By the Numbers

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Angus genetic evaluation research on pulmonary arterial pressure

High-altitude disease can be a concern for Angus breeders at greater elevations, especially as cattle death loss increases. Pulmonary arterial pressure (PAP) scores have traditionally been used to determine animals' suitability for higher elevations. Also, genetic selection could be used to breed cattle that adapt to high-altitude environments.

High-altitude disease and PAP

High-altitude disease, or "brisket disease," generally affects cattle at elevations 5,000 feet (ft.) or more above sea level. Because of the lower oxygen concentrations at higher elevations, the blood vessels in the lungs narrow, resulting in increased blood pressure. This increase in blood pressure forces the heart to work harder and to become enlarged. The heart valve becomes leaky, and fluid collects in the brisket, resulting in the common name of "brisket disease."

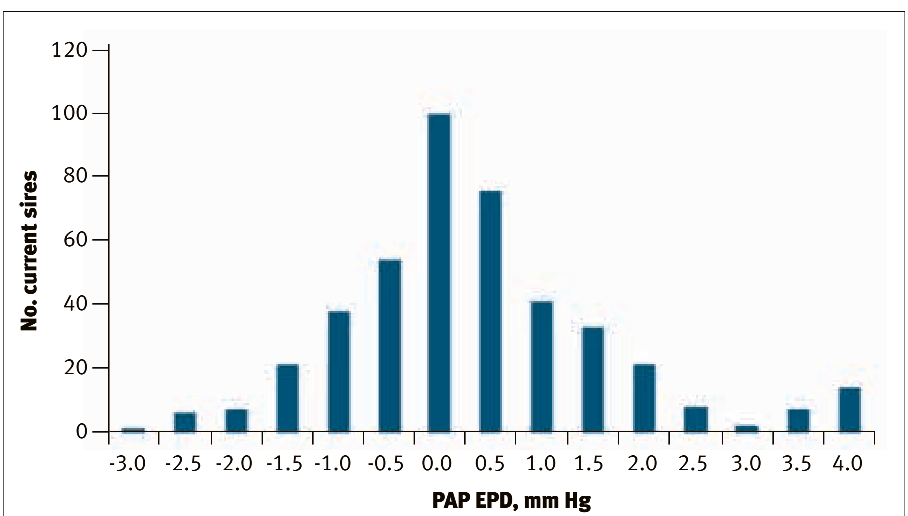
High-altitude disease often results in sudden unexplained death as a result of heart failure. Cattle can be taken to lower elevations as a treatment, but this remedy may not be feasible. One way to evaluate an animal's susceptibility to high-altitude disease is by measuring a phenotypic PAP score.

The PAP score is an average of the systolic and diastolic blood pressure in the pulmonary artery. The greater the PAP score, the more susceptible the animal is to high-altitude disease. Generally, cattle with PAP scores of 30 millimeters mercury (mm Hg) to 40 mm Hg are considered suited for high-altitude environments. PAP scores should be measured on cattle a year of age or older that have been at an elevation of 5,000 ft. or more above sea level for at least three weeks (Holt, 2008). PAP scores are an indicator for susceptibility to high-altitude disease, and previous research at Colorado State University (CSU) indicated PAP scores can be improved through genetic selection.

Table 1: Descriptive statistics for PAP scores and genetic evaluation

No. of PAP records	3,336			
No. of contemporary groups	358			
No. of animals with EPDs	7,720			
	Mean	**SD**	**Min.**	**Max.**
PAP Score	44	11	11	156
PAP EPD	-0.1	1.3	-3.4	16.0
Accuracy	0.15	0.11	0.00	0.75

Fig. 1: Distribution of PAP EPDs among American Angus Association current sires[a]



[a]Current sires have at least one calf recorded in the herdbook within the past two years.

Angus genetic evaluation research

PAP scores on bulls, heifers and steers were provided by four Angus herds as collected by CSU veterinarian Tim Holt. An animal model and three-generation pedigree were used in the analysis. Contemporary groups were based on yearling information and included herd, weaning date, yearling date and associated management codes. Expected progeny differences (EPDs) were generated for 7,720 animals, and descriptive statistics for EPDs and accuracies are provided in Table 1.

The heritability estimate for PAP score was 0.30 ± 0.05. This is consistent with the heritability estimate of 0.34 previously reported by Shirley et al. (2008). Thus, results indicate that Angus breeders and users of Angus genetics can select to reduce PAP scores to make their cattle better-adapted to high-altitude environments.

There were 429 current sires with PAP EPDs in this evaluation. Fig. 1 is the distribution of PAP EPDs for those current sires. The percentile breakdown for these sires is in Table 2. This table can be used to determine how an animal compares to the current sires in this research project.

Table 3 has the possible change values for the PAP EPD at different accuracy levels. These values should be added and subtracted from the EPD to determine the range where the "true" progeny difference is expected to be. Two-thirds of the time the true progeny difference should be within this range. As an example, an animal with a 0.50 accuracy and PAP EPD of 1 should have a true progeny difference within -0.5 to 2.5 about two-thirds of the time.

The average PAP EPD by birth year has not changed over time, meaning there is a flat genetic trend for this trait. Little genetic-selection pressure has been placed on PAP score. However, genetic progress could be made by using PAP EPDs in selection and mating decisions.

Angus PAP EPDs

PAP EPDs can be used to select for decreased PAP score, which is associated with a lesser incidence of high-altitude disease. EPDs are reported in units of mm Hg. Smaller or more negative EPDs are more desirable, just like lower numeric phenotypic PAP scores are more desirable. Table 4 provides an example of PAP EPDs for two sires. Bull A's EPD is 5 mm Hg less than Bull B's EPD. This means Bull A is expected to sire progeny that, on average, have PAP scores 5 mm Hg lower than Bull B's progeny's PAP scores.

This selection tool can be extremely valuable in areas of the country where high-altitude disease is a concern.

►PAP scores have traditionally been used to determine animals' suitability for higher elevations.

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Table 3: Accuracy and associated possible change for Angus PAP EPDs

Accuracy	Possible change
0.05	2.8
0.10	2.7
0.15	2.5
0.20	2.4
0.25	2.2
0.30	2.1
0.35	1.9
0.40	1.8
0.45	1.6
0.50	1.5
0.55	1.3
0.60	1.2
0.65	1.0
0.70	0.9
0.75	0.7
0.80	0.6
0.85	0.4
0.90	0.3
0.95	0.1
1.00	0.0

Table 4. Pulmonary arterial pressure (PAP) EPD example

Bull A	-1 mm Hg
Bull B	+4 mm Hg
Difference	-5 mm Hg

Angus breeders who are selling bulls or females to cattle producers in these places can benefit from the use of PAP EPDs. These producers can use PAP EPDs as a genetic selection tool to reduce PAP scores in their herd and to help customers identify the genetics that are most adaptable to their environment.

> **PAP EPDs can be used to select for decreased PAP score, which is associated with a lesser incidence of high-altitude disease.**

Genetic correlations with growth traits

Previous research by Shirley et al. (2008) indicated that birth and weaning weight had strong positive genetic correlations with PAP score. For the current study, the genetic correlation between PAP score and weaning weight was 0.32 ± 0.13. However, there was no significant genetic correlation between PAP score and yearling weight. When no selection pressure is placed on the PAP EPD, genetic selection for greater early growth results in the genetic potential for greater PAP score. This is an undesirable relationship, and producers who are concerned about high-altitude disease should place selection pressure on PAP.

Summary

An initial research genetic evaluation to generate PAP EPDs has been completed based on phenotypic data submitted to the Association by Angus breeders. Based on the EPDs and genetic parameters that were estimated, considerable genetic variation exists for PAP scores. This trait is moderately heritable, meaning producers can select to reduce PAP score and lessen the risk of high-altitude disease. A lower numeric PAP EPD is more desirable because this equates to lower PAP scores in the animal's future progeny. Cattle with lower phenotypic PAP scores are more adaptable to high-altitude environments.

The Association gratefully acknowledges the Angus breeders who submitted PAP scores for this preliminary genetic evaluation. Breeders wanting to submit data for future updates to the research PAP genetic evaluation should contact the Association.

Editor's Note: *Now a doctoral student at Kansas State University, Heather Bradford was the summer 2013 intern for AGI.*