Breeding Focus 2016 – Improving Welfare

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Preface

The inaugural 'Breeding Focus' workshop was held in 2014 to outline and discuss avenues for genetic improvement of resilience. The Breeding Focus workshop was developed to provide a forum for exchange between industry and research across livestock and aquaculture industries. The objective of Breeding Focus is to cross-foster ideas and to encourage discussion between representatives from different industries because the challenges faced by individual breeding organisations are similar across species. This book accompanies the Breeding Focus 2016 workshop. The topic of this workshop is 'Breeding Focus 2016 - Improving welfare'.

> *"Animal welfare means how an animal is coping with the conditions in which it lives. An animal is in a good state of welfare if (as indicated by scientific evidence) it is healthy, comfortable, well nourished, safe, able to express innate behaviour, and if it is not suffering from unpleasant states such as pain, fear, and distress. Good animal welfare requires disease prevention and veterinary treatment, appropriate shelter, management, nutrition, humane handling and humane slaughter/killing. Animal welfare refers to the state of the animal; the treatment that an animal receives is covered by other terms such as animal care, animal husbandry, and humane treatment."* (World Organisation for Animal Health 2008).

Animal breeding offers opportunities to improve the state of animals. Existing methodologies and technologies used in animal breeding can be used to improve welfare of animals on farm while maintaining productivity. Welfare and productivity are not necessarily in opposition because several welfare measures are genetically independent from productivity traits. Further, it is often economically beneficial to improve welfare traits. These aspects provide ample opportunities to improve both welfare and productivity through selective breeding.

The chapters of this book describe existing frameworks to define welfare of animals and outline examples of genetic improvement of welfare of farm animals. A reflection on ethical issues of animal breeding and welfare is presented and further avenues for genetic improvement of welfare are discussed.

We thank all authors for their contributions to this book and their presentations at the Breeding Focus 2016 workshop in Armidale. Each manuscript was subject to peer review by two referees. We thank all reviewers who generously gave their time to referee each book chapter. A special thank you goes to Kathy Dobos for looking after all details of organising this workshop and for her meticulous work on putting this book together.

Susanne Hermesch and Sonja Dominik

Armidale, September 2016.

How can we measure welfare of animals on farms?

Andrew Fisher, Animal Welfare Science Centre, University of Melbourne

In order to effectively address the animal welfare expectations of the general public and consumers, there is a requirement for the development of on-farm animal welfare measurement, improvement and assurance. However, complexities and challenges mean that there is not a single or even a few animal welfare measurement systems for on-farm application that have broad acceptance and general use. The conceptual basis for on-farm animal welfare management is best supported by viewing animal welfare as a reflection of the animal's biology. On-farm welfare measurement, particularly for assurance schemes, is often a compromise between assessing 1) the resources or management inputs for the animals; and 2) the welfare state of the animals themselves. The former approach is simpler, but the latter represents a better indication of actual animal welfare. Advances in automated data capture in farming combined with individual electronic animal identification have the capacity to enhance animal welfare assessment, particularly for breeding and selection purposes. In achieving this there will need to be recognition that the traits being measured need to have a genetic basis, and that the data is collected in a way that accounts for the considerable environmental influence on many attributes of an animals' welfare. For on-farm welfare assurance, measurement systems will need to become more streamlined and cost-effective to deploy, if there is to be useful uptake in more extensive farming industries.

Breeding for welfare traits in dairy cattle

Jennie Pryce[1], Mary Abdelsayed[2] & Michelle Axford[3], [1] Department of Economic Development, Jobs, Transport and Resources and La Trobe University, [2] Holstein Australia, [3] Australian Dairy Herd Improvement Scheme

Between 1990/91 and 2013/14 the average amount of milk produced by milk recorded cows in Australia has increased from 4,245 litres/year to 6,709 litres/year and genetic selection accounts for around 30% gain. As farm revenue is directly linked to milk production, they are and will continue to be key dairy selection objectives. However, from the mid-1990s, it was recognised that narrow breeding goals, focused on only production traits, has had negative consequences for fitness traits which has negatively impacted animal welfare. Notably, the deterioration in female fertility as a consequence of unfavourable genetic correlations with milk production traits has been observed worldwide. Since then, breeding goals have been extended and realised selection responses for traits such as fertility show that genetic selection can improve even low heritability traits. Multi-trait selection indices optimised for local conditions, such as Balanced Performance Index (BPI) in Australia, Economic Breeding Index (EBI) in Ireland, Breeding Worth (BW) in New Zealand, Profitable Lifetime Index (PLI) in the UK, Net Merit (NM) in USA etc. ensure simultaneous improvement in several traits that encompass farm revenue and costs. However, dairy cattle breeding goals are now becoming more complex in order to meet challenges set by consumers and society. For example, farmer preferences are accounted for in the development of national selection indices for dairy in several countries. Research to broaden breeding goals further still to include other traits important for animal welfare and farm profitability is underway worldwide. Genomic selection is already being used to develop breeding values for some of these traits and is proving to be especially useful for expensive or difficult to measure traits.

Improving the temperament of Australian cattle and implications for animal welfare

Sam Walkom, Animal Genetics and Breeding Unit, University of New England

Animals differ in their behavioural response to human interaction. Poor cattle temperament and the behavioural responses of cattle to handling by humans has been associated with losses in enterprise profitability. Breeders are able to improve the temperament and productivity of the herd by selecting on the cattle's behavioural response to human interaction. An increased focus on animal welfare and improved safety of handlers around cattle has brought forth a desire to breed cattle that are less fearful or stressed by human interactions, thus exhibiting a more docile temperament. The Australian beef industry uses docility score and flight time as selection traits to improve the temperament of the national herd. Both traits provide reliable and repeatable measures of temperament. The success of selection for docility in the Limousin breed has allowed seedstock breeders to produce a calmer tempered breed that was previously considered unmarketable due to being considered "stirry and difficult to manage". Genetic correlations for temperament traits with production traits are generally low and indicate that selection to improve temperament can occur without any significant negative impact on other economically important traits including growth, fat, muscle and reproduction. Selection on temperament will further improve the behavioural characteristics of cattle, improving animal welfare, whole farm productivity and handler safety.

Selection for immune competence in beef breeding programs modelled on potential reductions in the incidence of bovine respiratory disease

Sonja Dominik & Brad Hine, CSIRO Agriculture and Food

Livestock industries are expected to intensify as land resources for agricultural production decline and global demand for animal protein increases. As a consequence, strategies aimed at sustainably improving the health and welfare of livestock will be critical to the future of our livestock industries. This study has made a first attempt at modelling the potential benefits of incorporating measures of immune competence in beef cattle breeding programs with the aim of improving general disease resistance, and as a consequence animal welfare. This study explores a variety of selection strategies and estimates their potential economic benefits based on data stemming from the dairy industry. Results demonstrated that the estimated heritability and predicted relationship between immune competence and growth traits strongly affect the potential gains which can be expected in immune competence and also overall response to selection. The economic values used in this study were conservative, suggesting that higher selection genetic responses and dollar returns are possible. For more accurate predictions, it will be crucial to obtain genetic and phenotype parameters for immune competence and correlations with other traits specifically for beef cattle. Research is currently underway to determine such parameters for beef cattle. The study also emphasises the need for robust economic values for traits, such as immune competence, where potential economic benefits of the traits are not just purely driven by the cost versus profit of the product, but also strongly influenced through public perception of the industry.

Breeding polled cattle in Australia

Natalie Connors & Bruce Tier, Animal Genetics and Breeding Unit, University of New England

Economic losses in beef cattle due to bruised meat can be largely attributed to the presence of horns. While dehorning practices can provide some economic improvement, it is more labour intensive and is likely to be subject to renewed animal welfare legislation in the future. Breeding naturally polled animals is the long term alternative to reducing economic loss while maintaining best practice animal welfare. The haplotype Poll test is aimed to estimate the Poll genetics of an animal, given the alleles observed at 10 microsatellites in the vicinity of the Poll locus on chromosome 1. The following provides a summary of the genetics of polled cattle and the test used to estimate Poll probability of beef cattle.

Farming dinosaur cousins: the unique welfare challenges of farming crocodiles.

Sally Isberg, Centre for Crocodile Research

In the last five decades, the Australian saltwater crocodile population has recovered from near extinction back to pre-hunting levels because of a highly successful conservation strategy. Farming has been crucial in the recovery by providing economic-incentives to landowners to conserve the species and its habitat. However, farming a species that has evolved little since the dinosaurs has unique challenges compared to traditional livestock species. The lack of selection and domestication (wild harvested eggs) equates to large phenotypic variation and, given the industry's infancy, has relied on developing husbandry approaches that balance the physiological needs of crocodiles and production outputs. This approach appears to have successfully satisfied the welfare needs of the crocodiles although improvements are continually being sought. Novel equipment and handling techniques have been developed to ensure safe working environments for staff whilst maintaining animal welfare. The primary product is the skin, which is also unique as skins/hides are normally a by-product of traditional farming operations. This brings more idiosyncratic challenges as buyers demand blemish-free skins that will produce flawless high-end fashion products. Overall, in a short period of time, the Australian crocodile industry has emerged as an economically-viable, sustainable conservation-based industry but still has many challenges ahead as we continue to learn about the husbandry and welfare requirements of these dinosaurian descendants.

Breeding for improved welfare of growing pigs

Susanne Hermesch, Animal Genetics and Breeding Unit, University of New England

Welfare should be considered in pig breeding programs. A number of welfare traits related to pork quality, health and survival of pigs have already been included in pig breeding programs and this list of welfare traits should be extended further. It is important to provide the best-possible environment to pigs on farms. Animal breeding can contribute to this aim indirectly by providing

descriptors of environmental conditions from genetic analyses of performance traits which can be used for assessment and optimisation of husbandry practices. Further, selection for improved disease resistance reduces pathogen load in the environment. Maintaining good welfare for all pigs on farms all the time requires a detailed monitoring system which has been provided by the Welfare Quality® (2009) protocol. The 12 welfare criteria defined by the Welfare Quality® (2009) protocol provide guidance for the genetic improvement of welfare in pigs. Genetic variation exists for numerous traits related to these 12 welfare criteria. For example, genetic variation was found for the number of shoulder ulcers in sows which is an important welfare trait of sows. Selecting pigs with less skin ulcers may also offer opportunities to improve comfort of growing pigs. Growth is an important performance trait which is affected by the health status of animals. Therefore, growth has been used as a proxy for health which affects the welfare of pigs. For this purpose, it is important to record growth of all animals including sick pigs to better identify pigs with health and welfare problems. This will also enhance estimates of indirect genetic effects for growth which may be a selection strategy to improve behaviour of group-housed pigs and reduce the incidence of tail biting. Indirect genetic effects quantify the heritable component of the social effects a pig has on performance of its group mates. Multiple factors and traits affect and describe welfare of pigs and numerous avenues are open for pig breeding to further improve welfare of pigs on farms.

Breeding sows better suited to group housing

Kim Bunter[1], Craig Lewis[2] & Scott Newman[3], [1]Animal Genetics and Breeding Unit, University of New England, [2]PIC Europe, [3]Genus Plc, USA

The re-introduction of group housing for gestating sows in Australia, and elsewhere, has implications for both sow welfare and performance through enabling interactions (both positive and negative) between sows. Several strategies were investigated to identify selection criteria which might facilitate selection of sows better suited to group housing. These include: 1) estimation of social genetic effects; 2) use of proximity loggers for recording contacts between animals in groups; and 3) evaluation of flight time and fight lesion scores as potential selection criteria. Using strategy 1, significant social genetic effects were evident for litter size outcomes of group-housed sows. This implies that interactions between sows in groups have an impact on their reproductive performance, and this could be accommodated by appropriate models to estimate breeding values simultaneously for social genetic and additive genetic effects. Using strategy 2, proximity loggers provided opportunities to record all contacts between individual sows in group settings, but on animal implementation with off-the-shelf collars and modified (with harness) loggers failed in the age class of interest (gilts). Using strategy 3, both flight time and fight lesion scores were moderately heritable, but only fight lesion scores recorded 24 hours post-mixing in gilts had any association with other important sow characteristics. Preliminary parameter estimates suggest that under current housing and selection in maternal lines, post-mixing fight lesions recorded gilts would be expected to reduce, favouring improvement in some welfare related traits. Additional direct selection against fighting behaviour is also possible, and would be expected to reduce early culling of gilts. Overall, while developing meaningful selection criteria based on behavioural attributes which are practical to implement in commercial breeding programs is difficult, some opportunities to improve sow welfare and performance in group housing were identified in our studies.

Using genomic prediction for footrot resistance in sheep based on case-control industry data

Cecilia Esquivelzeta-Rabell[1], Kim Bunter[1], Daniel Brown[1] &, Mark Ferguson[2], [1]Animal Genetics and Breeding Unit, University of New England; [2]The New Zealand Merino Company

Footrot is a highly contagious hoof disease of sheep and other ungulates that has substantial welfare and economic impacts. The extent to which animals are affected by footrot is heritable. However, there are some significant operational limitations to applying traditional pedigree based selection methods for increasing resistance to footrot. The New Zealand Merino sheep industry have investigated genomic tools in order to use unpedigreed industry animals with footrot phenotypes to predict genomic breeding values. It is imperative to evaluate the accuracy of such genomic predictions. Using cross-validation techniques and a range of reference data sets, we demonstrated a wide range in the average accuracy of prediction for GBVs. These were highest with large reference data sets (which included contrasts within flock) and were reduced with lower reference data set size and when predictions were made for flocks outside the reference set. Further analyses will be performed when industry genotypic data are finalised, including validation for sires in ram breeding flocks. However, this preliminary study suggests that there will be some merit for genomic selection against footrot based on industry data.

Livestock breeding and welfare– reflections on ethical issues

Imke Tammen, University of Sydney

Animal breeding has been an effective way to shape companion and production animals to our needs. However, as the technologies used in animal breeding are becoming more advanced and effective, and as people's views on the use of animals for human benefit change, ethical questions in relation to animal breeding of companion and production animals have been raised. I will explore why the ethical debate relating to the use of animals is complex. I propose the use of an Ethical Matrix to encourage structured discussions relating to the ethics of livestock breeding. The Ethical Matrix may assist animal geneticists and breeders to gain greater awareness about the complexity of the ethical issues relating to livestock breeding. Reflection on these issues and more informed engagement with other stakeholders can facilitate the development of transparent and more broadly accepted decisions relating to animal breeding and is likely to encourage the development of more balanced animal breeding programs with a greater focus on animal welfare and sustainability.