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Breeding for better health and welfare in sheep – what is compromised if we do?

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Summary
Incorporating broader breeding goals into meat sheep breeding programmes such as traits that are important for health, welfare and maternal efficiency are important because they are often antagonistic to other breeding goals at a genetic level. This means that selection for higher productivity alone (e.g. lamb growth and litter size reared) can compromise animal welfare in the longer term particularly if new constraints (e.g. legislative) on farmers to control disease are introduced such as restrictions on the use of antimicrobials. Having key welfare indicators as new breeding goal traits, accurately recorded at birth and measured on animals of strategic importance in the population under selection, and under commercially-relevant rearing conditions widens the opportunity to select higher–performing sheep also with better innate ability to withstand disease in the future.

Introduction
Breeding programmes for sheep bred for meat production typically are geared towards maximising the weight of lamb reared either per hectare or per ewe, per annum. As most of our systems are largely grass-based in extensive rearing systems, unlike other livestock species, they have rarely been the subject of scrutiny from a health and welfare perspective. However as many sheep in extensive rearing conditions often graze poor quality pastures in marginal land areas, aspects of poor welfare are often overlooked, such as sub-optimal nutrition and low body condition score, exposure to climatic extremes of rainfall or temperature and high mortality rates. Also, in some sheep systems, farmers’ ability to identify and individually treat animals for diseases such as mastitis and footrot are limited by the very nature of the extensive grazing systems and lack of access to animal handling facilities in remote rangelands. With the drive to reduce reliance and use of antimicrobials and other pharmaceuticals in farmed livestock, it is logical that breeding more disease-resistant sheep will result in a ‘win-win’ scenario for both sheep and farmers alike. It will also reduce the rate of involuntary culling of ewes, thereby extending productive ewe longevity and lowering ewe replacement rate. However, older ewes tend to have higher litter sizes, which in turn have higher rates of lamb mortality and they also tend to have higher levels of footrot and mastitis. Having a lower annual ewe replacement rate by keeping an older flock age structure increases the generation interval and affects (lowers) the rate of genetic improvement possible in the flock(s). Similarly, we take it for granted that ewes will utilise their body reserves to fuel lactation for lamb growth but our research suggests that this may be at the expense of their own longevity. Such trade-offs – or compromises – that are made by flockmasters across the globe, will differ greatly according to the different sheep systems, yet all of them share the same solution to addressing them within the context of genetic selection index methodology. Combining new breeding goals for aspects of health and welfare into selection indices for sheep and weighting them appropriately, will both enable more profitable sheep farming, whilst halting the deterioration of these traits in the longer term. Four key aspects of sheep breeding systems are considered in the presentation.

Ewe Longevity
The definition of ewe longevity as a breeding goal has been the subject of previous and more recent industry-funded research to define productive longevity and to investigate the relationships with lifetime reproduction (Conington et al 2004). Ewe longevity can be considered as a relatively ‘blunt tool’ to improve ewe welfare because essentially it is the end result of ewes surviving several annual cycles of exposure to disease, tooth loss, pregnancy and parturition. It is a trait that is only expressed once in the lifetime of a ewe, and compared to other breeding goals, the economic value of improving ewe longevity is relatively low. On the positive side, ewe longevity can be automatically recorded within a performance recording scheme without relying on separate, additional recording undertaken by farmers. Our research shows that ewe longevity is under low genetic control, but for some breeds is antagonistically genetically correlated with lifetime productivity, indicating that high levels of performance leads to premature culling and lower longevity EBVs.

Disease resistance
It is usual that purebred rams are bought for use in more challenging environments compared to that of the purebred sector. Having good phenotypes on daughter disease status from these commercial flocks
is a powerful tool to generate genetic and genomic information and to reduce the impact of Genotype by Environment (GxE) interactions if that information is built into selection programmes. Detailed health screening in genetically-linked networks of purebred and commercial phenotype farms is a means to deliver a solution for endemic diseases of economic importance to the sheep industry; mastitis and footrot are examples of such diseases. The UK Texel Sheep Society is currently using this methodology to work towards the delivery of genomic breeding values (GEBV) for resistance/susceptibility to these diseases (Mucha et al., 2015). New, on-farm phenotypes for subclinical mastitis, that are cheap and easy to collect, are highly correlated with somatic cell count, both genetically and phenotypically, and routine screening has been put in place for udder and teat lesion phenotypes to continue selection for these traits in the future. The first genomic breeding values for such ‘hard to measure’ traits will be estimated this year in the UK.

Lamb survival
Lamb survival is the cornerstone of flock profitability and keeping lambs alive after birth is more profitable and better for welfare, rather than focussing on increasing the litter size of ewes to achieve a higher number of lambs weaned. Industry data from 4 major breeds (Scottish Blackface, Texel, Lleyn and Dorset) were used to estimate heritabilities for lamb survival as a direct trait of the lamb, which were all low (0.05-0.09) but significantly different from zero. Again, this is another ‘blunt’ tool that masks subtle differences in lambs and their behaviour that are indicative of greater ability to survive such as aspects of lamb vigour (Matheson et al 2012; Dwyer et al., 2015). As with ewe longevity, there is a large amount of information available from records currently collected within existing breeding programmes that can be used to estimate lamb survival, so there is not a requirement for additional farmer-dependent recording. Finding new proxy traits indicative of lamb survival and with higher heritabilities, measured quickly on a large number of animals in the recorded population is still needed, despite extensive research on the components of lamb survival behaviours described by Dwyer and Lawrence (2005). Survival rates differ significantly according to gender, litter size and dam age. Lamb survival and litter size born are antagonistically correlated, yet including them together in a breeding programme will enable both selection of sires and dams with higher propensity for survival without compromising greatly on genetic gain in litter size reared.

Body tissue mobilisation
Body condition score (BCS) is indicative of subcutaneous body tissue (fat and muscle) cover over the loin region of sheep (Russel et al., 1969). It reflects previous nutrition and is an indicator of future performance ability of ewes, and carcass attribute of lambs. Despite being widely accepted as a management tool, to date, BCS in ewes has not been included into sheep breeding programmes, yet it is a relatively simple measure that can be taken quickly and cheaply on a large number of animals. The genetic correlations among BCS and ultrasound fat and muscle depths measured from pre-mating through to 2nd weaning are positive and high (between 0.5 and 0.8; Anang 1995) and body tissue depletion and repletion of different fat and muscle depots, as measured by ultrasound and Computer Tomography (CT), has been shown to be under moderate genetic control (Lambe et al., 2004; 2005). The ability to mobilise body tissues is largely positively linked to offspring performance (Lambe et al 2007) and survival, but in part, antagonistically correlated to ewe longevity (unpublished results). Integrating BCS into sheep breeding programmes will enable both selection for ewes that maintain body condition throughout the year as well as supply enough milk without compromising lamb performance.

References