



ANIMAL WELFARE  
SCIENCE CENTRE

# **THE ANIMAL WELFARE SCIENCE CENTRE ANNUAL REPORT 2018-2019**

## Contents

Background .....	2
Staff of the Centre.....	4
Postgraduate students.....	6
Board of Management .....	6
AWSC Representation on committees in a technical/advisory capacity .....	7
Summary of Centre RD&E projects and 2018/19 project funding.....	8
Significant collaboration.....	14
Centre RD&E Communications .....	15
Animal Welfare Science Centre Seminars.....	18

## Background

The Centre has two 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).

This year, the AWSC has 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.

## 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 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.

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"

## **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.

## Centre personnel

### Staff of the Centre (VIC Node)

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.

## Post-doctoral research fellow

**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.

## Supporting scientists

**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 is 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.

**Asst Prof. Katy Proudfoot** (Dept. of Veterinary Preventive Medicine, The Ohio State University) - Specialises in animal welfare and behavior in farm animals, with a focus on dairy cow management and housing.

**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

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

**Tracie Storey**, 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.

**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.

**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.

**Carolina Munoz** (UOM) - Assessing and addressing on-farm sheep welfare.

**Monoar Sayeed Pallab** (UOM) - The assessment and management of calf health and welfare in dairy systems.

**Lydia Rehnberg** (UOM) - Working within the ARC Linkage Project, Human-animal relationships in zoos: Optimising animal and visitor experiences.

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

**Natalie Roadknight** (UOM) - Bobby calf welfare.

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

## 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**

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



## Summary of major Centre RD&E projects and 2018/19 project funding if applicable

2018/19 External and internal cash funding - \$ 1,304,739

### 1. Dairy sector

#### 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)

Student: Gabriela Marquett

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

2018/19 – €22,000

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. Bobby calf welfare

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

Student: N. Roadknight

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

2018/19 – \$ 22,438

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.

## 2. Pork sector

### 2.1. **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

2018/19 - \$ na

Commencement date: 2017

Completion date: 2018

A global review of the international scientific literature around pig welfare was completed. The review, funded by Australian Pork Limited provides recommendations and future research suggestions for welfare issues relevant to the Australian pig industry ahead of the development of new Australian Animal Welfare Standards and Guidelines for Pigs.

### 2.2. **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)

Student: M. Hayes

Funding: Australian Research Council – Linkage Program

2018/19 - \$ n/a

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.

### 2.3. **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

2018/19 - \$ 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.

## **2.4. ProHand® Pigs and Pork Abattoir**

Investigators: J. Skuse, S. Moeller, P.Hemsworth and G. Coleman  
Funding: n/a

Commencement date: 2012  
Completion date: ongoing

Research in both experimental and commercial settings demonstrate that stockperson characteristics, such as attitudes and handling behaviour, affect fear responses in farm animals, which through acute and chronic stress, can seriously limit farm animal welfare. The ProHand® training programs, which were originally developed by Australian Pork Limited and the AWSC, use cognitive-behavioural training, in which the key attitudes and behaviour of stockpeople are targeted for improvement. Studies in the dairy and pig industries have shown that cognitive-behavioural training can successfully improve the attitudes and behaviour of stockpeople towards their animals, with consequent beneficial effects on animal fear, stress, productivity and meat quality. ProHand® is an on-line training program which is offered by Australian Pork Limited to farm and abattoir stockpeople working in the Australian and New Zealand pork industries. The on-line program was developed by the AWSC in collaboration with the Temple Grandin with funding from Australian Pork Limited and the Australian Meat Processor Corporation. The program has been successfully trialed in North America prior to a planned release in the United States.

## **3. Sheep/cattle sector**

### **3.1. Identifying public and producer attitudes to sheep and cattle animal welfare to inform education strategies**

Investigators: G. Coleman, P. Hemsworth, L. Hemsworth, M.Rice  
Funding: Animal Welfare Strategic Partnership Program  
2018/19 - \$ 155,081  
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. Poultry sector

### 4.1. What causes smothering in commercial free-range laying hens

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

Student: M. Rice

Funding: Australian Eggs Ltd  
2018/19 - \$ 154,306

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.

### 4.2. Animal welfare and values

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

Funding: Australian Eggs Ltd  
2018/19 - \$ 99,579

Commencement date: 2018

Completion date: 2019

This project is working with 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 will conclude in 2019.

### **4.3. Hen welfare literature review**

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

Funding: Australian Eggs Ltd  
2018/19 - \$ 102,000

Commencement date: 2018

Completion date: 2019

This project will conduct 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 will involve major collaboration from prominent Australian poultry researchers and veterinarians.

## **5. Companion, zoo, sport and work animals**

### **5.1. Duty of care to companion animals**

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

Students: C. Glanville

Funding: \$ n/a

Commencement date: 2018

Completion date: 2021

This project which is being conducted in conjunction with RSPCA Victoria has the following objectives:

1. Gain a qualitative understanding of the cognitive elements of duty of care, including the salient values, beliefs, and attitudes in Victorian companion animal carers, particularly those that abuse, neglect, or mistreat their animals.
2. Develop a range of targeted intervention messages and appropriate delivery methods.
3. Test the effectiveness of intervention messages and methods to form the basis of an extensive evidence-based behaviour change program.

## 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  
2018/19 - \$ 104,665  
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 will develop and refine a tool to monitor public perceptions and sources of knowledge in relation to the livestock industries and livestock welfare over time.

### 6.2. Animal Welfare Science Centre

Investigators: A. Fisher, J. Skuse  
Funding: Victorian Department of Jobs, Precincts and Regions.  
Agriculture Victoria Research Division and The University of Melbourne  
2018/19 - \$ 194,649  
Commencement date: 2015  
Completion date: 2020

This project supports the operation of the AWSC to deliver services to the AWSC board in its governance activities, effectively communicate the work of the AWSC in providing independent, authoritative scientific knowledge and advice to government, industry and the community and maintain a reliable, independent and accessible knowledge resource. The project also supports the AWSC's program of Industry Education & Training.

### 6.3. Executive Support, National Primary Industries Animal Welfare RD&E Strategy (NAWRDE)

Investigators: J. Skuse  
Funding: NAWRDE  
2018/19 - \$ 59,878  
Commencement date: 2012  
Completion date: 2020

This project supports the Executive function for the NAWRDE and includes the provision of the Annual NAWRDE Forum, the eighth of which was held in Melbourne in November 2018.

#### **6.4. 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  
2018/19 - \$ 308,000  
Commencement date: 2018  
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.

### **Significant collaboration**

#### **Gap evaluation of pain alleviation research**

Investigators: A. Small (CSIRO), I. Colditz (CSIRO), A. Fisher.  
Funding: Australian Wool Innovation  
2018/19 - \$ 20,000  
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.

### **Final reports**

**Australian Research Council. Linkage Project LP140100373.** *Human-animal relationships in zoos: optimising animal and visitor experiences.* Hemsworth, P.H.

**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.

**Australian Eggs Ltd. Project 1HS905.** *Hen welfare literature review.* Hemsworth, P.H.

**Australian Eggs Ltd. Project 1HS904.** *Animal welfare and values.* Fisher, A.D., Hemsworth, P.H., Ankeny, R.A., Millar, H. and Acharya, R.

**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.

### 1.a Research publication in refereed journals

1. **Aleri, J.W.**, Hine, B.C., Pyman, M.F., Wales, W.J., Mallard, B., Stevenson, M.A. and **Fisher, A.D.** (2019). Associations between immune competence, stress responsiveness, and production in Holstein-Friesian and Holstein-Friesian x Jersey heifers reared in a pasture-based production system in Australia. *J. Dairy Sci.* 2019 Apr;102(4):3282-3294. <https://doi.org/10.3168/jds.2018-14578>
2. **Beggs, D.S.**, **Jongman, E.C.**, **Hemsworth, P.H.** and **Fisher, A.D.** (2019). The effects of herd size on the welfare of dairy cows in a pasture-based system using animal- and resource-based indicators. *J. Dairy Sci.* 2019 Apr;102(4):3406-3420. <https://doi.org/10.3168/jds.2018-14850>
3. **Beggs, D.S.**, **Jongman, E.C.**, **Hemsworth, P.H.** and **Fisher, A.D.** (2019). Lameness in Australian dairy farms: A comparison of farmer-identified lameness and formal lameness scoring, and the position of lame cows within the milking order. *J. Dairy Sci.* 2019 Feb; 102(2): 1522-1529. <https://doi.org/10.3168/jds.2018-14847>
4. **Beggs, D.S.**, **Jongman, E.C.**, **Hemsworth, P.H.** and **Fisher, A.D.** (2018). Implications of prolonged milking time on time budgets and lying behavior of cows in large pasture-based dairy herds. *J. Dairy Sci.* 101: 10391–10397. <https://doi.org/10.3168/jds.2018-15049>
5. Burkemper, M.C., Pairis-Garcia, M.D., Moraes, L.E., Park, R.M. and **Moeller, S.J.** (2019). Effects of Oral Meloxicam and Topical Lidocaine on Pain associated Behaviors of Piglets Undergoing Surgical Castration. *Journal of Applied Animal Welfare Science.* <https://doi.org/10.1080/10888705.2019.1590717>
6. Campler M.R., Pairis-Garcia M.D., Kieffer J. and **Moeller, S.J.** (2019). Sow behavior and productivity in a small stable group-housing system. *J Swine Health Prod* 2019;27(2):76-86. <https://www.aasv.org/shap/issues/v27n2/v27n2p76.pdf>
7. Campler, M.R. Pairis-Garcia, M.D., Rault, J-L., **Coleman, G.J.** and Arruda, A.G. (2018). Caretaker attitudes toward swine euthanasia, *Translational Animal Science*, Volume 2, Issue 3, 25 July 2018, Pages 254–262. <https://doi.org/10.1093/tas/txy015>
8. **Chiew, S.J.**, **Butler, K.L.**, Sherwen, S.L., **Coleman, G.J.**, Fanson, F.V., **Hemsworth, P.H.** (2019). Effects of regulating visitor viewing proximity and the intensity of visitor behaviour on little penguin (*Eudyptula minor*) behaviour and welfare. *Animals* 9(6), 285. <https://www.mdpi.com/2076-2615/9/6/285>
9. **Coleman, G.J.** (2018). Public animal welfare discussions and outlooks in Australia. *Animal Frontiers*, 8:1 1, 14–19, <https://doi.org/10.1093/af/vfx004>
10. **Edwards, L.E.**, **Coleman, G.J.**, **Butler, K.L.** and **Hemsworth, P.H.** (2019). The human-animal relationship in Australian caged laying hens. *Animals* 2019, 9(5), 211. <https://doi.org/10.3390/ani9050211>
11. Engel, J.M, Widowski, T.M., Tilbrook, A.J., **Butler, K.L.** and **Hemsworth, P.H.** (2018). The effects of floor space and nest box access on the physiology and behavior of caged laying hens. *Poultry Science*, pey378, <https://doi.org/10.3382/ps/pey378>
12. **Hemsworth, P.H.**, **Rice, M.**, **Borg, S.**, **Edwards, L.E.**, Ponnampalam, E.N. and **Coleman, G.J.** (2018). Relationship between handling, behaviour and stress in lambs at abattoirs. *Animal.* <https://doi.org/10.1017/S1751731118002744>
13. **Jorquera-Chavez, M.**, Fuentes, S., Dunshea, F.R., **Jongman, E.C.** and Warner, R.D. (2019). Computer vision and remote sensing to assess physiological responses of cattle to pre-slaughter stress, and its impact on beef quality: A review. *Meat Science*. Vol 156, October 2019, Pages 11-22. <https://doi.org/10.1016/j.meatsci.2019.05.007>
14. **Learmonth, M.J.** (2019). Dilemmas for Natural Living Concepts of Zoo Animal Welfare. *Animals* 2019, 9(6), 318; <https://doi.org/10.3390/ani9060318>



15. **Learmonth, M.J.**, Sherwen, S. and **Hemsworth, P.H.** (2018). The effects of zoo visitors on Quokka (*Setonix brachyurus*) avoidance behavior in a wall-through exhibit. *Zoo Biology* 37, 223-228. <https://doi.org/10.1002/zoo.21433>
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## 1.b Research papers in press

27. Taylor, P.S., **Hemsworth, P.H.**, Groves, P.J., Gebhardt-Henrich, S.G and Rault, J.L. (2019). Frequent range visits further from the 1 shed relates positively to free-range broiler chicken welfare. *Animal* (In press 28/05/19).
28. **Munoz, C.A., Campbell, A.D., Hemsworth, P.H.** and **Doyle, R.E.** (2019). Evaluating the welfare of extensively managed sheep. *PLoS One* (In press 30/05/19)

## 2. Refereed conference publications

29. 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
30. **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.
31. **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.
32. **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.
33. **Coleman G.J.** (2018). Public perceptions of farm animal welfare and their relevance to livestock welfare. 2018 AVA ANNUAL CONFERENCE. Invited speaker.
34. **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.
35. **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.
36. **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.
37. **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.
38. **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.
39. **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.
40. **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.
41. **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.
42. **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.

43. **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.

### 3. Theses

**Taylor, P.S.** The University of Melbourne (2018). Relationships between ranging behaviour and welfare of commercial free-range broiler chickens.

**Larsen, H.** The University of Melbourne (2018). Relationships between range characteristics, ranging behaviour, and welfare of commercial free-range laying hens.

## Animal Welfare Science Centre Seminars

<https://www.animalwelfare-science.net/seminars.html>

### May 2019

#### AWSC Seminar

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

*"Assessing animal affect"*

[pdf](#) [Vimeo presentation](#)

### February 2019

#### AWSC/RSPCA Seminar

Dr. Tad Sonstegard, Chief Scientific Officer, Acceligen and

Dr Laercio Porto-Neto, Research Scientist, CSIRO.

*"Advanced biotechnologies to improve the welfare of farm animals"*

[pdf](#) [Vimeo presentation](#)

#### AWSC Dairy Seminar

Prof. Anne Marie de Passille, Adjunct Professor, University of British Columbia.

*"Why keep calves in groups? Behavioural and welfare aspects"*

[pdf](#) [Vimeo presentation](#)

Prof. Jeff Rushen, Adjunct Professor, University of British Columbia

*"Play behaviour and welfare of dairy calves"*

[pdf](#) [Vimeo presentation](#)

### December 2018

#### AWSC Dairy Seminar

Prof. Dan Weary, University of British Columbia

*"Disentangling separation: bringing new data to the old problem of cow-calf separation"*

[pdf](#) [Vimeo presentation](#)

Dr. David Beggs, AWSC, The University of Melbourne

*"The welfare of cows in large herds"*

[pdf](#) [Vimeo presentation](#)

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

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

### October 2018

#### AWSC/Zoos Victoria Seminar

Mr. Ben Pearson, World Animal Protection

*"Don't get taken for a ride (Animal welfare issues associated with wildlife entertainment)"*

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