Feet and Leg Traits are Moderately to Lowly Heritable in Red Angus Cattle

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Introduction

Feet and leg structure traits play a critical role in beef cattle production. Poor feet and leg traits rank as a top reason for culling beef cows from a herd and culling is very costly to producers if an animal has not generated enough income to pay for the cost of development. Feet and leg traits are lowly heritable, so genetic progress can be made with selection pressure for improved feet and leg soundness.

Beef producers select for soundness as they make decisions about culling animals; however, many of these animals may have been in a herd long enough to make a negative lasting impact. This causes particular harm to seedstock operations, especially with young unproven bulls being used in artificial insemination and for natural service because it is unknown if they will develop poor feet and leg traits later in life. Developing a feet and leg genetic evaluation to identify problem animals earlier in their life could be one method to make genetic improvement for herd profitability and longevity.

Feet and leg trait evaluation has been present in the dairy industry since the early 1980s and currently ranks as one of the most economically relevant traits in their genetic evaluations. The Australian Angus Association recently incorporated feet and leg traits into their genetic evaluation. The association reports estimated breeding values for front feet angle, front feet claw set, rear feet angle, rear leg hind view, and rear leg side view. Feet and leg traits are typically scored on an intermediate scale as an ordered category with the desirable score in the middle and less desirable scores on the two extremes.

The Red Angus Association of America and American Simmental Association breed organizations are currently developing a genetic evaluation and selection tool for feet and leg traits. The goals of this study were to identify feet and leg indicator traits and develop a scoring method that can be easily adopted by cattle producers for both breeds.

Experimental Procedures

Feet and leg phenotypes were obtained from August 2015 through September 2017 for 14 traits: body condition score, front hoof angle, front hoof depth, front claw shape, rear hoof angle, rear hoof depth, rear claw shape, foot size, front side view, front hoof orientation, knee orientation, rear leg side view, rear leg hind view, and composite score. Scores were obtained by trained livestock evaluators as subjective measurements and each animal was scored by at least two observers. A scale of 1-100 was used for all

feet and leg traits (1 and 100 are extreme, 50 is desirable), body condition score was measured on a scale of 1-9 (1 and 9 are extreme, 5 is desirable), and composite score was measured on a scale of 1-50 (1 and 50 are extreme, 25 is desirable). Feet and leg trait phenotypes were later truncated to a 1-9 scale (1 and 9 are extreme, 5 is desirable) and composite score was truncated to a 1-4 scale (1 and 4 are extreme, 2.5 is desirable). Measurements were collected using an electronic tablet with a scoring survey and offline data storage capacity.

Data were obtained on 1,885 Red Angus cattle, and after editing, 1,720 records were used for analysis. A three-generation pedigree file was provided by the Red Angus Association of America, which contained 13,306 animals. Data were analyzed using multiple bivariate logistic animal models with random effects of additive genetic and residual genetic, and fixed effects of contemporary group and age in months.

Contemporary group was defined as the combination of herd and year born. There were 48 contemporary groups represented in the Red Angus dataset. Bull age ranged from 1 to 2 years of age, with no bulls older than 3 years of age–as most production systems would not have large contemporary groups of mature bulls. Cow age ranged from 1 to 18 years of age, with decreasing number of animals represented with increasing age.

Results and Discussion

An average heritability and standard error estimate for both measures of scale can be found in Table 1. Heritability estimates were moderate for traits such as front hoof angle (0.18-0.20), rear heel depth (0.24-0.25), foot size (0.29-0.36), and rear leg side view (0.29-0.30). This informs producers that genetic selection pressure for these particular traits can result in improved feet and leg conformation. Estimates that were lowly heritable, yet could still exhibit progress through selection were rear hoof angle (0.17-0.19), rear claw shape (0.15-0.17), front side view (0.17-0.17), and rear leg rear view (0.11-0.14). The comparison of heritability estimates from both measurements of scale indicate granularity of scale, in other words using the 9-point scale compared to the 100-point scale, had little effect on heritability differences.

Implications

Feet and leg traits are moderately to lowly heritable; however, producers can still select on traits for improved soundness. Scoring on a less granular measurement of scale (1-9) may be an important simplification for developing an established scoring method for Red Angus and Simmental producers. Further validation on a larger and more diverse population of Red Angus and Simmental cattle could help further understand feet and leg trait differences and their impacts on herd profitability.

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Table 1. Comparison of heritability estimates for feet and leg traits observed on a 1-9 scale and 1-100 scale in Red Angus cattle

	1-9 Scale[1]		1-100 Scale[2]	
Trait	Average heritability	Standard error	Average heritability	Standard error
Body condition score	0.13	0.05	0.11	0.04
Front hoof angle	0.18	0.06	0.20	0.06
Front heel depth	0.12	0.04	0.17	0.05
Front claw shape	0.08	0.04	0.09	0.04
Rear hoof angle	0.17	0.05	0.19	0.06
Rear heel depth	0.24	0.06	0.25	0.06
Rear claw shape	0.15	0.05	0.17	0.05
Foot size	0.29	0.06	0.36	0.06
Front side view	0.15	0.05	0.16	0.05
Hoof orientation	0.15	0.05	0.17	0.05
Knee orientation	0.11	0.05	0.17	0.05
Rear leg side view	0.29	0.06	0.30	0.06
Rear leg rear view	0.11	0.04	0.14	0.05
Composite score	0.09	0.04	0.12	0.05

[1]The 9-point scale is equivalent to attributes of the 100-point scale.
[2]The 100-point scale.