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.

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Armidale, September 2016.

How can we measure welfare of animals on farms?

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Abstract

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.

Introduction

During the past century, community views on animal welfare have moved from being concerned only with acts of wanton cruelty toward animals, to concerns about standards of animal care. An area of focus of this public concern has been systems where animals are kept for profit, such as agriculture. Intensive farming systems, where animals are managed in man-made environments, have received particular attention from animal welfare interest groups, and were the subject of the first farm animal welfare campaigns and regulatory scrutiny during the 1960s and 1970s. More recently, extensive animal production systems have also faced questions about the standards of animal welfare involved in food and fibre production.

In response to such questioning by the public and animal welfare advocacy groups, the response of governments and animal industries has been firstly to clarify and strengthen the regulatory system underpinning animal welfare obligations in western countries. This has typically

involved moving beyond enforcing avoidance of cruelty to requiring farmers and other animal owners to fulfil basic obligations of duty of care, such as sufficient feed, water, shelter and healthcare. However, regulatory approaches are best used to provide a lowest common denominator, and to enforce and prosecute those who fall below this minimum standard of care. In order to more effectively address the animal welfare expectations of the general public and consumers, there is a requirement for the development of animal welfare measurement, improvement and assurance. Such animal industry engagement with animal welfare requires from science the ability to: 1) evaluate the welfare status of farm animal husbandry practices and production environments; 2) address any welfare issues in practices that are revealed; and 3) provide assurance to markets, regulatory authorities and the general public of the welfare standards of the industry.

The need for objective and practical methods of measuring the welfare of farm animals has been identified for some time. However, unlike something as simple as say, body weight, *what* to measure in assessing animal welfare is just as complex an issue as the question of *how* to measure it. In addition, measures of animal welfare may be applied in controlled research studies (e.g. comparing husbandry practice A vs. husbandry practice B), or in spot check or audit schemes, or in broad scale assurance of genetic selection and evaluation. Furthermore, the animal welfare issue that is being addressed may manifest in a very specific way (such as malignant hyperthermia seen previously in pigs), or a more general assessment of animal welfare status may be what is being sought.

These 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. This chapter will examine the key features, guiding principles and strengths and weaknesses of some of the key approaches that have been developed, as well as consider useful future directions in on-farm welfare measurement.

Concepts of animal welfare and its measurement

It is probably under-recognised that the concepts and definitions involved in animal welfare provoke almost as much debate among professionals directly working within this field as the welfare issue does within society at large. Many people prefer to differentiate between defining animal welfare as a concern for the highest standards of care for animals, and animal rights as a philosophical concept that translates into an avoidance of the utilisation of animals. Within the animal welfare spectrum, some concepts act essentially as checklists that may be used as screening tools, or to support "tick-box" welfare assurance. The UK's Farm Animal Welfare Council's "Five Freedoms" are an influential example (Farm Animal Welfare Council 1993). The Five Freedoms incorporate elements relating to nutrition, health, normal behaviour, comfort and psychological stress of animals. As can be seen from Table 1, although concepts such as the Five Freedoms may be a useful screening tool, they do not easily translate to objective measurement for herd improvement or selection purposes.

Table 1. The Five Freedoms

Freedom	Explanatory detail
1. Freedom from hunger and thirst	By ready access to fresh water and a diet to maintain full health and vigour
2. Freedom from discomfort	By providing an appropriate environment including shelter and a comfortable resting area
3. Freedom from pain, injury or disease	By prevention through rapid diagnosis and treatment
4. Freedom to express normal behaviour	By providing sufficient space, proper facilities and company of the animal's own kind
5. Freedom from fear and distress	By ensuring conditions and treatment which avoid mental suffering

More complex models of animal welfare attempt to understand what constitutes normal levels of these welfare components, and what the consequences may be for the animal if they are not normal. The most widely-utilised definition views animal welfare as an optimal condition of the animal's biology. An alternative model of animal welfare argues that how an animal feels is the prime determinant of its welfare. A third concept places great emphasis on the naturalness of a production system.

The biological state concept of animal welfare readily incorporates the various challenges to animal welfare that can occur, such as infectious disease, congenital defects, physical trauma, thermal challenges, and perturbations in the animal's social environment. The biological responses that result can be used to assess animal welfare. Such responses may include alterations in behaviour, physiological changes, clinical signs of disease, reductions in weight gain and reduced reproduction. Accordingly, for improvements in animal breeding, measurement systems based on the biological state concept of animal welfare are most applicable, although it is useful to appreciate that alternative concepts of animal welfare do exist.

In measuring animal welfare on farm, another important concept to understand is that of 'input' measures compared with 'output' measures. For ease of use, particularly in intensive farming environments, many animal welfare measures used are not technically measures of the animals' welfare (because they are not measures of the animals), but are instead measures of the environmental and management 'inputs' to animal welfare. These inputs then influence the animals' responses – i.e. their welfare. Examples of these input measures may include stocking density, air quality, water quality, feed quality, flooring cleanliness and stockperson behaviour. By contrast, 'output' measures may more directly reflect animal welfare, but can be harder to measure. Output measures may include measures of animal conformation, behaviour, production, reproduction, disease status and physiological state. It is axiomatic that

if a specific animal welfare issue is being addressed through a selection and breeding program, then the corresponding output measures (or related indicator traits) ought to be targeted in animal welfare measurement – for example measuring flystrike rates or indicator breech traits to select sheep for greater resistance to breech strike. In general, input measures may be easier to achieve (especially in more intensive farming systems), but output measures are more likely to directly reflect the animals' welfare and be useful in breeding strategies.

'Big data' versus targeted measurement

As described earlier, the goal of animal welfare assessment on-farm raises the questions of both what to measure and also how to measure it. The two questions are not easily separated, because often the decision on what to measure is a compromise between trying to measure the animals' welfare as directly as possible, and doing what is practical, available and cost-effective. Although, as outlined in the next section, most animal welfare on-farm assessment schemes record (input and output) measures directly through farm visits or farmer-recorded data, an alternative approach that should always be considered is to utilise existing datasets that are recorded anyway. These datasets may serve as a useful indicator of welfare, especially when subjected to epidemiological or similar analyses suited for big data. An outline of the epidemiological approach to measuring welfare in comparison with direct measurement is presented by Whay *et al.* (2003).

A more specific example of the big data approach is contained in the study by Llonch *et al.* (2015). In this study, the authors examined the data that is available at point of slaughter in sheep abattoirs in the United Kingdom, and determined what might be useful to indicate the state of the sheep's welfare back on the farm of origin. It was decided that body cleanliness, carcass bruising, diarrhoea, skin lesions, skin irritation, castration, ear notching, tail docking and animals recorded as 'obviously sick' during ante mortem inspection could be useful. Another example is recent work in which cow milk production records were examined in conjunction with meteorological data from proximate weather stations in order to identify cows across multiple herds that were more resistant to heat stress, as indicated by a lesser drop in milk production in hot weather (Nguyen *et al.* 2016).

If the goal is improving animal welfare through genetic selection and breeding strategies, then there is an obvious attraction to using the big data approach if the dataset is already available in some form or is readily collectible. The costs are less than directly measuring animals in a targeted manner on farm, especially when it is considered that a large number of individuals may need to be assessed to draw meaningful conclusions from genetic or genomic analyses. However, it is necessary that individual animal identification is associated with recorded phenotype information, in particular to meaningfully link samples that might be taken for genotyping purposes at the same time. A further caveat of course is that just because something is available doesn't mean that it is a good measure of welfare.

For schemes or studies where targeted animal welfare measures are taken on farm, another consideration is who should undertake the measurements. For quality assurance purposes, the gold standard is considered to be 3rd party audits, notwithstanding the fact that these auditors are effectively paid by either the scheme operator or the farmer involved. In many cases, depending on the individual scheme, these auditors are also reviewing records and information that the farmer has collected themselves, as well as doing some spot checks on management inputs. As outlined below, schemes in which independent auditors undertake detailed animal measures are rarer, and expensive to administer. The question then arises as to whether the expense of the scheme can be recouped by consumers being willing to pay significantly higher prices, or by the value of the information for other purposes. If farmers or farm workers collect animal welfare data on their animals, particularly if it is something that can be objectively measured, then it is probably suitable for herd improvement purposes, but may pose difficulties for the credibility of welfare assurance due to the perception of conflict of interest.

Examples of on-farm welfare assessment schemes and measures

There are a number of instructive examples where industries, non-governmental organisations or other groupings have aimed to develop comprehensive on-farm welfare assessment schemes. In terms of investment (in this case by government funds) the largest effort was the European Union (EU)-funded WelfareQuality® project, which ran from 2004-2009. The project involved researchers and other experts from 13 EU countries and had an overall budget of €17 million (86% from the EU). The stated goal was to accommodate societal concerns and market demands, to develop reliable on-farm monitoring systems, product information systems, and practical species-specific strategies to improve animal welfare. Efforts were focused on three main species and their products: cattle (beef and dairy), pigs, and poultry (broiler chickens and laying hens). The approach of the WelfareQuality® project to on farm animal welfare assessment is outlined in Table 2. Essentially, assessments are made of feeding, housing, health and animal behaviour.

The detailed assessment protocols of each species have been published and are available online (Welfare Quality Network 2014). What is clear from reading the protocols, is that they require a prolonged and detailed farm visit by an assessor, combined with subsequent data analysis. The farm visit time for an assessment of a farm with 125 dairy cows would be 7 hours (Heath *et al*. 2014). It is also clear that the protocols are designed for animals that (in the European context) are housed, but which may not be housed in Australia (e.g. cattle). Even in a European context, where farms generally are more closely settled and fewer animals than in Australia, the detailed WelfareQuality® protocols have not been adopted in their entirety, and subsequent efforts have been undertaken to try to develop more streamlined and less costly abridged versions (Heath *et al*. 2014).

Table 2. Criteria used in WelfareQuality® to develop an overall welfare assessment (Botreau et al. 2007).

Criteria	Subcriteria	Specifications
Good feeding	1. Absence of prolonged hunger 2. Absence of prolonged thirst	
Good housing	3. Comfort around resting 4. Thermal comfort 5. Ease of movement	Assessed through behaviour (including rising up and lying down movements) but not injuries (included in 5). Not considering health problems (included in 6, 7, 8) and movements around resting (included in 3).
Good health	6. Absence of injuries 7. Absence of disease 8. Absence of pain induced by management procedures	Except those produced by a disease or voluntary interventions Absence of clinical problems other than injuries For example: castration and dehorning pain

The general approach of the earlier WelfareQuality® initiative has also been adapted in a subsequent EU-funded project titled AWIN (Animal welfare indicators) to develop on-farm welfare assessment protocols for farmed species not covered in the earlier project- specifically sheep, goats, horses, donkeys and turkeys. The sheep assessment protocol is interesting from an Australasian context, because it covers the possibility that the animals are not housed, but are instead permanently grazed at pasture. In this scenario, the *Good housing* criterion uses assessments of fleece cleanliness to assess comfort around resting, and panting and access to shelter/shade to gauge thermal comfort (AWIN 2015). The ease of movement sub-criterion is not assessed for paddock-based animals. On the downside, the protocol was not tested with sheep intended for wool production, and the assessment visit would still take a considerable amount of time as detailed individual measurements would be required on 92 animals in a typical Australian commercial flock, plus taking time to assess various resource inputs.

Animal welfare assurance schemes that have been brought into action thus generally have relatively simple on-farm assessments, or rely on paper-based audits and record-keeping. One example is the RSPCA 'Assured' scheme (previously Freedom Foods), which was developed in the UK (RSPCA 2013), and is also present in a modified form in Australia (RSPCA 2016). The assessment tools for this scheme are largely input-based (e.g. 'Calves must have access at all times to a lying area which is well drained and/or well maintained with dry bedding'), and are designed for the on-farm assessor to progress through the checklist without having to measure

things on multiple animals. Other, similar schemes are overseen by major supermarkets or other organisations – for example the Red Tractor Scheme in the UK (Red Tractor 2014). One of the challenges for such schemes, particularly if the measures are input-based and assessment visits are infrequent, is that there is not necessarily a guarantee that the welfare of animals on an assured farm is better in all aspects than the welfare of animals on a non-assured farm. For example, a study by David Main and colleagues from the University of Bristol found that although a sample of RSPCA-approved dairy farms in England had better results than a sample of matched non-assured farms for 12 welfare indicators, including mastitis, non-hock injuries, cow cleanliness and body condition, the assured farms had poorer welfare indicators for eight of the measures, including hock injuries, lameness and restrictions in rising behaviour (Main *et al.* 2003).

Leaving aside the challenges and goals of broad-scale assurance schemes, the measurement of animal welfare on-farm for the purposes of improving management practices or identifying breeding strategies presents its own set of hurdles and requirements (Johnsen *et al.* 2001). Input measures are not suitable, and measures need to be made of the animals and their responses. The measurement of animal welfare on farm is a field of research and innovation in its own right, and new approaches and technologies are published, and are also presented at conferences, particularly the International Conference on the Assessment of Animal Welfare at Farm and Group Level (WAFL), which is held every three years. The proceedings from WAFL are available online (WAFL 2011; WAFL 2014). Some of the notable innovations that have arisen in this field include the use of quantitative behavioural assessment (QBA). This measurement system uses an integrated human observation of the whole animal to assess its welfare state (Wemelsfelder 2007), and can be used as part of on farm health and welfare assessment (Wemelsfelder and Mullan 2014). Essentially, observers view the animals and use either free-choice words or selections from a list of descriptors to describe how they view the state of the animal - for example ‘calm’, ‘anxious’ and so forth. The use of QBA has been examined in a range of farmed species, for example Australian and UK research has shown that QBA can reliably reflect the welfare challenges of sheep exposed to varying situations (Phythian *et al.* 2013; Stockman *et al.* 2014; Fleming *et al.* 2015).

Whereas QBA represents an approach of minimal technology and direct human observation of animals, other developments have utilised technological advances to improve animal welfare measurement and data capture. One example is that of non-contact imaging and sensing technology, such as infra-red thermography (Stewart *et al.* 2005), which has been shown to provide an early warning of calves that are developing respiratory disease (Schaefer *et al.* 2012). Other approaches use image analysis or underfoot sensors to detect lameness in animals (e.g. Pluym *et al.* 2013), or ruminal sensors to measure digestive health and detect problems such as acidosis (Mottram *et al.* 2014). What is obvious is that such measurement systems, often combined with wireless telemetry and automated individual animal ID through RFID tags, offer the opportunity to collect large amounts of data without undue human intervention, particularly if the measuring device does not have to be attached to the animal. Researchers are also exploring methods of interrogating information that may be collected automatically but not originally intended for animal welfare purposes, in order to measure attributes of animal

wellbeing, such as the use of automated milking records to identify cows that are consistently last in the milking order or that suddenly drop in the milking order (D. Beggs, personal communication).

Future directions

Given the drivers for animal welfare measurement, the current challenges in implementing on-farm measurement for broad-scale assurance, and the technological developments described above, several key directions are likely over the next few years. Firstly, there is likely to be a continued effort to streamline and simplify the assessment cost and time involved in on-farm measurement for welfare assurance. This is particularly the case if robust and meaningful welfare assessment schemes are to be deployed for extensive livestock industries in countries such as Australia. Concurrently, because of the recognised weaknesses in input-based measures, there will be further work to improve the conceptual base of welfare assessment for broad-scale assurance. One example of further developed thinking in this area is the Unified field index (UFI) proposed by Colditz *et al.* (2014). The proposed UFI would incorporate a combination of measures comprising: 1) Animal based measures; 2) Resource based measures; 3) Management-based measures; and 4) Other ethical criteria. Importantly, these measures would then be applied in two layers, with the farm manager undertaking the majority of risk identification, measurement, corrective action and review, and external auditors and analysts undertaking external auditing of the above steps as well as determining across-enterprise benchmarking. As well as being more suited to extensive, lower-cost farming systems, potential advantages of this approach include extension of the concept of good animal welfare to encompass a broader concept of good livestock management and that it would treat welfare as a continuous performance attribute rather than a pass / fail criterion, facilitating continual improvement.

Beyond the goals of welfare assurance, we will see targeted welfare measurements for management decisions or breeding programs utilising more of the technological advances that enable specific data to be automatically captured on free-ranging animals in a cost-effective manner, linked to individual animal ID, and facilitating analyses on larger datasets for genetic evaluation. In addition, we may also see conceptual advances in integrating such measurements into a more unified assessment of animal welfare, such as the concept of animal resilience explored by Colditz and Hine (2016). Together, these advances should facilitate effective animal welfare management at achievable costs as herd sizes and operations grow, and the public demand and interest in the welfare credentials of animal-derived food and fibre continues to develop.

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