



ANIMAL WELFARE
SCIENCE CENTRE

THE ANIMAL WELFARE SCIENCE CENTRE ANNUAL REPORT 2019-2020

Contents

Background	2
Staff of the Centre	4
Postgraduate students	6
Board of Management	7
AWSC Representation on committees in a technical/advisory capacity	8
Summary of Centre RD&E projects and 2019/20 project funding	9
Significant collaboration	12
Centre RD&E Communications	13
Animal Welfare Science Centre Seminars	16

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).

The AWSC through the University of Melbourne has 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.

It was pleasing to see Prof. Paul Hemsworth's contribution to animal welfare science recognised by his award of an Order of Australia (AM) in 2019. Details are available [HERE](#).

The AWSC commissioned an external review in 2020. The review team, Prof. Craig Johnson (Massey University), Dr. Bidda Jones (RSPCA Australia) and Dr. Darryl D'Souza (Sunpork Solutions) met in February and their report can be found on the AWSC website [HERE](#).

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, The University of Queensland (Centre for Animal Welfare and Ethics) and the Commonwealth Department of Agriculture, Water and the Environment are the Australian partners in the OIE Collaborating Centre for Animal Welfare Science and Bioethical Analysis; the David Bayvel Consortium, 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. This Centre 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 Animal Welfare Science 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

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.

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, companion animals and zoo animals.

Prof. Paul Hemsworth (Faculty of Veterinary and Agricultural Sciences, The University of Melbourne) – A research career studying the influence of human behaviour on the behaviour, welfare and productivity of farm animals but more recently the influence of human behaviour on the behaviour and welfare of zoo and companion animals. He has also studied the influence of a wide range of housing and husbandry practices on common behavioural problems and welfare risks in farm animals, particularly pigs, poultry, sheep, and dairy cattle.

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. Carolina Munoz (Faculty of Veterinary & Agricultural Sciences, The University of Melbourne) – Carolina is working within the MLA project examining Mulesing in prime lamb systems and her 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. Mia Cobb (Faculty of Veterinary and Agricultural Sciences, The University of Melbourne) – Honorary Research Fellow. Research explores human attitudes, housing and management practices, animal behaviour, stress physiology and how animal welfare relates to the sustainability of animal-based industries.

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.

Will Coombs, 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.

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

PhD candidates

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

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

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

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

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

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

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

Megan Hayes - Human enrichment in pigs.

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

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

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

Natalie Roadknight - Bobby calf welfare.

Sarah Snyder - The Relationship between Welfare and Hoof Care of Recreational Horses in Australia.

Natarsha Williams - What are the triggers, barriers, attitudes and behaviours that contribute to poor welfare of livestock?

Madeleine Woodruff – How can best practice become normal practice? Using tail docking in sheep as an example.

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
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
Faculty of Veterinary and Agricultural Sciences Human Ethics Advisory Group (HEAG)	Ellen Jongman
Global Agenda for Sustainable Livestock - Animal Welfare Action Network	Rebecca Doyle
Greyhound Racing Victoria Welfare Committee	Grahame Coleman
International Livestock Research Institute Institutional animal care and use committee	Rebecca Doyle
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 Poultry Production Systems	Paul Hemsworth
OIE Collaborating Centre for Animal Welfare Science and Bioethical Analysis Management Committee	Andrew Fisher
Pork Industry Advisory Group for Standards and Guidelines	Paul Hemsworth
Standards Australia technical committee MB-029 Private Security and Detection Dogs (Chair)	Mia Cobb
Swinburne University Postgraduate Applied Statistics Course Advisory Committee.	Kym Butler
The Animal Welfare Collaborative Advisory Panel	Jeremy Skuse
The Lost Dogs Home, Animal Welfare & Ethics Committee	Ellen Jongman
Virtual Herding Project (Rural R&D for Profit programme) Steering Group	Paul Hemsworth
Zoos Victoria Animal Welfare Peer Review Committee	Paul Hemsworth

Summary of major Centre RD&E projects and 2019/20 project funding if applicable

2019/20 External and internal cash funding - \$ 1,195,352

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.

2019/20 – € 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. 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.

2019/20 – \$ 22,437

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. 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

2019/20 - \$ 175,403

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. 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.

The program has been successfully trialled in North America prior to a planned release in North America.

3. Sheep/cattle sector

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

Investigators: A. Fisher, C. Munoz

Funding: Meat and Livestock Australia
2019/20 - \$ 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.

3.2. 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
2019/20 - \$ 396,216 (UOM - \$108k, MLA - \$167k, MDC - \$121k)

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
2019/20 - \$ 118,186

Commencement date: 2018

Completion date: 2021

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.

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

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. 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
2019/20 - \$ 160,138

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.

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

Investigators: J. Skuse
Funding: NAWRDE
2019/20 - \$ 59,878
Commencement date: 2012
Completion date: 2020

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

6.3. 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
2019/20 - \$ 146,315
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
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 included a gap analysis and recommendations as to future research directions.

Centre RD&E Communications

1. Books and book chapters

1. **Skuse, J.M, Hemsworth, P.H.** and Rault, J-L. (2020). Improving human-animal interactions. In: I. Camerlink (Ed.). Pigs: Welfare in Practice. Sheffield: 5m Publishing.

2.a Research publication in refereed journals

2. **Acaralp-Rehnberg, L.K., Coleman, G.J.,** Magrath, M.J.L., Melfi, V., Fanson, K.V. and **Bland, I.M.** (2020). The effect of behind-the-scenes encounters and interactive presentations on the welfare of captive servals (*Leptailurus serval*). *Animals* 2020, 10, 743. <https://doi.org/10.3390/ani10040743>
3. Ashcroft, L., **Cobb, M.,** Bailey, L., Martin, J. and Daniel, S. (2020). 'The Australian Science Communicators conference 2020'. *JCOM* 19 (03), C01. <https://doi.org/10.22323/2.19030301>
4. **Chiew, S.J., Hemsworth, P.H.,** Sherwen, S.L., Melfi, V. and **Coleman, G.J.** (2019). The Effect of Regulating Zoo Visitor-Penguin Interactions on Zoo Visitor Attitudes. *Front.Psych*, 10, p2351. <https://doi.org/10.3389/fpsyg.2019.02351>
5. **Cobb, M.L.** and Bennett, P.C. (2020). Not all dogs are equal: perception of canine welfare varies with context. *Animal Welfare*, Volume 29, Number 1, January 2020, pp. 27-35(9). <https://doi.org/10.7120/09627286.29.1.027>
6. **Cramer, S.R., Munoz, C.A.,** McGill, D.M., **Rice, M., and Doyle, R.E.** (2020). Investigating the effect of pen shape and pen size on group flight distance of extensively managed ewes. *App An Behav Sci.* 222 104887. <https://doi.org/10.1016/j.applanim.2019.104887>
7. **Edwards, L.E,** Plush, K. J., Ralph, C. R., Morrison, R. S., **Acharya, R. Y. and Doyle, R. E.** (2019). Enrichment with lucerne hay improves sow maternal behaviour and improves piglet survival. *Animals* 9, 558. <https://doi.org/10.3390/ani9080558>
8. **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>
9. Engel, J.M, Widowski, T.M., Tilbrook, A.J., **Butler, K.L. and Hemsworth, P.H.** (2019). 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>
10. Fawcett, A., Hazel, S., Collins, T., Degeling, C., **Fisher, A.,** Freire, R., Hood, J., Johnson, J., Lloyd, J., Phillips, C., Stafford, K., Tzioumis, V. and McGreevy, P. (2019). Australian and New Zealand Veterinary Students' Opinions on Animal Welfare and Ethical Issues Concerning Animal Use within Sport, Recreation, and Display. *Journal of Veterinary Medical Education* 46: 264-272. <https://doi.org/10.3138/jvme.0717-086r>
11. **Glanville, C.,** Ford, J. and **Coleman, G.J.** (2019). Animal Cruelty and Neglect: Prevalence and Community Actions in Victoria, Australia. *Animals* 2019, 9, 1121. <https://doi.org/10.3390/ani912112>
12. Howell, T.J., McLeod, E.M. and **Coleman, G.J.** (2019). When zoo visitors “connect” with a zoo animal, what does that mean? *Zoo Biology.* 2019; 1– 10. <https://doi.org/10.1002/zoo.21509>
13. **Jongman, E.C., Conley, M.J., Borg, S., Butler, K.L. and Fisher, A.D.** (2020). The effect of milk quantity and feeding frequency on calf growth and behaviour. *Animal Production Science.* <https://doi.org/10.1071/AN19049>
14. **Jorquera-Chavez, M.,** Fuentes, S., Dunshea, F.R., Warner, R.D., Poblete, T., Morrison, R.S. and **Jongman, E.C.** (2020). Remotely Sensed Imagery for Early Detection of Respiratory Disease in Pigs: A Pilot Study. *Animals* 2020, 10, 451. <https://doi.org/10.3390/ani10030451>
15. **Jorquera-Chavez, M.,** Fuentes, S., Dunshea, F.R., Warner, R.D., Poblete, T. and **Jongman, E.C.** (2019). Modelling and Validation of Computer Vision Techniques to Assess Heart Rate, Eye Temperature, Ear-Base Temperature and Respiration Rate in Cattle. *Animals* 2019, 9(12), 1089; <https://doi.org/10.3390/ani9121089>
16. **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>
17. Knight, M.I., **Butler, K.L.**, Slocombe, L.L., Linden, N.P, Raeside, M.C., Burnett, V.P, Ball, A.J., McDonagh, M.B. and Behrendt, R. (2020). Reducing the level of nutrition of twin-bearing ewes during mid to late pregnancy produces leaner prime lambs at slaughter. *Animal*, 14, 864-872. <https://doi.org/10.1017/S1751731119002271>
 18. **Learmonth, M.J.** (2020). The Matter of Non-Avian Reptile Sentience, and Why It “Matters” to Them: A Conceptual, Ethical and Scientific Review. *Animals* 2020, 10, 901. <https://doi.org/10.3390/ani10050901>
 19. Lloyd, J.K.F., Collins,T., Cornish,A.R., Degeling,C., Fawcett,A., **Fisher,A.D.**, Freire,R., Hazel,S.J., Hood,J., Johnson,J., Phillips, C.J.C., Stafford, K.J., Tzioumis, V. and McGreevy, P.D. (2020) Australian and New Zealand Veterinary Students’ Ranking of Issues in Aquatic Animal Welfare and Ethics, *Anthrozoös*, 33:3, 325-337, <https://doi.org/10.1080/08927936.2020.1746522>
 20. **Munoz, C.A., Coleman, G.J., Hemsworth, P.H.**, Campbell, A.J.D. and **Doyle, R.E.** (2019). Positive attitudes, positive outcomes: The relationship between farmer attitudes, management behaviour and sheep welfare. *PLoS ONE* 14(7): e0220455. <https://doi.org/10.1371/journal.pone.0220455>
 21. Muri K., Tufte P.A., **Coleman G.J.** Oppermann Moe, R.. (2020). Exploring work-related characteristics as predictors of Norwegian sheep farmers affective job satisfaction. *Sociologia Ruralis*. <https://doi.org/10.1111/soru.12299>
 22. Otto, C. M., **Cobb, M.**, & Wilsson, E. (2019). Editorial: Working Dogs Form and Function. *Frontiers in veterinary science*, 6, 351. <https://doi.org/10.3389/fvets.2019.00351>
 23. Poulton, P.J., **Fisher, A.D.**, Mansell, P.D. and Pyman, M.F. (2019). Clinical findings from 104 cases of calving paralysis in dairy cows from Gippsland, Australia. *New Zealand Veterinary Journal* 67:214-218. <https://doi.org/10.1080/00480169.2019.1602086>
 24. Rault, J. L., **Truong, S., Hemsworth, L.**, Le Chevoir, M., Bauquier, S., & Lai, A. (2019). Gentle abdominal stroking (‘belly rubbing’) of pigs by a human reduces EEG total power and increases EEG frequencies. *Behavioural brain research*, 111892. <https://doi.org/10.1016/j.bbr.2019.04.006>
 25. **Rice, M., Hemsworth, L.M., Hemsworth, P.H.** and **Coleman, G.J.** (2020). The impact of a negative media event on public attitudes towards animal welfare in the red meat industry. *Animals* 10, 619: <https://www.mdpi.com/2076-2615/10/4/619>
 26. **Roadknight, N.**, Courtman, N., Mansell, P., **Jongman, E.C.**, Clarke-Errey, S. and **Fisher, A.D.** (2020). Blood collection from dairy calves at exsanguination post-slaughter yields similar biochemical and packed cell volume measurements compared with in vivo collection during lairage. *Res Vet Sci* Vol 130, June 2020: 41-47. <https://doi.org/10.1016/j.rvsc.2020.02.013>.
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 31. **Woodruff, ME., Doyle, R.E., Coleman, G.J., Hemsworth, L.M.**, and **Munoz, C.A.** (2020) Knowledge and attitudes are important factors in farmers’ choice of lamb tail docking length. *Veterinary Record Published Online First*: 20 January 2020. doi: 10.1136/vr.105631. <https://dx.doi.org/10.1136/vr.105631>

2.b Research papers in press

32. **Cobb, M.**, Carter, A., Lill, A. and Bennett, P. (accepted, June 2020) Perceived importance of specific kennel management practices for the provision of canine welfare. *Applied Animal Behaviour Science*.
33. Tilbrook, A.J. and **Fisher, A.D.** (2020). Stress, health, and the welfare of laying hens. *Animal Production Science*. (in press).

3. Refereed conference publications

34. **Atkinson, L., Doyle, R. E., and Jongman, C.E.** (2019). Using humans as early life stressors to improve coping in sheep. International Ethological Conference, Chicago, USA. 2019. Oral presentation.
35. **Cobb M**, Carter A, Lill A, Bennett P (2019) Advancing the welfare of working dogs: what's preventing science help the canines who help us? Universities Federation for Animal Welfare International Symposium. 3-4 July, Bruges, Belgium. Oral presentation.
36. **Doyle, R. E.** (2019). Global Animal Welfare: animal welfare and the sustainable development goals. Science Week, Gold Coast, Australia. 2019. Oral presentation.
37. **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.
38. **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.
39. **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.
40. **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.
41. **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, Bruges, Belgium. Oral presentation.
42. **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.
43. **Rice, M., Acharya, R., Taylor, P., Fisher, A.D., and Hemsworth, P.H.** (2020). Smothers in free-range laying hens. Australian Veterinary Poultry Assoc. Scientific Meeting May. 2020.
44. Wilhelmsson, S., Yngvesson, J., **Hemsworth, P.H.**, Andersson, M. and Hultgren, J. (2019). Animal handling and stress-related behaviours in finishing pigs during transport loading and unloading. Proceedings of the 53rd Congress of the International Society for Applied Ethology. 5th-9th August 2019, Bergen, Norway, pg. 229.
45. Wilhelmsson, S., Yngvesson, J., **Hemsworth, P.H.**, Andersson, M. and Hultgren, J. (2019). Relationships between driver handling and pig behaviour during loading and unloading. Proceeding of the XIX International Congress of the International Society for Animal Hygiene Wrocław University of Environmental and Life Sciences, September 8th - 12th 2019, Wrocław, Poland, pg 35.

3. Theses

Marquette, G.A. (2020) Welfare implications of castration and disbudding procedures on calves. MPhil, The University of Melbourne.

Munoz, C.A. (2019). Assessing and addressing the welfare of extensively managed ewes. PhD, The University of Melbourne.

Pallab, M.S. (2019). Investigations into the critical aspects of the health and welfare of the bobby calves and dairy cows in Victorian dairy systems. PhD, The University of Melbourne.

4. Final reports

Agriculture Victoria CMI 105542. "Animal Welfare Science Centre". Andrew Fisher, Jeremy Skuse

AWI Gap Evaluation of Pain Alleviation Research. Alison Small, Caroline Lee, Ian Colditz (CSIRO), Andrew Fisher (AWSC) University of Melbourne

NAWRDES Project 2018/0014 – "Monitoring public attitudes to livestock industries and livestock welfare". Grahame Coleman, Lauren Hemsworth, Rutu Acharya.

https://www.awstrategy.net/uploads/1/2/3/2/123202832/nawrde_no._2018-0014_final_report.pdf

Animal Welfare Science Centre Seminars

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

February 2020

Cassandra Tucker, Center for Animal Welfare, UC Davis, USA.

Animal welfare assurance programs: What does success look like? [pdf](#) [video presentation](#)

October 2019

"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](#)

Animal Welfare Science Centre Newsletter

The AWSC published one newsletter in the year which gave an update on major projects and how they were being managed in light of restrictions imposed due to the COVID-19 pandemic.

The newsletter can be accessed [HERE](#).

**Copies of the Animal Welfare Science Centre
Annual Report 2019 – 2020 are available on request from:**

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