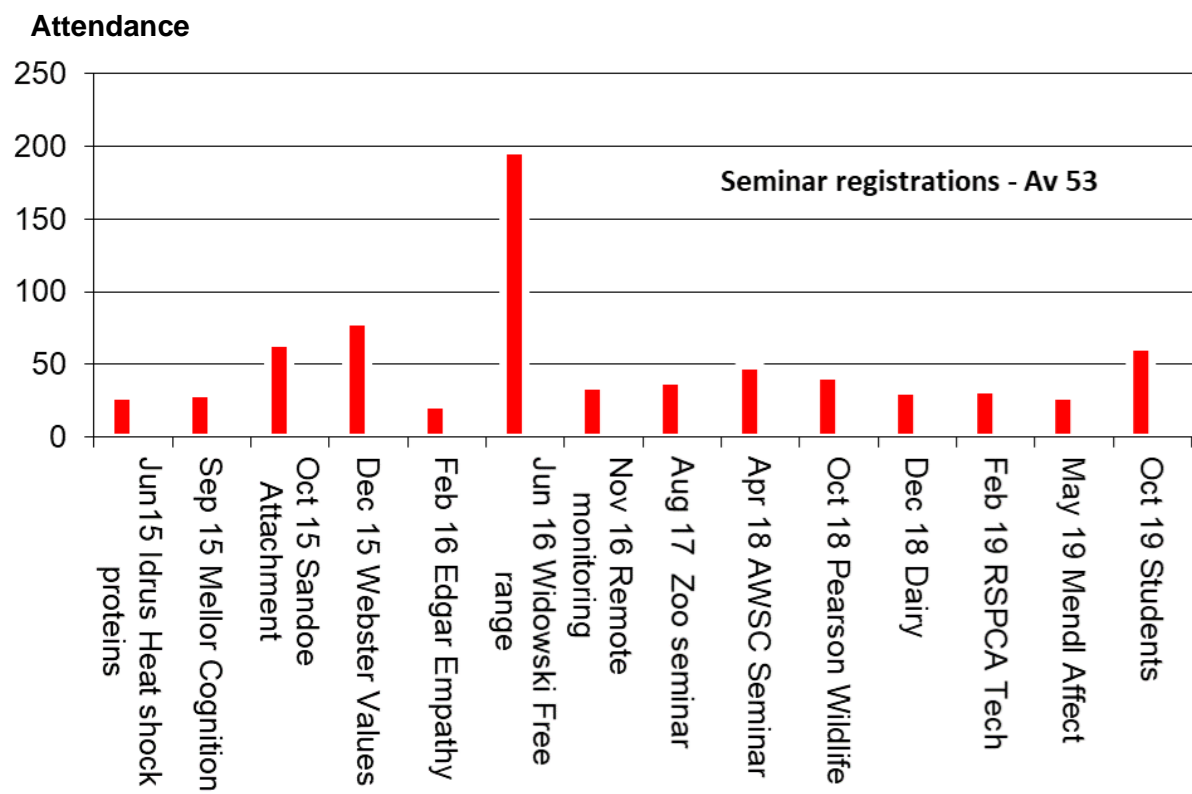
David Mellor, Massey University

"The onset of cognitively-based survival-critical behaviours in different groups of mammalian young" [pdf](#) [video presentation](#)

June

Zulfifli Idrus, University Putra

"Heat Shock Proteins as modifying factors in physiological stress responses" [pdf](#) [video presentation](#)



Appendix 5 - AWSC Funding Breakdown 2015-19

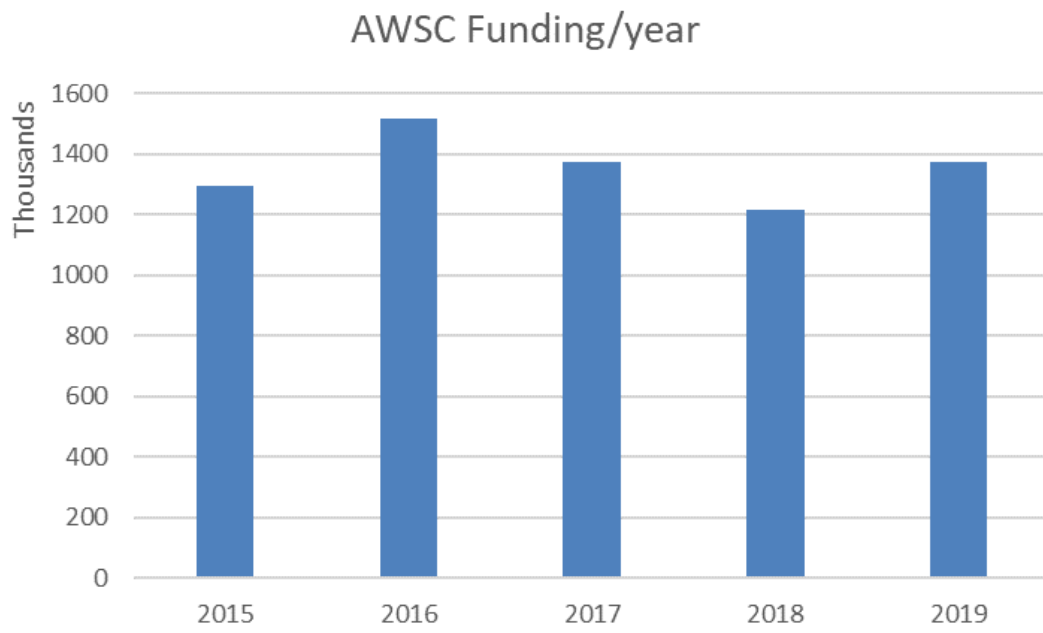
1. Total Funding 2015-19 (inc UOM funding into AW Strat Partnership) \$ 6,766,866

Funding	% rounded
STATE	20.9
Strat Partnership AW RD&A	16.6
MLA	9.9
APRIL/PORK CRC	8.7
UOM	7.0
ARC	6.9
AEL	6.8
NAWRDES	6.2
ACIAR	6.1
APL	4.1
OTHER	3.9
AMPC	1.7
DA	1.2

2. Sector funding 2015-19

Funding	\$	%
BEEF/SHEEP MEAT X-SECTOR	1,114,424	16.5
PORK	1,059,915	15.7
SHEEP MEAT	964,334	14.3
AWSC	948,928	14.0
DAIRY	719,059	10.6
EGG	460,829	6.8
GOAT	409,932	6.1
ZOO	291,995	4.3
NAWRDES	286,571	4.2
OTHER	174,594	2.6
NAWRDES X Sector	131,479	1.9
BEEF	123,027	1.8
WOOL (MLA FUNDED)	81,779	1.2

3. AWSC RD&E Funding by year 2015-19



Appendix 6 - Scientific performance of AWSC

Scientific Output from AWSC Website

The data on the following pages were sourced on 20/01/2020 from Scopus data up to 31/12/2019 and include output only from core AWSC Scientists.

The discrepancy in number of publications (AWSC Website – 133 vs Scopus 148) is likely to be due to Scopus classifying some refereed conference publications as refereed journal publications.

The following data include all publications (articles and reviews) from 2015-2019 inclusive only for the following core AWSC Scientists:

G.J. Coleman

R.E. Doyle

A.D. Fisher

L.M. Hemsworth

P.H. Hemsworth

E.C. Jongman

J-L. Rault*

** Jean-Loup resigned from the University of Melbourne in August 2017 – his AWSC attributed articles are included.*

Publications

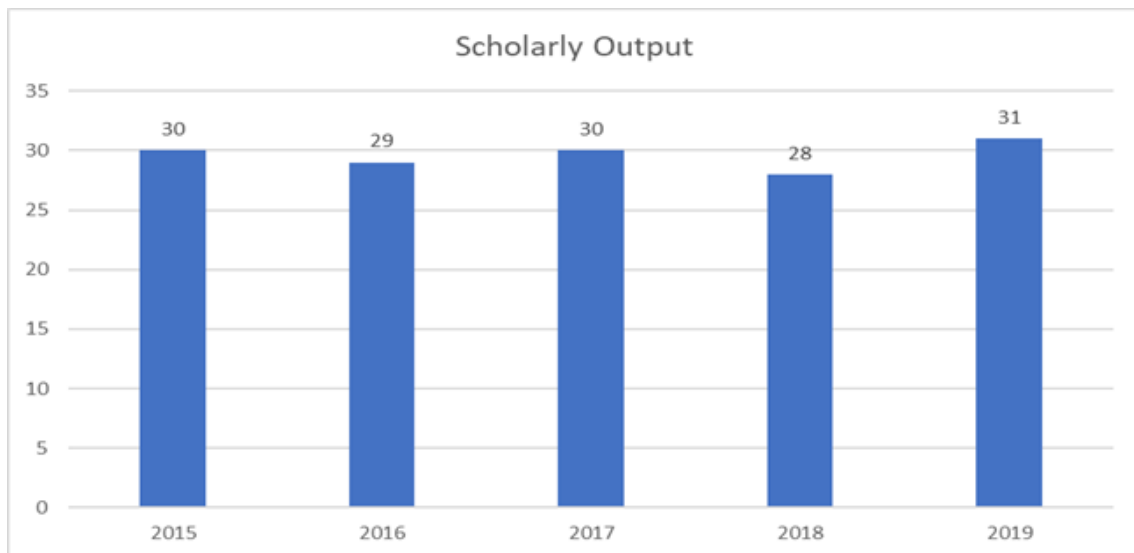


Figure 1: number of publications by researchers of Animal Welfare Science Centre (2015-2019); n=148

Journals in which AWSC published 2015-2019

Journal	SJR	5yr IF
ACM International Conference Proceeding Series	0.17	-
Advances in Pig Welfare	-	-
Advances in Sheep Welfare	-	-
Animal	0.791	2.401
Animal Cognition	1.233	2.35
Animal Frontiers	0.591	-
Animal Production Science	0.631	1.424
Animal Welfare	0.696	1.794
Animals	0.669	-
Animals and Us: 50 Years and More of Applied Ethology	-	-
Applied and Environmental Microbiology	1.663	4.701
Applied Animal Behaviour Science	0.857	2.175
Australian Veterinary Journal	0.407	1.079
Behavioural Brain Research	1.293	3.021
Behavioural Processes	0.798	1.881
Biology Letters	1.924	3.484
Current Zoology	1.219	2.457
Domestic Animal Endocrinology	0.79	2.063
Frontiers in Psychology	0.997	2.871
Frontiers in Veterinary Science	0.785	-
Journal of Animal Science	0.871	2.155
Journal of Applied Animal Welfare Science	0.477	1.391
Journal of Dairy Science	1.34	3.208
Journal of Ethology	0.559	1.374
Journal of the American Veterinary Medical Association	0.67	-
Journal of Veterinary Behavior: Clinical Applications and Research	0.642	-
Journal of Veterinary Medical Education	0.357	0.79
Meat Science	1.397	3.919
New Zealand Veterinary Journal	0.706	1.586
PeerJ	1.037	2.7
Physiology and Behavior	1.013	-
PLoS ONE	1.1	3.337
Poultry Science	0.977	2.537
Precision Livestock Farming 2019 - Papers Presented at the 9th European Conference on Precision Livestock Farming, ECPLF 2019	-	-
Psychoneuroendocrinology	2.013	4.888
Research in Veterinary Science	0.548	1.762
Society and Animals	0.19	0
Stress	0.986	0
Translational Animal Science	0.496	0
Veterinary Journal	0.908	2.174
Veterinary Microbiology	1.116	2.834
Veterinary Sciences	0.483	-
World's Poultry Science Journal	0.493	-
Zoo Biology	0.561	1.469

n.b.

SJR. "SCImago Journal Rank" is an alternative (c.f. IF – Impact Factor, Web of Science), prestige metric, whose methodology is similar to that of Google PageRank. It weights the value of a citation depending on the field, quality and reputation of the journal that the citation comes from, so that "all citations are not equal". SJR also takes differences in the behavior of academics in different disciplines into account, and can be used to compare journals in different fields. The average SJR value for all journals in Scopus is 1.000

Citations (more recent publications will always have a lower citation count)

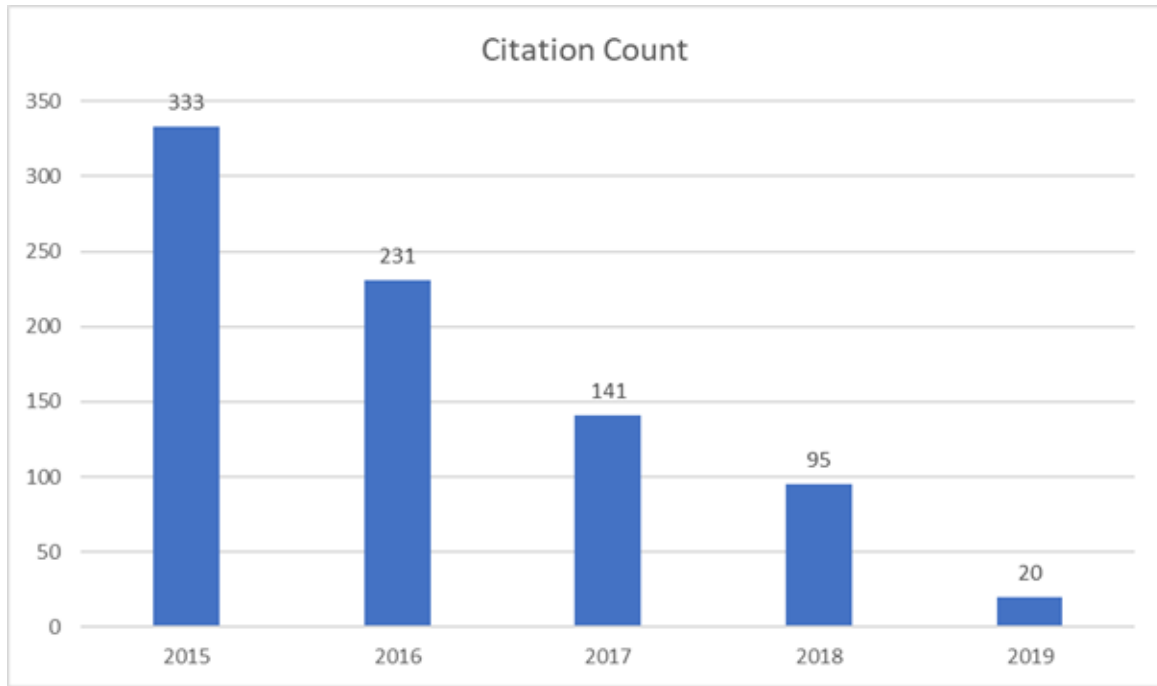


Figure 1: number of citations received by publications of Animal Welfare Science Centre (2015-2019); n=820

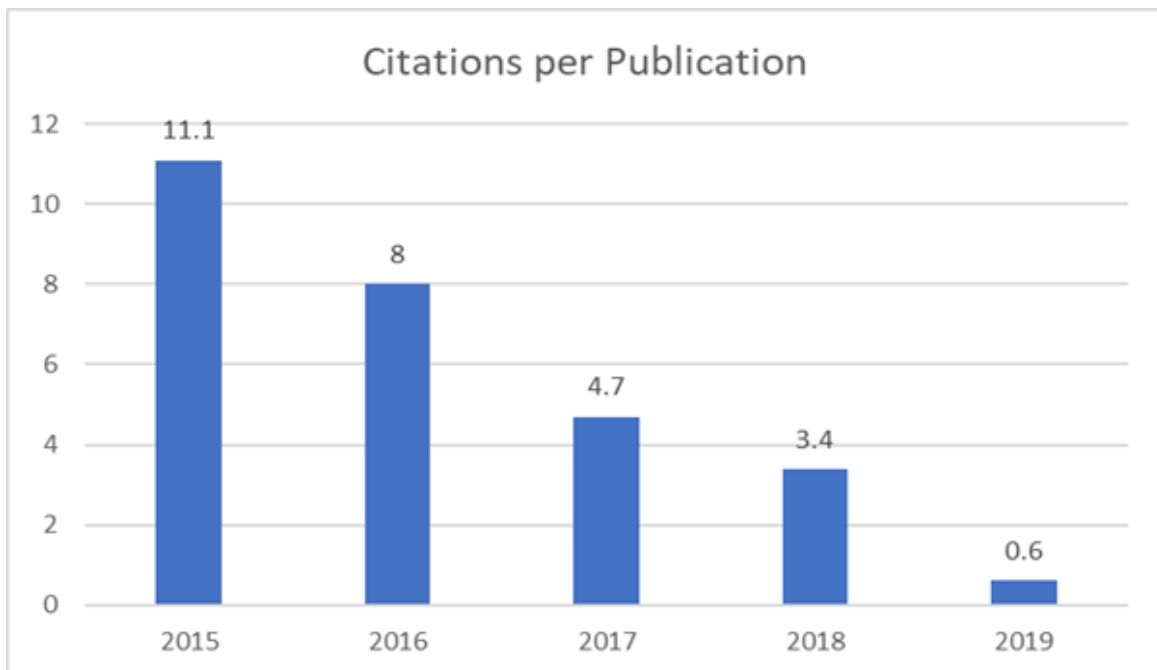


Figure 2: number of citations per publication received by publications of Animal Welfare Science Centre (2015-2019); average = 5.56

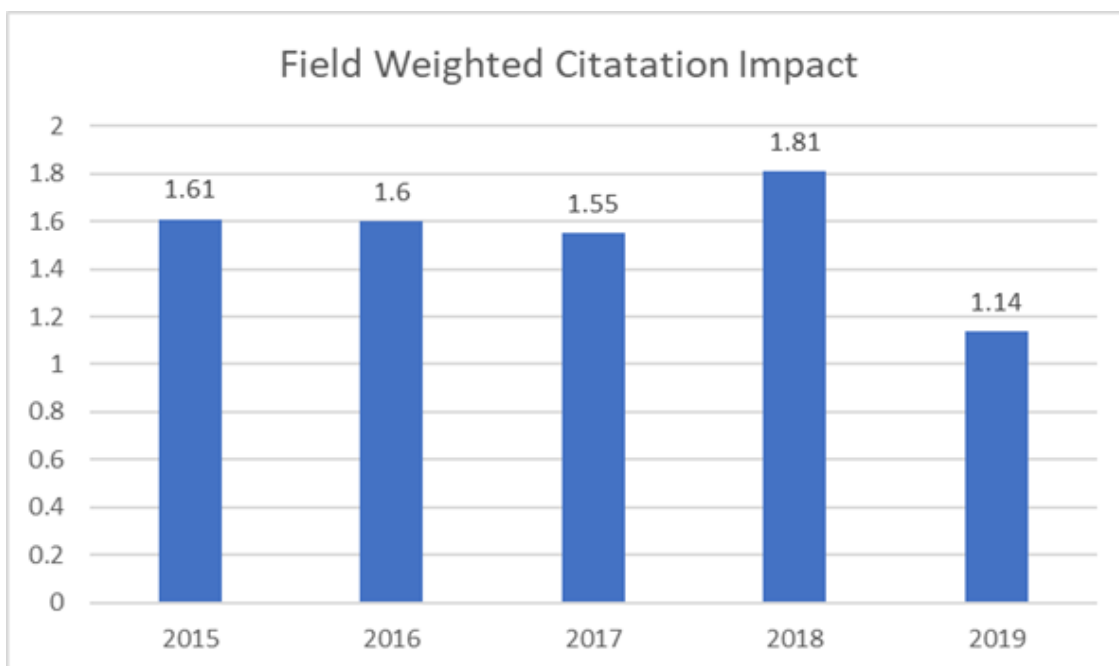


Figure 3: field-weighted citation impact of publications of Animal Welfare Science Centre (2015-2019); average: 1.542

n.b.

Field-Weighted Citation Impact in SciVal indicates how the number of citations received by an entity's publications compares with the average number of citations received by all other similar publications in the data universe: how do the citations received by this entity's publications compare with the world average?

- A Field-Weighted Citation Impact of 1.00 indicates that the entity's publications have been cited exactly as would be expected based on the global average for similar publications; the Field-Weighted Citation Impact of "World", or the entire Scopus database, is 1.00
- A Field-Weighted Citation Impact of more than 1.00 indicates that the entity's publications have been cited more than would be expected based on the global average for similar publications; for example, 2.11 means 111% more cited than world average
- A Field-Weighted Citation Impact of less than 1.00 indicates that the entity's publications have been cited less than would be expected based on the global average for similar publications; for example, 0.87 means 13% less cited than world average

Researchers

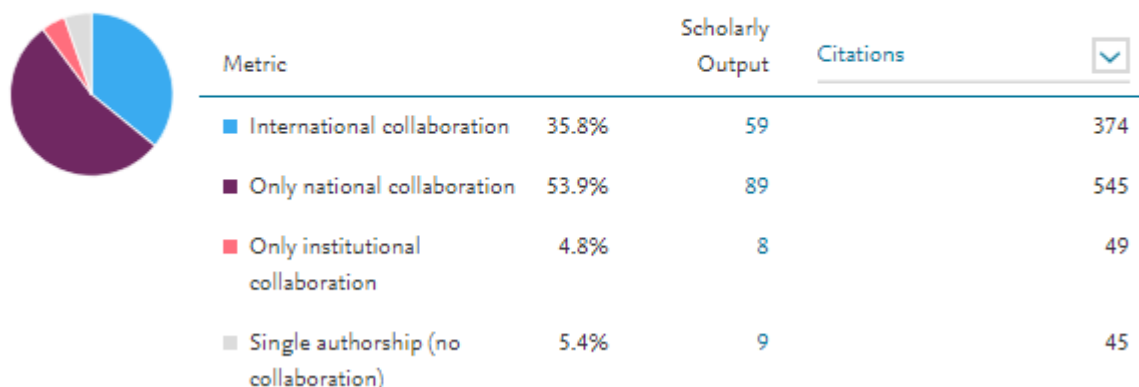
Name	Scholarly Output	Citation Count	Citations per Publication	Field-Weighted Citation Impact	h-index
Coleman, Grahame J.	22	87	4	1.53	30
Doyle, Rebecca E.	24	118	4.9	1.71	10
Fisher, Andrew D.	29	119	4.1	1.38	25
Hemsworth, Lauren M.	4	31	7.8	1.91	3
Hemsworth, Paul Hamilton	58	416	7.2	1.88	34
Jongman, E. C.	20	113	5.7	1.3	11
Rault, Jean Loup	45	249	5.5	1.47	11

Collaboration

Collaboration

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Scholarly Output of Animal Welfare Science Centre (2015-2019), by amount of international, national and institutional collaboration



Benchmarking

Scientific performance of the AWSC (core scientists as above) for the period 2015-2019 has been benchmarked against the performance of core scientists at comparable institutions world-wide.

The data on the following pages were sourced on 20/01/2020 from Scopus data up to 31/12/2019 and include output from core scientists at each institution.

The following data include all publications (articles and reviews) from 2015-2019 inclusive.

1. CSIRO – Animal Behaviour & Welfare

Scientists

1. I. G. Colditz
2. C. Lee
3. D. M. Ferguson
4. A. Small
5. D. Campbell
6. D. Marini

2. Murdoch University

Scientists

1. T. Collins
2. E. Dunston
3. D. Miller
4. A. Barnes
5. T. Fleming

3. Massey University – Animal Welfare & Bioethics Centre

Scientists

1. N.J. Beausoleil
2. C.B. Johnson
3. D.J Mellor
4. K.J. Stafford
5. P. Chambers
6. K. Kongara
7. P. Singh
8. N. Kells
9. K. Littlewood
10. S.Pain
11. R. Thomas-Corner
12. M. Heslop

4. Scotland's Rural College – Animal Behaviour & Welfare

Scientists

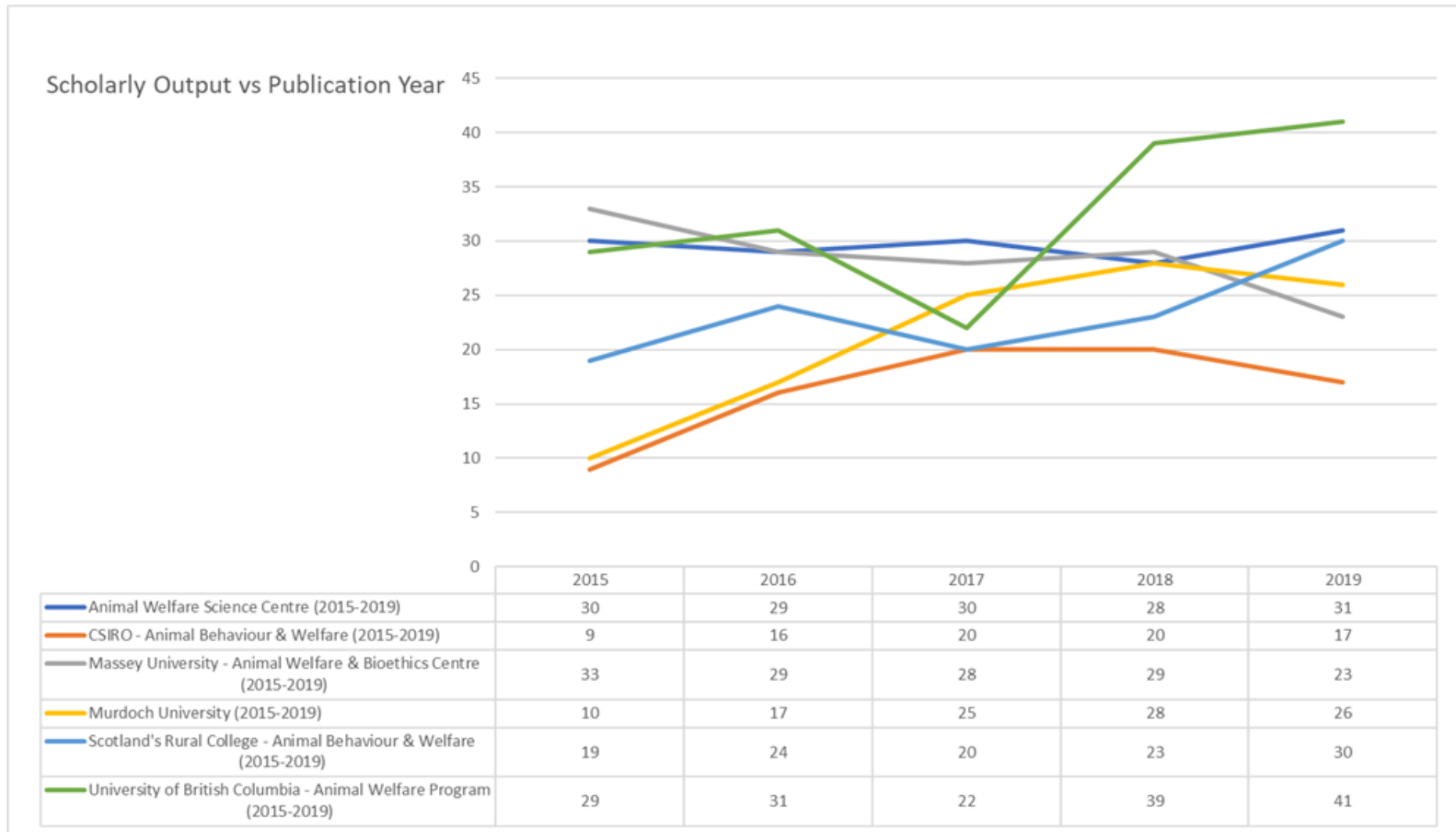
1. E.M. Baxter
2. C.M. Dwyer
3. A.B. Lawrence
4. K.M.D. Rutherford
5. S.P. Turner
6. F. Wemelsfelder
7. F. Langford

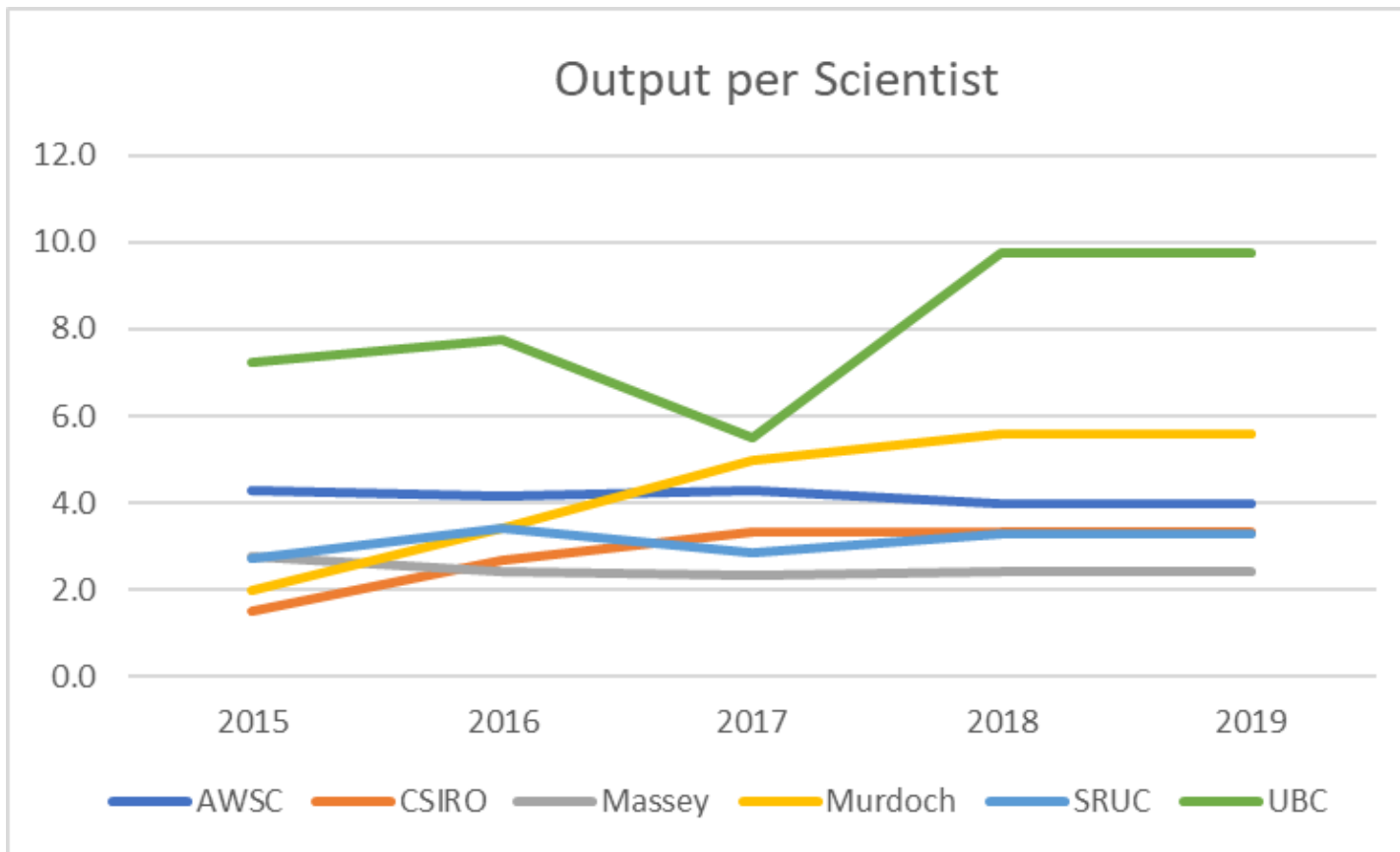
5. University of British Columbia – Animal Welfare Program

Scientists

1. D. Fraser
2. M.A.G. von Keyserlingk
3. D.M. Weary
4. A. Protopopova

Scholarly output (articles and reviews)





	2015	2016	2017	2018	2019
AWSC	4.3	4.1	4.3	4.0	4.0
CSIRO	1.5	2.7	3.3	3.3	3.3
Massey	2.8	2.4	2.3	2.4	2.4
Murdoch	2.0	3.4	5.0	5.6	5.6
SRUC	2.7	3.4	2.9	3.3	3.3
UBC	7.3	7.8	5.5	9.8	9.8

Scholarly output by journal (top 7/group)

AWSC

Journal	Publications	Citations	Authors	Citations/Publication	SJR	5yr IF
Applied Animal Behaviour Science	22	156	92	7.1	0.857	2.175
Animals	18	79	93	4.4	0.669	-
Journal of Dairy Science	9	33	47	3.7	1.34	3.208
Animal	8	43	39	5.4	0.791	2.401
Animal Production Science	6	12	23	2.0	0.631	1.424
Journal of Animal Science	6	63	31	10.5	0.871	2.155
Poultry Science	6	41	29	6.8	0.977	2.537

UBC

Journal	Publications	Citations	Authors	Citations/Pub	SJR	5yr IF
Journal of Dairy Science	59	786	260	13.32203	1.34	3.208
PLoS ONE	19	153	95	8.052632	1.1	3.337
Applied Animal Behaviour Science	15	121	56	8.066667	0.857	2.175
Animals	11	67	69	6.090909	0.669	-
Scientific Reports	8	45	30	5.625	1.414	4.525
Preventive Veterinary Medicine	5	31	22	6.2	1.102	2.686
Animal	3	39	11	13	0.791	2.401

CSIRO

Journal	Publications	Citations	Authors	Citations/Pub	SJR	5yr IF
Applied Animal Behaviour Science	14	91	64	6.5	0.857	2.175
Animals	10	34	44	3.4	0.669	-
Poultry Science	10	93	40	9.3	0.977	2.537
Australian Veterinary Journal	5	14	23	2.8	0.407	1.079
Research in Veterinary Science	5	10	27	2	0.548	1.762
PeerJ	4	14	19	3.5	1.037	2.7

Massey

Journal	Publications	Citations	Authors	Citations/Pub	SJR	5yr IF
New Zealand Veterinary Journal	21	267	76	12.71429	0.706	1.586
Animals	19	191	82	10.05263	0.669	-
Veterinary Anaesthesia and Analgesia	9	19	54	2.111111	0.823	2.008
New Zealand Journal of Agricultural Research	8	30	50	3.75	0.361	1.05
Animal Welfare	7	100	30	14.28571	0.696	1.794
Journal of Veterinary Pharmacology and Therapeutics	5	11	22	2.2	0.54	1.397
Small Ruminant Research	5	12	30	2.4	0.564	1.351

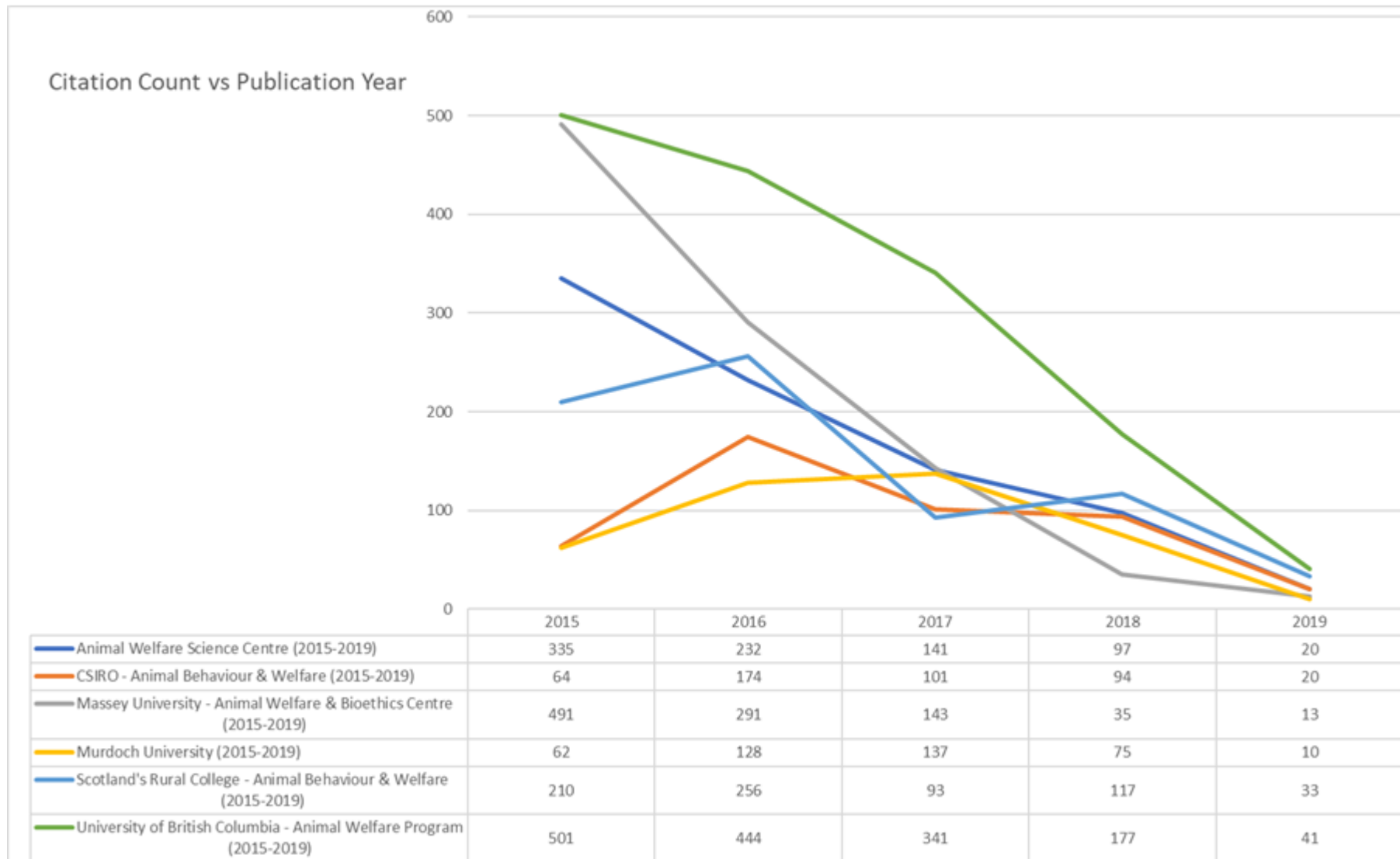
Murdoch

Journal	Publications	Citations	Authors	Citations/Pub	SJR	5yr IF
Wildlife Research	9	29	48	3.222222	0.802	1.579
Animals	8	27	48	3.375	0.669	-
Animal Production Science	6	31	31	5.166667	0.631	1.424
Applied Animal Behaviour Science	5	14	28	2.8	0.857	2.175
Journal of Zoology	4	22	21	5.5	0.912	2.077
Austral Ecology	4	22	24	5.5	0.764	1.672
Journal of Veterinary Medical Education	4	18	45	4.5	0.357	0.79

SRUC

Journal	Publications	Citations	Authors	Citations/Pub	SJR	5yr IF
Applied Animal Behaviour Science	27	228	139	8.444444	0.857	2.175
Animal	14	112	96	8	0.791	2.401
Animals	9	16	35	1.777778	0.669	-
PLoS ONE	7	16	36	2.285714	1.1	3.337
Advances in Pig Welfare	5	26	18	5.2	-	-
Scientific Reports	5	22	26	4.4	1.414	4.525
Animal Behaviour	4	41	18	10.25	1.493	3.101

Citation count (more recent publications will always have a lower citation count)



Citations per publication (more recent publications will always have a lower citation count)

	Citations per Publication					
	2015	2016	2017	2018	2019	Overall
Animal Welfare Science Centre (2015-2019)	11.2	8	4.7	3.5	0.6	5.6
CSIRO - Animal Behaviour & Welfare (2015-2019)	7.1	10.9	5.1	4.7	1.2	5.5
Massey University - Animal Welfare & Bioethics Centre (2015-2019)	14.9	10	5.1	1.2	0.6	6.9
Murdoch University (2015-2019)	6.2	7.5	5.5	2.7	0.4	3.9
Scotland's Rural College - Animal Behaviour & Welfare (2015-2019)	11.1	10.7	4.7	5.1	1.1	6.1
University of British Columbia - Animal Welfare Program (2015-2019)	17.3	14.3	15.5	4.5	1	9.3

Field-weighted citation impact

	Field-Weighted Citation Impact					
	2015	2016	2017	2018	2019	Overall
Animal Welfare Science Centre (2015-2019)	1.61	1.61	1.54	1.82	1.11	1.53
CSIRO - Animal Behaviour & Welfare (2015-2019)	1.17	2.05	1.66	2.55	2.91	2.16
Massey University - Animal Welfare & Bioethics Centre (2015-2019)	2.15	2.32	1.47	0.79	1.12	1.61
Murdoch University (2015-2019)	1.49	1.09	1.37	1.27	0.6	1.12
Scotland's Rural College - Animal Behaviour & Welfare (2015-2019)	1.98	2.05	1.15	1.96	2.36	1.95
University of British Columbia - Animal Welfare Program (2015-2019)	2.05	2.08	3.36	1.81	1.74	2.1

% International collaboration

	International Collaboration (%)					
	2015	2016	2017	2018	2019	Overall
Animal Welfare Science Centre (2015-2019)	40	34.5	36.7	28.6	38.7	35.8
CSIRO - Animal Behaviour & Welfare (2015-2019)	22.2	25	40	25	23.5	28.1
Massey University - Animal Welfare & Bioethics Centre (2015-2019)	36.4	44.8	46.4	24.1	26.1	35.9
Murdoch University (2015-2019)	30	23.5	32	14.3	29.6	25.2
Scotland's Rural College - Animal Behaviour & Welfare (2015-2019)	31.6	41.7	45	52.2	80.6	53
University of British Columbia - Animal Welfare Program (2015-2019)	48.3	29	54.5	48.7	48.8	45.7

% National collaboration

	National Collaboration (%)					
	2015	2016	2017	2018	2019	Overall
Animal Welfare Science Centre (2015-2019)	56.7	58.6	50	60.7	54.8	56.1
CSIRO - Animal Behaviour & Welfare (2015-2019)	66.7	43.8	50	65	52.9	54.9
Massey University - Animal Welfare & Bioethics Centre (2015-2019)	18.2	13.8	14.3	27.6	30.4	20.4
Murdoch University (2015-2019)	40	47.1	44	57.1	55.6	50.5
Scotland's Rural College - Animal Behaviour & Welfare (2015-2019)	47.4	41.7	45	39.1	16.1	35.9
University of British Columbia - Animal Welfare Program (2015-2019)	13.8	19.4	9.1	7.7	2.4	9.9

% Within institute collaboration

	Institutional Collaboration (%)					
	2015	2016	2017	2018	2019	Overall
Animal Welfare Science Centre (2015-2019)	0	3.4	3.3	3.6	3.2	2.7
CSIRO - Animal Behaviour & Welfare (2015-2019)	11.1	31.3	10	5	23.5	15.9
Massey University - Animal Welfare & Bioethics Centre (2015-2019)	33.3	31	32.1	41.4	34.8	34.5
Murdoch University (2015-2019)	30	29.4	24	28.6	14.8	24.3
Scotland's Rural College - Animal Behaviour & Welfare (2015-2019)	15.8	12.5	5	8.7	3.2	8.6
University of British Columbia - Animal Welfare Program (2015-2019)	34.5	45.2	36.4	41	48.8	42

% Single authorship

	Single Authorship (%)					
	2015	2016	2017	2018	2019	Overall
Animal Welfare Science Centre (2015-2019)	3.3	3.4	10	7.1	3.2	5.4
CSIRO - Animal Behaviour & Welfare (2015-2019)	0	0	0	5	0	1.2
Massey University - Animal Welfare & Bioethics Centre (2015-2019)	12.1	10.3	7.1	6.9	8.7	9.2
Murdoch University (2015-2019)	0	0	0	0	0	0
Scotland's Rural College - Animal Behaviour & Welfare (2015-2019)	5.3	4.2	5	0	0	2.6
University of British Columbia - Animal Welfare Program (2015-2019)	3.4	6.5	0	2.6	0	2.5

Collaborating institutions

AWSC

By # pubs co-authored with AWSC (2015-19)

Top collaborating Institutions

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by number of publications co-authored with Animal Welfare Science Centre (2015-2019)

Institution	Co-authored publications	Citations received for co-authored publications	Co-authors	Field-Weighted Citat...
1. University of Melbourne	155	974	83	1.49
2. University of Sydney	30	231	29	1.79
3. Charles Sturt University	17	58	18	0.78
4. University of Adelaide	15	156	13	1.37
5. Massey University	13	107	6	1.54
6. University of Veterinary Medicine Vienna	13	21	8	0.95
7. Murdoch University	11	41	5	1.03
8. CSIRO	10	99	13	2.24
9. University of Queensland	10	38	4	0.82
10. Monash University	8	76	7	1.99































UBC

By # pubs co-authored with UBC (2015-19)

Top collaborating Institutions

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by number of publications co-authored with University of British Columbia - Animal Welfare Program (2015-2019)

Institution	Co-authored publications 	Citations received for co-authored publications	Co-authors	Field-Weighted Citat... 
1.  University of British Columbia	177 	2,058	99 	2.18
2.  Universidade Federal de Santa Catarina	24 	277	12 	3.07
3.  University of Guelph	19 	233	29 	2.22
4.  Arizona State University	11 	89	6 	1.04
5.  Texas Tech University	9 	52	4 	0.75
6.  University of Florida	8 	82	7 	1.24
7.  University of California at Davis	5 	61	6 	0.92
8.  AgResearch	4 	115	2 	3.96
9.  New York University	4 	8	1 	1.22
10.  Ohio State University	4	60	1	2.14

CSIRO

By # pubs co-authored with CSIRO (2015-19)

Top collaborating Institutions

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by number of publications co-authored with CSIRO - Animal Behaviour & Welfare (2015-2019)

Institution	Co-authored publications	Citations received for co-authored publications	Co-authors	Field-Weighted Citat...
1. CSIRO	64	457	31	2.18
2. University of New England NSW	49	237	40	2.06
3. Michigan State University	13	99	12	2.45
4. University of Melbourne	9	80	5	2.62
5. University of Queensland	7	45	3	0.99
6. University of Sydney	5	48	3	3.32
7. NSW Department of Primary Industries	5	42	6	3.32
8. Cairo University	4	16	1	2.31
9. Wageningen University & Research	4	26	6	3.52
10. University of Guelph	4	21	7	0.94

Massey

By # pubs co-authored with Massey (2015-19)

Top collaborating Institutions

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by number of publications co-authored with Massey University - Animal Welfare & Bioethics Centre (2015-2019)

Institution	Co-authored publications	Citations received for co-authored publications	Co-authors	Field-Weighted Citat...
1. Massey University	167	1,157	121	1.50
2. AgResearch	17	85	14	1.19
3. University of Melbourne	15	108	13	1.51
4. University of Adelaide	14	94	11	1.43
5. University of Queensland	13	66	6	1.14
6. Murdoch University	11	37	6	1.36
7. University of Sydney	11	123	13	2.22
8. James Cook University Queensland	10	41	3	1.55
9. Charles Sturt University	9	26	4	1.11
10. Lincoln University	4	16	2	0.61

SRUC

By # pubs co-authored with SRUC (2015-19)

Top collaborating Institutions

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by number of publications co-authored with Scotland's Rural College - Animal Behaviour & Welfare (2015-2019)

Institution	Co-authored publications	Citations received for co-authored publications	Co-authors	Field-Weighted Citat...
1. Scotland's Rural College	132	1,033	65	1.93
2. University of Edinburgh	59	391	43	1.79
3. Queen's University Belfast	13	151	3	1.96
4. University of Veterinary Medicine Vienna	12	33	2	2.69
5. Teagasc - Irish Agriculture and Food Development Authority	11	43	5	4.90
6. Newcastle University	10	61	6	2.74
7. Institut national de la recherche agronomique	6	43	17	1.35
8. University of St Andrews	6	52	3	1.67
9. University of Copenhagen	5	94	5	2.85
10. Autonomous University of Barcelona	5	35	2	2.21

Murdoch

By # pubs co-authored with Murdoch (2015-19)

Top collaborating Institutions

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by number of publications co-authored with Murdoch University (2015-2019)

Institution	Co-authored publications	Citations received for co-authored publications	Co-authors	Field-Weighted Citat...
1. Murdoch University	124	682	100	1.15
2. Curtin University of Technology	28	186	2	1.42
3. Charles Sturt University	18	39	7	0.69
4. University of Melbourne	16	52	7	0.88
5. University of Adelaide	15	47	8	1.13
6. University of Western Australia	15	164	12	1.21
7. NSW Department of Primary Industries	11	28	4	0.82
8. Massey University	10	37	6	1.50
9. James Cook University Queensland	9	32	2	1.43
10. University of Sydney	9	32	8	1.43

Interpretation of results

The research output of the AWSC in the last 5 years is comparable to other similarly sized animal welfare groups internationally.

Compared with the AWSC, the other research groups have a higher number of full-time, senior researchers. As a result, the number of research students and subsequent research output are likely to be higher for scientists that have been established at an FTE of 1.0 within a University for a long period of time (e.g. UBC).

Compared with other groups, the reported international collaborations from the AWSC were low, whereas there was a relatively high percentage of national collaborations (which was a key objective in establishing the AWSC in 1997 – facilitate national collaborations). This likely reflects collaboration with previous Centre partners (Monash University) and previous employers of AWSC scientists (Fisher).

AWSC publishes in the same journals as the other groups, however the average impact factor of journals is lower than others, possibly reflecting the more applied research undertaken by the AWSC in recent years. Publishing in higher ranking journals, when appropriate, would be of strategic benefit in the future, and has the potential to enhance citation rates and competitiveness for national research grants (e.g. ARC).

Citations were chosen as the metric to analyse the impact of generated publications. Overall, the papers produced by AWSC seem to have a similar level of impact to those from other research groups, indicating that the publications produced are being used by the scientific community, and are seen as meaningful.

Appendix 7 – Engagement/achievement

2019

In February, AWSC Scientists met with Kelly George, Center for Human-Animal Interactions Research & Education of The Ohio State University (OSU). Discussion focused on areas common interest prior to OSU joining the AWSC. As an outcome of this meeting, animal welfare science students at the University of Melbourne met with their counterpart at OSU via video conference to share information in relation to their studies.

In February, Rebecca Doyle was invited by IKEA to present to the company sustainability group: Her presentation 'Animal welfare, human welfare and the Sustainable Development Goals' will assist IKEA in determining appropriate certification to be applied in their supply chain.

In March, Rebecca Doyle attended International Livestock Research Institute (ILRI) meetings in Nairobi and Ethiopia to contribute an animal welfare perspective to ILRI's mission to improve food and nutritional security and to reduce poverty in developing countries through research for efficient, safe and sustainable use of livestock—ensuring better lives through livestock. Interaction with Compassion in World Farming also took place at the ILRI meeting.

The University of Queensland's Animal Welfare Collaborative (AWC) conducted a workshop in Sydney in April. Andrew Fisher, Joe Jacobs and Jeremy Skuse attended the event. Over 80 stakeholders discussed the role, governance and scope of this proposed mechanism to deliver animal welfare outcomes in the livestock industries. Outcomes from the discussion will be used by AWC to formulate its Strategic Plan and Governance model.

In March, Jeremy Skuse and Joe Jacobs attended the National Primary Industries Animal Welfare RD&E Strategy Committee (NAWRDES) meeting in Sydney. Three cross-sectoral project proposals were discussed. A full research proposal for a project (from the University of New England and CSIRO) to conduct a cross-sectoral review of effective and economic environmental enrichment was requested by the Committee.

Andrew Fisher contributed to DAWR as one of the four members of the Live Export Heat Stress Risk Assessment Technical Review Panel. A meeting in April considered public submissions received in response to the draft report which is available on-line at <https://haveyoursay.agriculture.gov.au/39528/documents/95066> .

The Australian Animal Welfare Standards and Guidelines for Poultry is currently under review. Paul Hemsworth is a member of the working group and attended a meeting in Canberra in June.

In June, it was announced that Paul Hemsworth has been awarded the Order of Australia (AM) for services to agricultural science and to animal welfare.

In April, Animal Welfare Science Students of the University of Melbourne organised a scientific writing workshop conducted by Prof. David Lindsay. The workshop was attended by over 40 graduate students from the Faculty of Veterinary and Agricultural Sciences at the University of Melbourne.

The AWSC launched a new website in January. The site has a fresh look and highlights partners, staff, students, research, publications and other communication activities. In this reporting period, the site has attracted 8,322 unique visits and 19,133 page views <https://www.animalwelfare-science.net/>

ProHand Pigs and Pork abattoir have been released in NZ. Over 1,400 trainees have undertaken ProHand Pigs training and over 220 have undertaken ProHand Pork abattoir training.

Several large pork producing companies in North America have expressed a strong interest in the programs and negotiations are taking place with Australian Pork limited to increase server capacity to cater for a larger number of trainees.

AWSC is working with OSU colleagues to develop a funding application under the USDA Inter-Disciplinary Engagement in Animal Systems (IDEAS) program to develop ProHand Dairy training for the US Dairy industry.

Lauren Hemsworth and Andrew Fisher presented at the MLA 'Red Meat Industry Animal Welfare Research Forum' held in Sydney in December. Lauren presented on the public and producer attitudes project, and Andrew presented on the bobby calf welfare project.

In December, Paul Hemsworth and Mia Cobb presented at The Animal Welfare Collaborative meeting in Brisbane which attracted over 70 attendees. The event was entitled Animal Welfare Horizons; Paul's presentation addressed the issue of human effects on animals and Mia spoke about environmental enrichment in working dog environments.

In December, Paul Hemsworth was awarded the title of Redmond Barry Distinguished Professor at the University of Melbourne.

Andrew Fisher, Ellen Jongman and PhD students Laura Field and Natalie Roadknight participated in a Dairy Australia forum on cow-calf extended contact in early December. The forum identified research strategies for examining the logistics and implications of extended cow-calf contact in dairy systems.

Lauren Hemsworth presented at the National Primary Industries Animal Welfare RD&E Strategy (NAWRDES) Forum in Melbourne. "Monitoring Community Attitudes". Her presentation can be found at:

https://www.awstrategy.net/uploads/1/2/3/2/123202832/2_hemsworth_et_al.pdf and audio at

<https://www.awstrategy.net/uploads/1/2/3/2/123202832/1hemsworth.mp4>

Andrew Fisher presented at the Mackinnon Seminar for farmers: 'The "Good Oil" on Lamb Finishing Systems'. Andrew presented on ensuring animal welfare in lamb feedlots, and there were around 85 farmers in attendance.

AWSC PhD Students Lydia Rehnberg, Sam Chiew, Mark Learmonth, Madeleine Holmes, Belinda Hall and Jess Taylor presented their research at Zoos Vic AW Research Symposium in July.

Andrew Fisher and Jeremy Skuse contributed to The Animal Welfare Collaborative workshop on transparency in animal use. The November workshop was attended by around 20 representatives from animal use sectors, government, research and animal welfare groups.

Andrew Fisher and Lauren Hemsworth contributed to the November NAWRDES Workshop in Melbourne. Andrew presented on behalf of Dr Drewe Ferguson (CSIRO). The workshop, attended by 42 stakeholders, contributed to the NAWRDES priorities for the facilitation of cross-sectoral animal welfare RD&E. Their presentations can be found at:

<https://www.awstrategy.net/uploads/1/2/3/2/123202832/ferguson.pdf> and

<https://www.awstrategy.net/uploads/1/2/3/2/123202832/hemsworth.pdf>

Jeremy Skuse and Megan Hayes participated in Australian Pork Limited's strategic planning exercise in Melbourne in November.

In October, Andrew Fisher visited and advised the Fiji National University on their animal health and welfare education programs.

David Beggs attend the Victorian Animal Welfare Advisory Committee meeting in September.

Paul Hemsworth presented to Victorian Government “Inquiry into Impact of Animal Rights Activism on Victorian Agriculture”. September.

Paul Hemsworth participated in Meeting 3 of the Stakeholder Advisory Group - Australian Animal Welfare Standards and Guidelines for Poultry in September.

In December, it was announced that Paul Hemsworth was awarded the title of Redmond Barry Distinguished Professor at the University of Melbourne.

Laura Field, AWSC PhD Student (supervisor Ellen Jongman) investigating cow/calf separation, was awarded the 2019 RSPCA Australia Hugh Wirth Humane Animal Production Scholarship in December.

Megan Hayes, AWSC PhD Student (supervisor Paul Hemsworth) won the 2019 APSA Medal at the 17th Australasian Pig Science Association Conference in Adelaide for her presentation "Positive human contact reduces avoidance behaviour of gestating sows during routine husbandry procedures".

Carmen Glanville, AWSC PhD Student (supervisor Grahame Coleman) won third prize in the international Visualise Your Thesis competition. “Protecting pets by changing people” https://visualiseyourthesis.figshare.com/articles/Protecting_Pets_by_Changing_People_/9992726 September.

Paul Hemsworth was awarded the Universities Federation for Animal Welfare Medal for Outstanding Contributions to Animal Welfare Science in July.

Andrew Fisher wrote an article for The Conversation - "The milk, the whole milk and nothing but the milk: the story behind our dairy woes". <http://theconversation.com/the-milk-the-whole-milk-and-nothing-but-the-milk-the-story-behind-our-dairy-woes-124290> November.

Andrew Fisher wrote article for The Conversation - "The ban on live sheep exports has just been lifted. Here’s what’s changed". <https://theconversation.com/the-ban-on-live-sheep-exports-has-just-been-lifted-heres-whats-changed-123998> September.

Lauren Edwards wrote an article for Pig Site: “What can pig carcasses tell us about farm welfare?”, <https://thepigsite.com/articles/what-can-pig-carcasses-tell-us-about-farm-welfare> September.

Lauren Edwards wrote an article for Poultry Site: “Why water access is the secret to duck health”, <https://thepoultrysite.com/articles/why-water-access-is-the-secret-to-duck-health> August.

Lauren Edwards wrote an article for Poultry Site: “Are mobile housing units a boost for free-range farmers?”, <https://thepoultrysite.com/articles/are-mobile-housing-units-a-boost-for-free-range-farmers> July.

Lauren Edwards wrote an article for Poultry Site: “The welfare of Japanese quail on farms”, <https://thepoultrysite.com/articles/the-welfare-of-japanese-quail-on-farms> July.

The Website the site attracted 10,170 unique visits and 23,971 page views <https://www.animalwelfare-science.net/>

The AWSC also has a presence on Facebook which generates global traffic. We have 2,485 followers (63% from overseas). <https://www.facebook.com/AWSciCent/> .

AWSC Seminars are hosted on Vimeo with 60% of plays originating from overseas. <https://vimeo.com/awsc> .



Figure 1. Vimeo Impressions (reach) January 2019 – December 2019

AWSC has established a presence on Twitter and has attracted 283 followers (an increase of 300% over the reporting period. <https://twitter.com/AWSciCent> . @AWSciCent

ProHand Pigs and Pork abattoir continue to attract trainees in Australia and New Zealand. Over 1,550 trainees have undertaken ProHand Pigs training and over 300 have undertaken ProHand Pork abattoir training.

Maple Leaf Foods, (Canada’s largest pork processor) is in contractual negotiations with Australian Pork Limited to enable them to train staff at their contract hog farms. Training of over 500 employees is expected to commence in April 2020 and AWSC will conduct “Train the Trainer” sessions at their facilities in Manitoba.

AWSC is working with a large multi-national milk processing company to explore the possibilities of developing a revised version of ProHand Dairy.

The AWSC convened a meeting of scientists and students to determine Centre RD&E priorities. The meeting, on December 4, was attended by AgVic scientists and the draft output is attached below -

2018

Forbes Brien (UoA) hosted 9 members of the EU-funded project 'SheepNet' on a tour of research facilities, farms and a feedlot in South Australia in January. Carolina Munoz (AWSC PhD student - UoM) accompanied the visitors. The group (included Forbes Brien and Carolina Munoz) also attended a workshop (c. 20 attendees from research and industry) in Sydney on 25 January, hosted by MLA and organised by Sabine Schmoelzl of CSIRO.

Grahame Coleman (UoM) was an invited speaker at the Manitoba Swine Seminar, Canada on 1-2 February. His presentation was titled The Human-Animal Relationship: Pig Welfare, Productivity and Training Strategies.

Susan Hazel (UoA) co-wrote an article which was published in The Conversation on 14 February. “As selling pets online becomes normal, we need to regulate it”. <https://theconversation.com/as-selling-pets-online-becomes-normal-we-need-to-regulate-it-91478>

Susan Hazel (UoA) presented at the Philippines Veterinary Association Annual Conference on the health effects of neutering in dogs in February.

Susan Hazel (UoA) was interviewed in February on ABC Drive (NSW) following her Conversation article “As selling pets online becomes normal, we need to regulate it”.

Paul Hemsworth (UoM) Paul Hemsworth appeared on ABC News 20 Feb - discussed welfare credentials of furnished cages. <http://www.abc.net.au/news/rural/2018-02-20/protests-over-caged-eggs-have-farmers-worried/9461064>

Forbes Brien (UoA) presented a paper on genetic improvement of lamb survival at the 11th World Congress on Genetics Applied to Livestock Production, Auckland, held 11-16 February.

Ellen Jongman (UoM) gave an invited presentation, "Behavioural responses of pigs to CO2 stunning under commercial conditions" at the RSPCA Science Seminar held in Canberra on 22 February.

David Beggs (UoM) project on milking order was reported on in the Weekly Times 7 February.

Rebecca Doyle (UoM) was selected for and attended "Homeward Bound" in March. The program is a leadership, strategic and science initiative to heighten the influence and impact of women with a science background.

<https://homewardboundprojects.com.au/participants/2018-participants/>

Jeremy Skuse (UoM) conducted ProHand Pigs training at Rivalea in March. 20 managers and supervisors were trained.

AWSC (UoM) hosted Prof. Yih-Fwu Lin, Director of the Taiwan Livestock Research Institute in March. Discussed potential collaborations in the field of human-animal interactions.

AWSC (UoM) hosted Steve Moeller from The Ohio State University in March. Discussed provision of ProHand in N America and other potential collaborations.

AWSC conducted a red meat / wool RD&E planning workshop in Adelaide on 7 March. Thirty industry representatives discussed current and future RD&E priorities across the sectors. The output of the workshop will inform future AWSC RD&E activities.

Susan Hazel (UoA) wrote an article for The Conversation, (published 9 April), answering children's questions about dogs. <https://theconversation.com/curious-kids-why-dont-dogs-live-as-long-as-humans-93374>

Susan Hazel (UoA) was invited to join the editorial board for the Journal of Veterinary Education in April.

Sarah Chaplin (DEDJTR) was co-author with Yvette Williams (DEDJTR) of an article published in the Australian Dairy Farmer magazine: "Basics of bedding for dairy cows". Published in the May/June edition, pp79-80.

Rebecca Doyle (UoM) was featured in the May edition of the University's magazine, Pursuit. <https://pursuit.unimelb.edu.au/articles/if-we-could-talk-to-the-animals>

Lauren Edwards (UoM) wrote an article on stunning methods used in the pork industry which was published on the Pig Site on 8 May. <http://www.thepigsite.com/articles/5428/stunning-at-slaughter-is-your-hard-work-going-to-waste/>

Andrew Fisher (UoM) was interviewed on radio about live export: ABC local radio. Overnight with Rod Quinn on 19 May.

Andrew Fisher (UoM) contributed to an article on live export published on 9 May in The Conversation. <https://theconversation.com/can-meat-exports-be-made-humane-here-are-three-key-strategies-96213>

Andrew Fisher, Grahame Coleman & David Beggs (UoM) presented invited papers at the 11th Boehringer International Animal Wellbeing Forum, held in Sydney on 31 May – 1 June. Fisher: "A meeting at the crossroads of animal welfare and international trade"; Coleman:

“Public attitudes and perceptions towards farm animal welfare”; Beggs: “Do cows think grass tastes good?”

<https://farmanimalwellbeing.com/recurso.php?tipo=forum&subtipo=pdf&id=12>

Andrew Fisher (UoM) presented an invited paper, "Beef cattle welfare – Where is it headed? An international perspective" at the International Symposium on Beef Cattle Welfare held in Calgary on 19 – 21 June.

Sarah Chaplin (DEDJTR) was co-author of Dairy Australia study tour report 2017 – USA Dairy beef pathways. S. Chaplin. Uploaded to DA website in June. <https://bit.ly/2yKtkoS>

Paul Hemsworth (UoM) attended the OIE ad hoc Group on pig welfare meeting in Paris in January 2018.

Susan Hazel (University of Adelaide) attended the working group meeting for World Small Animal Veterinary Association (WSAVA) Animal Welfare Guidelines in the Philippines in February.

Andrew Fisher (UoM) provided advice to the Commonwealth Government’s McCarthy report concerning the technical review of live exports in May.

Andrew Fisher (UoM) and Sarah Chaplin (DEDJTR) attended the Dairy Moving Forward Husbandry steering committee in May to set priorities for future welfare research.

Jeremy Skuse delivered a presentation on ProHand Pork Abattoir to key personnel at BRF S.A. (Brazil’s largest pork processor) and discussed the development of a pilot program, July.

Jeremy Skuse delivered presentations on ProHand Pigs to 30 researchers at EMBRAPA (Brazilian Department of Agriculture) and 200 researchers and students at the Instituto Federal do Rio Grande do Sul

Paul Hemsworth visited The Ohio State University in October and met with Prof. Jim Kinder and the new Chair of Animal Sciences, Prof John Stolz. Collaboration and roll-out of ProHand in US were main items of discussion.

In October, Paul Hemsworth met with Dr Jeremy Marchand-Forde (US Department of Agriculture) and Dr Don Lay (Purdue University) in relation to collaboration in pig research to investigate stress resilience and human stunning.

Andrew Fisher contributed to the Australian Wool Innovation Breech Flystrike R, D & E Technical Update Forum in July 2018

In August, Andrew Fisher served as one of four members of the Heat Stress Risk Assessment Technical Reference Panel, advising the Federal Department of Agriculture on live export.

Rebecca Doyle and David Beggs were appointed to the Victorian Animal Welfare Advisory Committee in September.

Carolina Munoz wrote an article for RSPCA Australia (September) describing electro-immobilisation. https://kb.rspca.org.au/what-is-electro-immobilisation-and-what-impact-does-it-have-on-animal-welfare_747.html

Andrew Fisher advised DEDJTR Divisional Veterinary Officers on concepts of animal welfare in October.

Andrew Fisher participated at the Australian Wool Innovation Animal Welfare Forum in December.

Professor at the University of Melbourne, Andrew Fisher, was presented with the inaugural Teagasc (Irish Agriculture and Food Development authority) Alum of the Year award at the Walsh Fellowships 25th anniversary seminar in October.

The University of Melbourne joined the Global Agenda for Sustainable Livestock (GASL, <http://www.livestockdialogue.org/>), Rebecca Doyle represented the University at its October meeting and was elected Chair of the GASL Animal Welfare Action group.

Rebecca Doyle was a member of the organizing committee of Universities Federation for Animal Welfare conference, "Animal Welfare across Borders" which was held in Hong Kong in October.

Leigh Atkinson (PhD student, Early life stressors in sheep won winning 2nd prize for 1st year students at the Meat and Livestock Australia post-graduate conference in Sydney, November.

AWSC PhD students formed a group under the Graduate Students Association at the University of Melbourne. The group, Animal Welfare Science Students of the University of Melbourne organised a seminar entitled Paws for Productivity which featured a range of speakers addressing the topic of de-stressing with dogs, safeguarding human health and animal welfare. The event attracted over 80 people and was held in October 2018.

Carolina Muñoz was awarded third prize for her presentation at the International Society for Applied Ethology Conference in Valdivia, Chile in December.

Natalie Roadknight has been awarded the 2018 RSPCA Australia Scholarship for Humane Animal Production Research.

Rebecca Doyle, Madeline Woodruff and Sammy Cramer presented at the "Animal Welfare across Borders" conference which was attended by over 100 delegates in Hong Kong in October. Rebecca Doyle - Production animal welfare and the sustainable development goals, Madeline Woodruff - Too short: Understanding farmer knowledge of and attitudes towards appropriate lamb tail length, Sammy Cramer - Investigating the effect of pen shape and pen size on group flight distance of extensively managed ewes.

Paul Hemsworth gave an invited presentation Animal Welfare Research - Future directions at the Australian Association of Pig Veterinarians conference in Glenelg, SA, October. Over 80 attendees.

Natalie Roadknight was invited to present at Ireland's National Dairy conference in November. Her presentation was titled The Australian system for managing non-replacement dairy-calves.

Paul Hemsworth was an invited speaker at the International Meeting of Researchers in Animal Welfare in Valdivia, Chile. His presentation, How human interaction can affect animal welfare and productivity was received by over 150 attendees. December.

Carolina Munoz presented at the International Meeting of Researchers in Animal Welfare in Valdivia, Chile. Her presentation, Positive attitudes, positive outcomes: farmer attitudes and its relationship with sheep welfare was received by over 150 attendees. December

2017

Jeremy Skuse visited Central Queensland University in May to deliver an invited presentation on the human-animal relationship in the pork industry and to introduce the ProHand program. 30 attendees.

Paul Hemsworth gave an invited presentation to the World Association of Zoos and Aquariums (WAZA) Congress in Detroit in May. His presentation "Keeper-zoo animal relationships: proof of concept" was delivered to over 200 participants.

Paul Hemsworth gave an invited presentation to the Detroit Zoological Society's Center for Zoo Animal Welfare (CZAW) in May. His presentation on human-animal relationships in the zoo setting was received by approximately 100 people.

Andrew Fisher presented at the Barkly Herd Management Forum in April at Helen Springs station in the Northern Territory. Over 20 stockpeople and managers attended the event. Andrew delivered two presentations, "Animal welfare – its effects on production, markets and public perception" and "Pain management: Standards in other countries, Practical steps".

Grahame Coleman was an invited speaker at the February Manitoba Swine Seminar. He delivered 2 papers - "The human-animal relationship, Its implications for pig welfare and productivity and training strategies to safeguard pig welfare" and "Public attitudes predict community behaviours relevant to the swine industry" to over 120 delegates.
<http://audio.farmscape.com/2017/2/coleman-170201.mp3>

Jean-Loup Rault gave an invited presentation "Range use in meat chickens", at the Australian Poultry Veterinary Association meeting in Feb 2017. Over 40 delegates attended the meeting.

Jeremy Skuse conducted ProHand and Pig handling training to National Meat Industry Training Advisory Council Limited and Australian Meat Industry Council "Young Guns" event in Jandowie, QLD in February. Over 40 attendees.

Andrew Fisher represented the AWSC at the Australian Wool Innovation animal welfare forum in June.

Forbes Brien spoke on genetic gains in breeding for reduced flystrike at the Australian Wool Innovation Sheep Health and Welfare Workshop in May.

Jeremy Skuse and Paul Hemsworth met with Cherie Collins, Rebecca Morrison and Kristy Tickle in May to develop protocol for ProHand roll-out at Rivalea .

Andrew Fisher and Jeremy Skuse met with Rachael Holmes (DEDJTR) and George Buchahana (Game Management Authority) in March to discuss wild duck euthanasia options.

Paul Hemsworth and Cameron Ralph attended the Australian Pork Limited Specialist Group 2 meeting in Canberra in February.

Paul Hemsworth attended the OIE ad hoc Group on pig welfare meeting in Paris in January 2017.

The Board of the AWSC appointed two independent Directors. Ms. Lucinda Corrigan and Mr Rob Cumine.

Jeremy Skuse (UoM) met with Jamee Amundsen (USA National Pork Board animal welfare manager) in September to discuss the ProHand Pigs training package. The purpose of the meeting was to brief the National Pork Board on the intent of the AWSC and its partners to roll-out ProHand Pigs in North America in 2018.

Grahame Coleman and Paul Hemsworth (UoM) met with OSU Department of Animal Science and pork industry personnel to develop an Ohio and national USA implementation of the new ProHand Pigs (farm and abattoir) training package. Dr. Steve Moeller, Department of Animal Science, OSU) will lead a concerted effort to officially introduce ProHand Pigs to the U.S. swine industry, utilising several key activities such as short-term sabbatical at the AWSC in early 2018, work with the Ohio State ATI Business Training and Educational Services group to establish the training platform, establish a case study of ProHand Pigs training in three Ohio pork production systems and establish partnerships with key industry participants to further the value of ProHand training beyond the farm gate.

Jeremy Skuse (UoM) met with representatives of UK Supermarkets (Waitrose and ASDA) in September to discuss bespoke animal welfare standards in the UK retail sector. The purpose of the meeting was to communicate the activities of the AWSC and to gain an insight into the UK retail sector to inform an AWSC project proposal in Australia.

AWSC VIC/SA hosted colleagues from The Ohio State University in November. Discussions with Monique Pairis Garcia, Marcus Camplan and Katie Proudfoot (OSU) focused on current and future research collaborations and the intent of OSU to join the AWSC. Farm visits in South Australia were also arranged to provide a two-way exchange of information between a major Australian pork producer and our US colleagues.

AWSC VIC hosted Prof. Terry Maple (Georgia Institute of Technology) in November. Interactive discussion on animal welfare RD&E priorities in zoos. Provide an update on the current ARC Linkage project "Human-animal relationships in zoos: Optimising animal and visitor experiences" and explored future collaborations.

Jeremy Skuse (UoM) met with a representative of an Australian Company, which is investigating the development of licensed, mobile abattoirs. The meeting, in October was held to discuss the potential involvement of the AWSC in assessing the animal welfare implications of the system.

Forbes Brien (UoA) became President-Elect of the Association for the Advancement of Animal Breeding and Genetics (AAABG)

Cameron Ralph (SARDI) was appointed to a five-member R and D sub-committee for Australasian Pig Research Institute Limited (APRIL). This committee will oversee R and D activities of the general APRIL research committee.

Samantha Chiew (UoM PhD student) was successful in a grant application to the Douglas Houghton Memorial Fund to attend the Course on Animal Welfare Ethics and Law at the University of Cambridge Sept 2017).

Natalie Roadknight (UoM PhD student) was funded by MLA to attend an MLA study tour of New Zealand, speaking and learning about bobby calf management and welfare (December 2017).

Carmen Glanville (UoM honours student) received funding from the Minister/AWAC for her honours project on Duty of care.

Tanya Nowland UoA PhD student) won a Pork CRC award for her oral presentation at the 16th Australasian Pig Science Association Conference in Melbourne. Her paper was titled: Confinement of sows at parturition increases the incidence of behaviours thought to indicate pain.

Jemma Seyfang (UoA PhD student) won the University of Adelaide 3 Minute thesis competition and competed in the Asia-Pacific 3 minute thesis semi-finals at The University of Queensland where she finished in the top 10.

Cameron Ralph (SARDI) was re-elected as Secretary of the Australasian Pig Science Association

Robyn Terry (SARDI) was re-elected to the ordinary committee of the Australasian Pig Science Association

Grahame Coleman (UoM) presented an invited paper, "ProHand Pigs and exploring how the attitudes and beliefs of the caretaker can impact the well-being of the pig" at the National Pork Board Swine Welfare Symposium in Des Moines in November. Over 150 attendees from research, government, industry and NGOs were present.

Jean-Loup Rault (UoM, currently Professor of Animal Welfare at the University of Veterinary Medicine, Vienna) presented an invited paper, "What do pigs want, like or dislike, and how do we find out?" at the National Pork Board Swine Welfare Symposium in Des Moines in November. Over 150 attendees from research, government, industry and NGOs were present.

Paul Hemsworth (UoM) presented an invited paper, "Application of research to improve performance and welfare of group-housed sows" at the National Pork Board Swine Welfare

Symposium in Des Moines in November. Over 150 attendees from research, government, industry and NGOs were present.

Andrew Fisher presented an invited paper, "Welfare assessment toolkits" to the annual Science Week conference of the Australian and New Zealand College of Veterinary Scientists. Over 60 veterinarians from Australia and New Zealand with an interest in animal welfare were present.

Cameron Ralph (SARDI) was co-author of an invited review, "Neurophysiological assessment of animal welfare" at the 16th Biennial Conference of the Australasian Pig Science Association in Melbourne in November. Over 300 attendees from research, government, industry and NGOs were present.

Lauren Edwards wrote an article on pig handling which was published on The Pig Site - www.thepigsite.com/articles/5398/the-effects-of-poor-handling-on-pig-welfare-and-productivity/

2016

Jeremy Skuse was invited by Australian Pork Limited to the Pan-Pacific Pork Expo in May in order to update pork producers on the revised ProHand Pigs and Pork Abattoir stockperson training programs. As a result, over 80 stockpeople have registered to undertake this on-line training.

Paul Hemsworth attended the Dairy Research Foundation's 2016 symposium in Wagga Wagga in June and gave a presentation – "Influence of intensification on animal welfare: implications for dairy cow welfare".

Jean-Loup Rault interviewed on ABC Radio National "Sunday Extra" on 15 May. He discussed oxytocin secretion in pigs and how it relates to social contact. (http://mpegmedia.abc.net.au/rn/podcast/2016/05/sra_20160515_0730.mp3). This interview followed on from an article on the University of Melbourne's "Pursuit" web site in April. (<https://pursuit.unimelb.edu.au/articles/breaking-pigs-like-cuddles-too>)

Jean-Loup Rault was featured on the University of Melbourne's "Pursuit" web site in April. His article addressed the need to ensure that science informs the current debate surrounding free-range egg production. The article, (<https://pursuit.unimelb.edu.au/articles/free-range-debate-skips-the-science-of-animal-welfare>), led to similar pieces in the Herald sun and Telegraph.

Rebecca Doyle took part in a documentary to screen on SBS later in year on pork value chain. Spoke about pig cognition.

Rebecca Doyle was interviewed in February by "The Age" in relation to sheep cognition (<http://www.theage.com.au/victoria/ewes-20kilometre-journey-home-after-two-years-on-the-lam-20160205-gmmoz0.html>)

Jean-Loup Rault and Paul Hemsworth met with Productivity Commission (PC) 22nd April and the AWSC Vic made a submission to the PC - "Addressing ethical dilemmas in producing food and fibre: achieving a well-informed community and rational discussions." (Appendix B)

Ellen Jongman, Andrew Fisher and David Beggs met with DA in June to discuss AWSC / DA relationship. It was resolved that a workshop should be planned which will bring together core scientists working in the dairy RD&E sector.

Paul Hemsworth and Andrew Fisher attended the Dairy Moving Forward Steering committee meeting in March.

Paul Hemsworth attended the Australian Pork Limited Production and Welfare Steering Group meeting in February.

Paul Hemsworth attended the March meeting of the National Primary Industries' Animal Welfare RD&E Strategy. The Committee approved funding of an Animal Welfare RD&E Capability audit, which will report to the Committee in December 2016.

Paul Hemsworth attended 2 meetings of the Animal Welfare Advisory Committee.

Jeremy Skuse attended the February meeting of the Research & Innovation Committee and presented on behalf of the National Primary Industries' Animal Welfare RD&E Strategy.

Jeremy Skuse was an invited speaker at the Taiwan Animal Welfare Symposium in November. 98 participants attended the symposium. His presentation was "The development of welfare assessment in the Australian pork industry".

Megan Verdon presented in October at the Merck High Quality Pork Congress in the Philippines. Presentation "Animal Welfare - what, why and how?" 120 attendees.

Sarah Chaplin presented at the October AVA Dairy Days conference in Shepparton. Approximately 60 attendees. Her presentation was "Global trends in animal welfare and social licence to farm".

Jeremy Skuse presented on ProHand at APL Roadshow in Shepparton in October.

The ISAE regional meeting was held in Auckland in October. Rebecca Doyle retired as Hon. Sec and Carolina Munoz, Andrew Fisher and Sarah Kuyken presented papers.

Rebecca Doyle appeared on episode 2 of SBS program 'For the love of meat'. She demonstrated pig cognition using the mirror test. The program aired in October.

Grahame Coleman presented at the First International Conference on Human Behaviour Change for Animal Welfare, Dorking, UK. In September. His presentation was entitled "Behaviour Change for Stockpeople in the Livestock Industries".

<https://www.youtube.com/watch?v=C-lxpwu6bdk>

Jeremy Skuse presented on ProHand at APL Roadshow in Tanunda in September.

The Launch of expanded AWSC was held in Adelaide in July. Minister Hunter represented the South Australian Govt, Greg Harper represented DEDJTR, Brian Leury represented the University of Melbourne and Phil Hynd represented the University of Adelaide.

Paul Hemsworth, Grahame Coleman, Rebecca Doyle, Carolina Munoz, Jeremy Skuse and Maxine Rice attended and presented at the Australian Society of Animal Production conference in Adelaide in July.

Paul Hemsworth was an invited speaker at International Conference on Animal Welfare in Harbin, China and Swine and Poultry Development and Welfare meeting in July at Wuhan, China. His presentations were on "Good sow welfare practices". 220 and 40 attendees respectively.

Scientists and students attended the 50th ISAE Conference in Edinburgh in July. Mark Learmonth, Carolina Munoz, Peta Taylor, Jean-Loup Rault, Ellen Jongman, Samantha Chiew, Grahame Coleman, Lauren Hemsworth, Hannah Larsen and Andrew Fisher presented papers.

Paul Hemsworth participated in the Pork CRC R&D review meeting at the Park Royal, Melbourne Airport, 10 August, 2016.

Paul Hemsworth and Grahame Coleman conducted an industry sponsored ProHand Pig 'train the trainer' session for pork industry trainers and advisers, Park Royal, Melbourne Airport, 29 September 2016.

Scientists and students met with Lizzie Blandtorn (member for Pacoe Vale and Minister's Ambassador for Animal Welfare) on the 6th September 2016 to review the Animal Welfare Science Centre RD&E programs and discuss developing animal welfare issues.

Grahame Coleman and Ellen Jongman met with Dairy Australia in October to talk about public perception of welfare issues in the dairy industry.

Jean-Loup Rault was awarded the International Society of Applied Ethology Early (ISAE) Researcher Award in July at the 50th ISAE Conference in Edinburgh

Peta Taylor received third prize in the Student Presentation competition at ASAP in Adelaide in July.

Andrew Fisher, Paul Hemsworth, Ellen Jongman and Jeremy Skuse met with representatives of Parmalat in October to brief the company on the Centre's RD&E in the dairy sector. Parmalat will support an application to the Gardiner Foundation for a PhD project which aims to measure the health and welfare status of bobby calves within the supply chain, and to identify variations in calf hydration, glucose levels, and colostral immunity in relation to breed, bodyweight, time off feed and transport distance. Parmalat are also supportive of a proposed revision to ProHand Dairy Cows.

Jeremy Skuse, Grahame Coleman and Paul Hemsworth met with Dairy Australia to discuss updating and commercializing of ProHand Dairy.

AWSC VIC organized and hosted the Inaugural Aus/NZ Animal Welfare Judging Competition with support from the AVA - Jean-Loup Rault, Rebecca Doyle, Andrew Fisher and Bronwyn Stevens. The event was conducted at the University of Melbourne in September. Teams from The University of Adelaide, Charles Sturt University and The University of Melbourne competed, with The University of Melbourne declared as the winning team.

Paul Hemsworth and Jeremy Skuse met with Commonwealth Chief Vet, Mark Schipp to determine the level of support the Commonwealth will provide to the OIE Collaborating Centre for Animal Welfare Science and Bioethical Analysis – The David Bayvel Consortium and to offer AWSC support if needed.

The AWSC hosted two visitors in November, Prof Jim Kinder (The Ohio State University) to discuss the roll-out of ProHand Pigs in N America and Prof Dan Weary (University of British Columbia) to discuss issues surrounding the intensification of dairy cow management and lameness in dairy cows.

Jean-Loup Raul visited Thailand in September and met with Bettagro to discuss areas of common interest in pig welfare RD&E.

In September, Andrew Fisher hosted a visiting delegation from the Chinese Ministry of Agriculture and Meat Research Centre, and presented on the Centre and its activities.

Jeremy Skuse facilitated the provision of the 6th National Primary Industries Animal Welfare RD&E Forum at Attwood in August. The Forum focused on animal welfare issues over the next 10 years. 88 attendees.

2015

The AWSC admitted 2 new partners in July 2015. The University of Adelaide and The South Australian Research and Development Institute will greatly enhance the AWSCs capability to conduct animal welfare RD&E in all animal sectors.

The AWSC has commissioned an external, independent review of its performance; the recommendations of the review committee will be available in June 2015.

Professor Grahame Coleman joined the University of Melbourne from January 2013 as Professor of human - animal relationships.

Dr. Ellen Jongman joined the University of Melbourne as Research Fellow on a 3 year contract funded by EcoDev dairy and Lamb welfare projects.

Dr. Rebecca Doyle joined the University of Melbourne as a research fellow. Her position is jointly funded by the University of Melbourne, Meat and Livestock Australia and Department of Environment and Primary Industries.

The AWSC was contracted to provide 0.25FTE Executive support to the National Animal Welfare RD&E strategy. This strategy is a component of the National Primary Industries RD&E Framework, an initiative of the Primary Industries Ministerial Council (PIMC) and delivers animal welfare research, development and extension programs in the primary industries sector which are, nationally significant, high priority and cross-sectoral in application.

The AWSC convened welfare RD&E planning workshops for pork, poultry, dairy and sheep (inc lamb). The workshops will inform AWSC RD&E activities in these sectors.

May 2015 – Hemsforth, Pork CRC project – group housing of sows, on-line at GetFarming.com.au and Pigprogress.net

http://www.getfarming.com.au/pages/farming/articles_view.php?fld=9200020150421172145

<http://www.pigprogress.net/Breeding/Housing/2015/5/Group-housed-sows-adapt-to-mixing-shows-study-1760113W/>

May 2015 Rault - Multiple media reports re. Robotic Dogs (Rault, J-L. (2015). Pets in the digital era: live, robot or virtual? Front. Vet. Sci. doi: 10.3389/fvets.2015.00011). Included print (Age etc), on-line and radio interviews including ABC 774 Melbourne.

<https://www.theage.com.au/technology/robotic-pet-ownership-to-rise-in-an-overpopulated-world-professor-says-20150512-ggzrd8.html>

Attachment 1 – AWSC RD&E Priorities

AWSC RD&E priority planning session

4 Dec 2019

The AWSC conducted a workshop to examine RD&E priorities across animal use sectors.

Attendees:

AgVic

Ralph Behrendt, Kym Butler, Sarah Chaplin, Matt Knight, Iona Mcleod, Shyuan Seah

AWSC UoM

Lauren Edwards, Andrew Fisher, Lauren Hemsworth, Ellen Jongman, Carolina Munoz, Jeremy Skuse, Leigh Atkinson, Sam Chiew, Prabal Chowdhury, Sammie Cramer, Laura Field, Carmen Glanville, Belinda Hall, Megan Hayes, Maria Jorquera, Mark Learmonth, Lydia Rehnsberg, Maxine Rice, Natalie Roadknight, Jess Taylor, Natarsha Williams, Madeleine Woodruff, Leonie-Iva Pawlak

Chair

Andrew Fisher

Discussion

Andrew Fisher -

Northern Beef

- Fertility control to obviate spaying
- Pain relief for castration & dehorning
- Transport
- Welfare monitoring?

Southern Beef

- Pain relief for castration
- Welfare benchmarking/auditing

Feedlot

- Welfare benchmarking / auditing

Discussion

Transport is seen as increasingly important as a reduction in abattoirs leads to longer distances travelled. Transport is a very visible part of the industry. The industry should note the driver and truck accreditation scheme in NZ.

Welfare issues are arising as industry attempts to manage the effects of drought and climate change. In particular calf losses should be investigated and RD&E to mitigate these losses should be considered.

Australia needs to be proactive with regard to its duty of care to animals throughout the live export supply chain. There needs to be a recognition that live export is a factor in different species and supply chains and the AWSC needs to work in this space to improve the welfare of animals in these chains. In particular, AWSC should capitalise on its strengths to improve handling across the chains.

Key Areas for AWSC in Beef

- **Transport and handling.**
- **Practical Welfare assessment and benchmarking.**
- **Investigate calf losses in beef production systems.**

Dairy

- Social licence under threat at the same time as farmers under financial pressure
- Alternate sources of RD&E funding?
- Cow-calf contact
- Bobby calves
- Cow quality of life
 - Lameness
 - Mastitis
 - Longevity & Cull cows

DMF Animal Husbandry Steering Group
Issue analysis May 2017

**DAIRY
MOVING
FORWARD** >>>

Issues	Practice area	Average	Range (max-min)
Bobby calf numbers and disposal	Calf rearing	4.00	0.00
Cow calf separation	Breeding	4.00	0.00
Euthanasia of livestock	Animal handling	3.58	1.00
Disbudding	Calf rearing	3.47	1.00
Down cows	Health	3.44	2.00
Lameness	Health	3.42	2.00
Tail docking	Calf rearing	3.33	2.00
Induction	Breeding	3.30	2.00
Heat stress	Environment	3.17	2.00
Recognition of need for pain relief	Pain management	3.17	2.00
Clinical mastitis	Health	2.97	2.00
Animal handling skills	Animal handling	2.81	2.00
Access to affordable drugs and veterinary services	Pain management	2.78	2.00
Antibiotic usage	Health	2.72	3.00
Reduced longevity	Breeding	2.72	3.00
Body condition	Nutrition	2.72	2.00
Sub-optimal feeding of heifers and transition cows	Nutrition	2.69	1.25

Discussion

Heat stress and the effects of climate change are factors which not only affect productivity but also affect the cow's quality of life. Ongoing research in this area should focus on heat tolerance.

Environmental enrichment is not seen as a high priority, but research needs to be developed which will enable tools to measure the affective state of dairy cows.

The practice of on-demand feeding of calves might be investigated from an enrichment point of view.

Research should be considered which looks at the use of "Shade sheds / Compost barns" where cows have access to pasture in the morning but then have free choice to access shelter.

Dairy cows are often transported in stock crates which are designed for smaller beef cattle which results in bruising and carcass damage to the back.

Intensification is often a positive for AW as it allows for specialisation and training of staff, engagement of consultants etc, but the impact of longer distances walked each day by cows and the amount of time spent in the yard needs to be investigated.

Need to be aware of developments in marketing with regard to dairy beef.

Cow welfare benchmarking will probably be driven for competitive advantage by processors / retailers.

Key Areas for AWSC in Dairy

- **Cow/calf contact including bobby calves.**
- **Investigate time budgets in relation to herd size.**
- **Development of measures to determine affective state and develop practical welfare assessment and benchmarking programs.**
- **Effect of heat stress on cow welfare and assessment of measures to mitigate heat stress.**

Carolina Munoz - Sheep

- **Manage pain associated with procedures in short term**
- **Replace painful and aversive husbandry procedures in long term**
- **Welfare assessment and Benchmarking**
 - **Physiological/behavioural parameters, biomarkers, remote sensing/monitoring**
 - **Establish a livestock wellbeing benchmark**
- **Manage Predators (dogs, foxes)**
- **Community perceptions**
- **Improve lamb survival**
- **Improve handling and facilities in transport and at the abattoir**
- **Address barriers to adoption of improved practices**

Discussion

Need to consider the use of drones to monitor sheep welfare.

New technologies are being investigated which can block semen transport.

The area of climate change and heat stress is of great importance and the effect on animal welfare and productivity of mitigating strategies (eg shelter) needs to be studied.

Development of valid welfare assessment tools is of increasing importance – for example the validation of panting indices, indicators of lameness etc

Barriers to adoption is important and the development of strategies to increase farmer uptake of improved technologies / management practices needs to be a focus (e.g. tail length)

Lamb mortality is an area which does not yet have the public eye – it is important to continue to work on strategies to improve lamb survival.

Key Areas for AWSC in Sheep

- **Develop practical and valid welfare assessment and benchmarking programs.**
- **Develop packages to improve sheep handling throughout the chain.**
- **Development of strategies to increase farmer uptake of improved technologies / management practices.**
- **Develop strategies to improve lamb survival.**
- **Community and farmer attitudes to sheep meat / wool production.**

Ellen Jongman -

Chicken Meat

- **Stocking density (incl multiple pick-ups, litter and air quality, heat stress)**
- **Environmental enrichment and range use (lack of use)**
- **Growth rate (skeletal deformities, ascites, feed restriction, different breeds)**
- **Slaughter methods (including whole house euthanasia with CO2 and water-based foam)**
- **Broiler breeders**

Discussion

Consider an AgriFutures call for work in the area of mass depopulation.

Welfare auditing is likely to be driven by PrimeSafe or retailers.

Need to look at strategies to influence industry's uptake of slower growing strains.

Key Areas for AWSC in Chicken Meat

- Develop practical and valid welfare assessment and benchmarking programs.
- Develop packages to improve chicken handling throughout the chain.

Laying Hens

- **Cages, furnishing / enrichment**
- **Range design and use**
- **Free range mortality rates (incl smothering)**
- **Beak trimming / feather pecking**
- **Slaughter/euthanasia**

Discussion

Measure community attitudes towards the culling of male chicks.

Consider the in-house slaughter of spent hens as opposed to transport to abattoir.

Assess the risks and benefits to chicken welfare of mobile laying units (chicken tractors). Heat stress and other climatic factors may pose a risk to welfare.

Key Areas for AWSC in Laying Hens

- Develop practical and valid welfare assessment and benchmarking programs – these will feed into all housing systems
- Develop a risk analysis for housing systems, including mobile laying units
- Develop packages to improve chicken handling throughout the chain.

Lauren Hemsworth –

Pigs

INDUSTRY -

African Swine Fever (AFS)

- **Mass euthanasia of sick/infected pigs**
 - **Euthanasia on welfare grounds (stock standstill, disruption of feed delivery)**
 - **Public attitudes**
- **Continuous improvement**

- **Elimination of the need for tail-docking of piglets: understanding the causal factors and interactions that contribute to tail biting in order to eliminate or manage factors**
- **Farrowing and lactation: optimizing sow welfare in farrowing crates; improving piglet survival in alternative systems**
- **Reducing antimicrobials: reducing in-feed medication**
- **Improving heat tolerance/resilience**
- **Development of real-time monitoring and surveillance technologies under commercial conditions: monitoring environment, performance, feed consumption, and health and welfare of pigs; early detection of health and welfare challenges**

AWSC

- **Early experience: the effect of housing and handling on animal welfare, stress resilience and productivity**
 - **current ARC LP project 'Early life stress and subsequent stress resilience and emotionality in pigs'**
 - **traditional vs alternative systems: behavioural differences (fear of novelty and humans)**
- **Eliminating the need for tail-docking: understanding the causal factors and interactions contributing to tail biting in Australasian pig production systems**
 - **APRIL Tails CRCP under development**
- **Remote monitoring technology: monitoring animal behaviour, health and welfare (early detection)**

Discussion

The work on early experiences is important and the effects of human contact on stress resilience / productivity AND as an enricher should continue to be studied.

Elimination of surgical procedures is important and the proposed work on tail biting is of international significance.

Work should be considered on development of practical, welfare friendly methods of on-farm euthanasia – these methods need to be accepted by public and stockpeople.

Environmental enrichment is an area of increasing importance as barren environments do not look good to community.

Key Areas for AWSC in Pigs

- Continue to develop research programs to eliminate the practice of tail docking
- Develop practical, effective enrichments and assess the effectiveness of current "enrichments".
- Work with key collaborators to develop novel, valid monitors of animal behaviour, health and welfare
- Work to improve piglet survival outcomes for alternative farrowing accommodation
- Develop programs / strategies to improve adoption of SOPs by stockpeople.

Zoo animal

Industry

- **Keeper-animal relationships**
- **Better understanding time budgets (trailing different methodologies to allow keeper-collected data)**
- **Addressing abnormal repetitive behaviours**
- **Evaluating enrichment programs**
- **Fish welfare assessment**
- **Reptile welfare assessment**
- **Using technology to give animals more control over their environments**
- **Interface between animal welfare science and conservation biology**
- **The impact of training programs on animal welfare**

AWSC

- **Human-animal relationship (HAR): understanding the relationship between keeper attributes (beliefs/attitudes and behaviour) and animal welfare (behaviour and physiology)**
 - **Meerkat model: ARC LP 2020 application under development 'Zookeeper-zoo animal relationships: A model to improve zoo animal welfare'**
- **Animal welfare monitoring**
 - **time budgets of behaviour**
 - **daily behaviour monitoring**
- **Animal welfare assessment: fish**
- **Environmental enrichment**
- **Public attitudes**
 - **close encounters**

Discussion

Develop recommendations with regard to what animals are unsuitable for a zoo environment.

Look at assessing community attitudes to culling zoo animals.

Research should be conducted with multiple zoos as there seem to be subtle differences in enclosure design which may have a marked effect on animal behaviour and welfare.

Translation of research outputs and effective dissemination / engagement to / with non-English speaking zoos / countries is of paramount importance and should be considered in project proposals.

Key Areas for AWSC in Zoos

- Continue to develop research programs focusing on the keeper – animal relationship
- Assess the effectiveness of current “enrichments”.
- Monitor public attitudes to zoos – in particular to close encounters and culling.
- Work to develop novel methods of welfare monitoring.

Companion Animal Industry

Animal Welfare Victoria: Animal Welfare Strategy Victoria

- **Action Area 3: Education – Responsible Pet Ownership**
 - Provide communication and training on animal welfare to improve knowledge, attitudes and behaviours ('Better for Pets', Living Safely with Dogs Program)
- **Action Area 4: Compliance and enforcement**
 - Improve compliance through behavioural change

RSPCA Victoria

- **Prevention: safeguarding animal welfare**
- **Animal welfare assessment and monitoring in animal shelters: dogs and cats**
- **Length of stay: behaviour, health and welfare implications**

AWSC

- **Human-animal relationship (HAR): understanding the relationship between owner attributes (beliefs/attitudes and behaviour) and animal welfare (behaviour and physiology) – safeguarding animal welfare**
 - **Dog model: ARC LP 2020 application under development 'The Pet Care Competency Program: protecting dogs by changing mindsets'**
 - **problem behaviours, socialization, obesity**
- **Animal welfare assessment and monitoring in animal shelters**
 - **collaboration with RSPCA VIC to develop animal welfare assessment tool for dogs and cats**
- **Indoor cats: meeting the needs of a cat in an indoor environment**
 - **transitioning cats to 'indoor' living**
- **Working dogs**
 - **understanding the effect of housing and handling (training) on animal welfare**
 - **public attitudes**

Discussion

Difficult to get funding in this area; State & RSPCA Vic are contributing cash and in-kind to an ARC LP proposal. Pharmaceutical companies should be approached (Boehringer).

Little is known about transitioning cats from outdoor living to indoor living

Semi-owned cats are a huge problem – AWSC previously contributed to the "Who's for cats?" campaign. The volume of cats entering shelters is overwhelming.

Why do people continue to make poor choices when purchasing a dog? – i.e. poor breed choices.

Punishment-based dog training is a problem and perhaps AWSC should develop/promote "best practice" dog training.

Look at success factors in re-homing racehorses.

Drought is having an effect on horse welfare, perhaps enlist pony clubs to get messages across to the rec horse owner.

Investigate the practice of “cosmetic” surgery in horses which is performed to improve a horse’s compliance with standards.

Pocket pets and reptiles are an area of growing importance and there is little information in relation to safeguarding their welfare.

Key Areas for AWSC in Companion animals

- Continue to develop programs focusing on the human – animal relationship.
- Develop programs which promote “duty of care”.
- Work to develop novel methods of welfare monitoring in shelters.
- Work on programs which assist in transitioning cats from outdoor to indoor living.
- Work to understand the effect of housing and handling (training) on animal welfare

Cross-sector / other

Discussion

Development of effective, humane pest control methods

The welfare of males in artificial breeding centres is a poorly understood area

We should not forget the welfare of animals in research and teaching and should be responsive to requests for work in this area

Work on close encounters should not be restricted to the zoo sector – should also include static and mobile petting zoos and reptile shows.