Breeding for future social license for beef production

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Abstract
Examples from Angus cattle provide evidence of positive genetic trends for production traits and, with increasing frequency, for traits more directly related to welfare outcomes. Genetic improvement programs are optimized when clear market signals linked to the commercial sector are in place. When welfare related traits like foot structure were added to profit driven selection indexes, recording levels increased and the accuracy of the evaluation for these traits improved. It is postulated that effective recording and genetic selection for improved welfare should be of interest to consumers. When faced with an informed choice, consumers should be more attracted to beef products which are sourced from production systems where through selection, welfare issues such as dystocia, lameness and reduced longevity are actively minimized. Beef breeders should be making efforts now to ensure a future 'social license' for their products by preparing for such economic feedback in the future.

Introduction
Beef cattle have been improved considerably through selection, resulting in cattle which better meet consumer demands, generate greater profits for breeders and are more competitive as a protein source. However, a focus on existing breeding objectives may not ensure future success for beef production. Breeding priorities for the future will need to address changing consumer demands.

Consumers are becoming more informed and more critical of their purchases across a range of products, with ethical considerations and environmental impacts being increasingly important. It is expected other papers will address reducing cattle's impact on the environment at this congress. This paper will focus on genetic solutions to improve welfare, enabling what is described as a future 'social license'. The term social license refers to the consumer acceptance of the practises underpinning beef production. Although the concept of a social license to produce beef is a relatively new one, this paper highlights genetic improvement initiatives that are already well established and address aspects of animal welfare. Thoughts are put forward as to how direct consumer pressure in the marketplace could accelerate the adoption, development, and genetic improvement of welfare related traits.

Materials & Methods
To illustrate genetic improvement and changes to recording practices over time genetic trends and counts of performance records were acquired from the American Angus Association's as used in the National Cattle Evaluation (American Angus Association 2022).

Results
Recent genetic trends for traits influencing animal welfare, along with selected production traits are presented in Figure 1 as are the changes in trait recording levels.
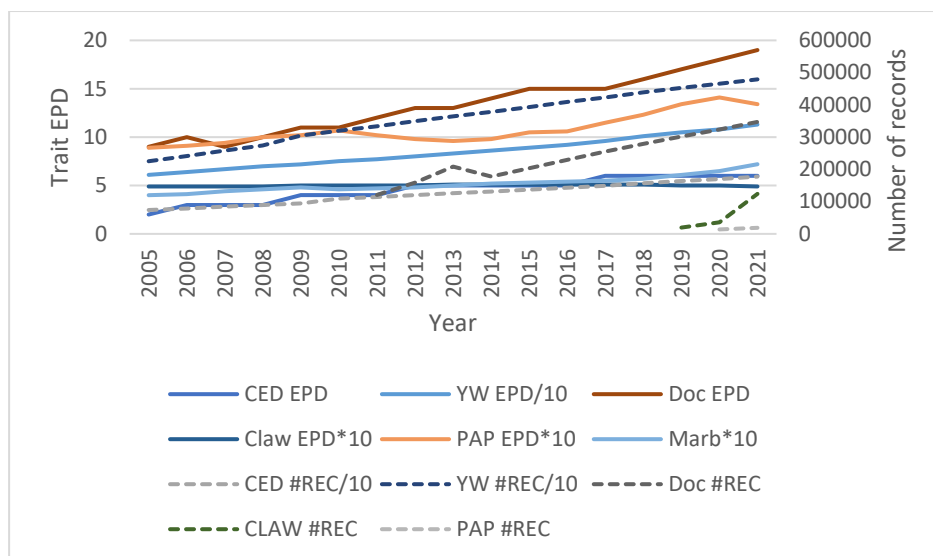
Figure 1. Genetic trends and records available for genetic evaluation for selected traits in American Angus cattle. Traits illustrated are: Calving Ease Direct (CED), Yearling Weight (YW), Docility (Doc), Foot Claw Set (Claw), Pulmonary Arterial Pressure (PAP), Carcass Marbling (Marb). The number of records used in the evaluation from all sources including Canada and Australia, where applicable (#REC).

Discussion

The genetic trends in Figure 1 demonstrate improvement across a range of traits, which has been supported by the levels of phenotype recording, also presented. How these trends relate to improving welfare will be discussed for each trait separately.

Calving Difficulty. A remarkable thing about the American Angus genetic trends is the continued increase in growth while improving calving ease (reducing dystocia), given the positive genetic correlation between post-weaning gain and birth weight (0.29). Through effective multi-trait selection, aided by the application of economic selection indexes, the Angus breed is now the heaviest breed at a year of age, while also being one of the leading breeds for calving ease as evaluated by the USDA (Kuehn and Thallman 2020). Commercial producers in the USA are conscious of selecting sires that will present very low dystocia rates. There is no doubt dystocia is an animal welfare concern, and it should be recognized that selection for improved calving ease plays a significant role in improving animal well-being.

Docility. The first Docility EPD were presented in 2011 based on 120,770 records and there has been steady improvement in both genetic merit and recording of the trait since. Docility also ranked high in the American Angus survey from 2019 (Santos *et al.*, 2019), but this was also noticeable in interviews involving large processors and feedlots, which indicated that cattle with better temperament were better for their businesses. The docility EPD was added to the maternal component of Angus economic selection indexes ($Values) in 2019. The emphasis has been on improving temperament for the betterment of the farmer, but it should be realized that cattle with better temperament also have better welfare outcomes with *inter alia* less stress and bruising.

Pulmonary Arterial Pressure (PAP). A disease which affects cattle at higher altitudes in the USA (typically over 1,800m) is caused by right-heart failure and severe cases lead to death. It is a heritable condition that can be measured with the related trait of Pulmonary Arterial

Pressure and significant research has been done on this trait by scientists at Colorado State University (Crawford *et al*., 2016). Despite the complexity of recording the trait, the PAP measure has been adopted in the region. In 2019, the first EPD were released for PAP, including genomic prediction through the weekly single step evaluation, enabling selection for this difficult trait for breeders across the country. Speaking directly with farmers with affected stock, this disease puts stress on the cattle in their care but also the mental wellbeing of the farmers who need to deal with these losses.

Foot Score. Improving foot structure remains a high priority for breeders as demonstrated by recent survey work (Santos *et al*., 2019). For this reason, there was much interest in the launch of EPDs for claw set and foot angle in 2018. The evaluation has seen a significant increase in foot score recording since the foot score EPD were incorporated into the economic multiple trait selection indexes ($Values) in 2019. The records contributing to EPDs spiked in 2020 due to a new joint evaluation incorporating records from Angus Australia as described by Alvarenga *et al*. (2022) in a paper submitted to this congress. Cattlemen are searching for 'trouble free' cattle and those with better foot structure will suffer less from lameness and are less likely to be culled. It is clear that improving foot structure is a 'step' towards better animal welfare.

Hair Shedding. Based on work from the University of Missouri (Durbin *et al*., 2020) a hair shedding research EPD was first released in 2020, based on analyses of 14,396 records and a 2021 re-evaluation involved 22,564 hair shedding phenotypes. The phenotype is based on a simple score (1-5) describing the proportion of winter coat an animal has shed, typically recorded in late spring. This EPD is of most interest to breeders in hotter states, and those in areas that suffer from endophyte infected fescue. With a warming environment, and Angus cattle pushing into hotter regions, such efforts to improve heat tolerance will remain important.

Longevity. Recent research has investigated the potential of a random regression model to estimate breeding values for longevity in Canadian and American Angus but more work is required to further develop a research EPD for release to the membership (Oliveira *et al*., 2021). In an effort to further improve the data structure to determine longevity, changes have been made to encourage more whole-herd inventory-based reporting from members. Improving longevity will contribute to improved welfare and enhance social license as cows will be less likely to be culled early due to health and structural problems.

Fostering selection for improved animal welfare
Reasons behind breeders' choice to record and select for the traits impacting welfare is likely two-fold. Breeders are also farmers; they naturally want to maintain and improve the health of animals in their care. An example of this not mentioned above is the extensive genotyping Angus breeders have undertaken to reduce the incidence of recessive genetic conditions that result in dead or deformed calves at birth. The other reason for this selection pressure, also pointed out above, is the relationship between these EPDs, $Values and prices for the bulls they sell. By including welfare related traits in the economic selection indexes, which contribute significantly to bull prices, selection of welfare related traits naturally follows.
Proposed here is an additional avenue to put greater economic incentive on animal welfare traits. Afterall, breeding is inevitably about trade-offs. The genetic progress for growth and carcass above is obvious. Any pressure on welfare traits will reduce the progress for these big economic drivers. Welfare traits can become more important economic drivers if more incentives are available in the commercial sector. Work on profit-based selection indexes makes it clear that traits related directly to carcass value, such as marbling in Angus cattle in America,

naturally receive significant weighting. If welfare related traits were more directly related to profit in the commercial industry, this would influence selection pressure in the seedstock sector.

To date consumer pressure on production related practices has been evident in other industries, and the objection to caged birds in the laying industry is a good example. Now consumers in developed countries are typically faced with a wide array of choices for eggs, with cage-free, free-range, etc. being predominant options at a premium to cage-laid eggs. This is a typical example of how the marketplace is impacted by welfare concerns, in a straightforward categorical way. The result here being pressure to reduce cage-based production systems.

In beef cattle we could see welfare related traits being addressed in a similar manner. Horns vs. polled is a good example, with de-horning becoming an unacceptable practice when there is a genetic alternative available. A breeding program to increase the frequency of polled in the commercial tier is described by Johnston *et al*. (2022) in a paper submitted to this congress. With this economic driver looming, as well as obvious husbandry benefits, the prices of 'polled genetics' in breeds that are introgressing this allele show a significant premium.

The genetic incentive for better welfare should not be restricted to such categorical traits. Consider calving difficulty, where a surgical calving is a greater compromise to welfare than horns disbudded at birth. Like horns, the calving problem could have been avoided in most cases with selection. If consumer pressure can promote differential prices for things like 'cage-free' in hens and perhaps polledness in the future, does it not make sense that this could be extended to all traits impacting welfare? Consider commercial producers purchasing bulls facing the choice between Bull A, which has no genetic description of welfare related traits (as is common in the marketplace now) and Bull B, which is from a seedstock breeder who actively records, and makes EPDs for welfare related traits available to buyers. Should the producer purchasing from supplier B not be rewarded for the due diligence demonstrated to use the tools available to improve animal welfare at the genetic level?

It is argued here that this should be given similar emphasis to moving hens from cages or eliminating horns. If the economic incentive was in the commercial marketplace to reward such selection practices, the increase in recording, selection pressure, and development of new traits could be significant. It has been demonstrated time and again that the greatest incentives for change in cattle breeding always come from the commercial marketplace. Cattle breeders are making good progress in improving welfare related traits now, but if greater direct pull from the commercial sector was present, through demand from consumers, this would improve much faster. It seems such pressure will come and the seedstock sector should be proactive in getting ahead of this demand to ensure a future 'social license' for their products.

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