



By the Numbers

by Stephen Miller, AGI director of genetic research

Foot structure is quite heritable

As a step toward developing tools to enable breeders to sustain and improve foot structure in Angus cattle, the Association launched two traits for producers to score in February 2015. Since that time 7,133 records have been received in yearling cattle and 2,942 at later ages, representing 9,888 unique animals with phenotypes. This level of recording in a short period of time is a tribute to Angus breeders' dedication to recording, the precursor to sustained improvement in the breed.

A closer look at foot scoring

Like all recorded traits, the best tool for selection is an expected progeny difference (EPD). An important ingredient in the development of an EPD is the trait's heritability. Using data collected to date, the heritability of the foot structure traits collected by Angus breeders has been determined with some good news for breeders wishing to make progress.

The heritability of a trait refers to the proportion of variation seen due to genetics and is generally presented as a percentage. A trait like growth typically has a heritability of about 0.25, which is considered a moderate heritability. There is little doubt among experienced breeders what kind of progress can be made for moderately heritable traits once animals have measurements.

Generally, fertility traits would have lower heritability. Traits related to animal structure, such as carcass traits, are higher in heritability. At Angus, the highest heritability estimated is for mature height, which is consistent to other studies in beef cattle, as well as in dairy cattle, which have a much deeper history of

measuring "type" traits such as feet and legs, mammary and body traits, with "stature" typically being most heritable.

According to the Holstein USA website, the heritability of foot angle in their population is 0.15. The goal of this project was to investigate alternative analysis models and determine the heritability of the foot structure traits as evaluated by Angus breeders.

The Association accepts categorical scores of 1 to 9, with 5 being ideal, for two traits, foot angle and claw set (for scoring charts, see page 184 of the February 2017 *Angus Journal*). Initial objectives were to explore alternative genetic evaluation approaches for these traits and estimate genetic parameters using 5,722 records collected on yearling bulls and heifers ranging from 320 to 460 days of age. Frequency of observations in the 1-9 categories are illustrated in Fig. 1. Notice how most animals score ideal (5). If there is a problem, it is likely a score 6, which is a slightly shallow heel and long toe, or a slight tendency for claws to curl. Other scores were much less frequent.

In addition to using all phenotypes (1-9) in the analysis, both foot angle and claw set were also analyzed as two independent traits, depending on where the reported score fell on the 1-9 scale. This was done to investigate whether foot angle scores ranging from 1-5 (steep) are different from scores ranging from 5-9 (weak), and also if claw set scores ranging from 1-5 (spread) are different from 5-9 scores (scissor) with 5 being ideal for each trait. All models accounted for variation due to contemporary group (customer, scoring date, sex and diet type), weaning creep type and age at measurement.

Heritability estimates were 0.34 and 0.21, respectively, for foot angle and claw set. When scores were split into steep and weak foot angle categories, the heritability of each of these components was 0.22 and 0.37, respectively. Likewise, when we split the claw set into spread and scissor, the heritability was 0.16 and 0.25, respectively.

In both cases, the heritability was higher for the group of scores (weak and scissor) with the most records.

Cattle are more likely to have a weak foot angle or scissor claw set, and these scores also appear more heritable than the alternative. A low genetic correlation between claw set and foot angle (0.22) was determined, indicating these are actually independent traits. Therefore, placing selection pressure on correcting claw set may not automatically correct foot angle and vice versa.

The moderate heritability estimates for these foot score traits indicate genetic evaluations are warranted, and also that breeders have been collecting data of excellent quality. Next steps will be to consider how measurements on older cattle can be incorporated into the evaluation, and if splitting the scores into scissor and weak (5-9) with their slightly higher heritability and frequency than the respective overall (1-9) traits is warranted.

Once the genetic evaluation model is finalized, the next progression will be a research EPD for breeders to evaluate.

This research will be presented as a scientific abstract at the American Society of Animal Science meeting with AGI geneticist Dr. Lizhen Wang as lead author in Baltimore, Md., in July.

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Fig. 1: Distribution of observations for foot structure traits

