PHOTO BY SHAUNA ROSE HERMEL

Consider Structural Integrity

While some consider the problem mostly environmental and some consider it mostly genetic, most agree there is room for improvement.

*by **Troy Smith**, field editor*

Let's consider some of the reasons why a breeding bull might become lame and unfit for service. We're not talking about foot rot and other infections, wicked wire cuts or broken appendages. Forget about disease and accidental injury. Think about other reasons that some bulls become lame and physically unable to bear the rigors of natural service.

It could be cows that fall out of the herd too soon due to problems with their feet or failed hock, stifle or hip joints. Let's think about failures related to structural integrity.

An engineering-savvy professor at the University of Oxford once described structural integrity as *the application of science and artful working in order to stress materials such that the arrangement and mutual relation of parts of complex structures remain in an unimpaired and complete state.* That's a mouthful, but most cattle-savvy people can see how it might be applied to the structural integrity of cattle.

That part about "the arrangement and mutual relation of parts of complex structures" could relate to a critter's conformation.

"Application of science and artful working" is an apt description of animal husbandry — the attention to genetic selection, proper nutrition and all the management practices necessary to promote desired levels of productive and reproductive performance. Cattle producers skilled in animal husbandry seek performance but certainly want animals to thrive, or "remain in an unimpaired and complete state." It's essential to the longevity of breeding animals.

Of course, some breeding animals do become impaired or incomplete and exit the herd prematurely. Opinions differ as to why breakdowns in structural integrity occur. Some people think it's genetic, while others claim more fault lies with management of nutrition.

"Today, we've got animals whose performance is far superior to animals of 50 years ago, but we haven't necessarily figured out how to feed them."

— David Anderson

Room for improvement

People also disagree as to whether there is any sort of industrywide trend toward a worsening of structural integrity. Some people fear a trend exists, but others say the situation is no worse than it ever was. That there is room for improvement is something on which the knowledgeable people interviewed for this story do agree.

Representatives of some major companies that merchandise beef cattle semen and artificial insemination (AI) services say they have become pretty picky when evaluating and procuring AI sires. They are particularly leery of foot issues — shallow heels, long or crooked toes, and feet that are soft or too small. Hooves are an extension of the animal's skeleton, so "defects" are often associated with poor limb conformation. However, foot problems may also be associated with dietary excesses and deficiencies, restricted exercise and other

CONTINUED ON PAGE 68

►**Above:** According to University of Nebraska geneticist Matt Spangler, evidence suggests "structure" is at least moderately heritable, meaning genetic change can be made by including it in a genetic evaluation.

Consider Structural Integrity CONTINUED FROM PAGE 66

conditions associated with the environment.

"We do eliminate a lot of bulls from consideration because of their feet," says ABS Global's Doug Frank. "It's not breed specific, but whether it's because of genetics or environment, some herds appear to have more problems than others."

Frank suspects genetic selection, at least in some situations, may place greater emphasis on traits other than those influencing structural integrity.

Don Trimmer, with Accelerated Genetics, says genetics contribute to some problems, but management and the environment are major factors.

"Foot problems seem to be less likely to occur among bulls marketed at an older age — bulls that are developed slowly, where they have plenty of room, and are encouraged to travel," Trimmer states. "I see foot problems most often in bulls that are pushed hard to be marketed as yearlings. Wet, muddy growing lots and too little exercise make it worse."

Heritable

According to University of Nebraska geneticist Matt Spangler, evidence suggests "structure" is at least moderately heritable, meaning genetic change can be made by including it in a genetic evaluation — the process used to develop expected progeny difference (EPD) values. Accumulation of the necessary data would require that registered seedstock be scored, according to a standardized scale, with results submitted to the breed association.

In Australia, Spangler says, a numerical scoring system is applied to evaluate toes or claws on each front and rear foot, as well as the angle or slope of pastern for each limb. A side and rear view of the hind legs are also scored. Australia requires that scoring be done by "accredited assessors."

Still, it's a subjective evaluation and potentially vulnerable to inconsistent scoring and, perhaps, recording bias. Spangler says these types of categorical traits might also suffer from low incidence rates, which can create computational issues for genetic evaluations.

Spangler says there is no question that management plays a huge role in the structural integrity of bulls, and many mainstream seedstock producers overdevelop young bulls.

"It can lead to a general decrease in longevity if the feeding regime creates foot problems. Bulls need to be fed such that genetic differences in growth and carcass merit can be expressed and structural integrity is not jeopardized," Spangler states.

"That being said, it is my observation that the average bull buyer is willing to pay for overdeveloped, or fat, bulls," he continues. "In fact, their eye gravitates toward them. It's an unfortunate consequence of visual and not genetic appraisal of candidate sires."

Outpacing bone development

David Anderson, who heads the Large Animal Clinical Sciences Department at the University of Tennessee College of Veterinary Medicine, understands the temptation to feed bulls aggressively and maximize production traits. Unfortunately, he says, animals genetically programmed to develop muscle rapidly may do so at a rate that outpaces development of bone and connective tissue.

"Today, we've got animals whose performance is far superior to animals of 50

CONTINUED ON PAGE 70

Scoring structural soundness

"We were seeing structural problems in some bulls. There were complaints from commercial bull buyers," says Al Kennett, a recently retired University of Missouri (MU) Extension livestock specialist and advisor for a bull test and sale held in northeast Missouri.

Kennett says the majority of complaints cited "hooked" and overgrown toes as the reason bulls became unwilling or unable to travel well and provide satisfactory service.

"Several years ago, Eldon Cole and I worked out a scoring system for feet and leg structure. Bulls that scored poorly wouldn't make the sale. Long-term, it's been good for our sale," Kennett adds.

An Extension livestock specialist serving the southwestern part of the state, Cole had heard complaints about consignments to his region's performance-tested bull sale. Adjustments to bull development seemed prudent, but Cole also thought it was time for more formal scrutiny of animal conformation.

"Evaluation of seedstock really has to start at the ground, and you work up from there. Feet and leg structure can't be neglected," Cole states.

According to Cole, bulls are numerically scored from 1 to 10. Scores of 10 or 9 are considered perfect or nearly perfect for hoof size, toe shape and symmetry, and correctness of slope to pasterns, hocks and shoulders. Bulls assigned scores of 8, 7 or 6 are considered sound and exhibit good foot size, even toes and good heel depth. Joint angles are generally correct.

Moving down the scale, scores of 5 or 4 indicate an animal's structure is without serious faults and at least acceptable. However, they may have mild toe unevenness, slight rolling of rear toes, early signs of corns, the need for some hoof trimming and a short, choppy stride. The latter may be due to a very straight set to the rear legs or the shoulder.

Animals receiving scores of 3, 2 or 1 do exhibit serious faults likely to impair movement and expected longevity. These may include excessive toe growth, uneven or spread toes, corns or hoof cracks. Low-scoring animals also may exhibit faulty limb conformation.

Cole says buyers are more enthusiastic about soundness scoring than are some breeders.

Tennessee experience

That's probably true for the University of Tennessee's bull-testing program, says Tennessee Extension Beef Cattle Specialist David Kirkpatrick. In response to similar buyer concerns, Kirkpatrick introduced soundness scoring four years ago, but has borrowed from the Australian model.

"Buyers have complained about bulls' feet going bad, with curled toes, abnormal growth and the need for routine trimming. I hear the same things about bulls bought through independent bull tests. And there does seem to be some similarity of pedigrees among problem bulls," Kirkpatrick says.

Responding to complaints about the developing diet being too 'hot,' Kirkpatrick says the ration was adjusted, and the test period was shortened from 112 to 84 days. To help address genetic influences, he started scoring bulls. Producers are also introduced to the scoring system through Tennessee's Master Beef Producer program.

"I want scoring data for analysis," Kirkpatrick adds. "If structure, particularly feet and claw, is heritable, then we should be able to develop genetic evaluations for these traits. This would entail subjective scoring within a given set of guidelines, which is similar to evaluations presently used in developing both docility and calving ease EPDs (expected progeny differences). In Australia, they're already calculating EPDs (estimated breeding values, or EBVs, in Australia) for structural traits. Structural integrity is important. It's fundamental."

Scoring in Australia

Attempting to aid cattle producers in genetic selection for structural integrity, Angus Australia has produced trial estimated breeding values (EBVs) for five foot and leg traits. The five traits include front feet claw set, front feet angle, rear feet angle, correctness of rear legs from a side view and correctness of rear legs from a rear view.

Carel Teseling, Angus Australia's breed development and information manager, says data from 9,000 animals representing 40 Angus herds were used to generate structure EBVs. Structure scores are accepted only for animals assessed by technicians accredited by the Performance Beef Breeders Association.

Teseling emphasizes that the new EBVs have been produced as a trial only, but the information is available on the Angus Australia website. Posted structure EBVs have accuracies of 40% or greater.

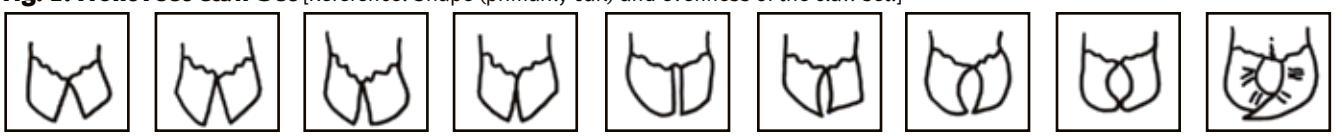
The assessment system uses a 1-to-9 scoring system for feet-and-leg structure, with a 5 being ideal (see Figs. 1-4). Scores 4 and 6 show slight variations from ideal, but would include most animals and would be acceptable in any breeding program. Scores 3 and 7 represent greater variation, but would be acceptable in most commercial breeding programs, but seedstock producers should be wary.

Scores 2 and 8 are low-scoring animals and should be looked at carefully before purchasing, according to the Australian scoring system. Scores 1 and 9 should not be catalogued and are considered culls.

PHOTO COURTESY OF DAVID KIRKPATRICK

►"I want scoring data for analysis," David Kirkpatrick adds. "In Australia, they're already calculating EPDs (estimated breeding values, or EBVs, in Australia) for structural traits. Structural integrity is important. It's fundamental."

Fig. 1: Front Feet Claw Set [Reference: Shape (primarily curl) and evenness of the claw set.]



1 2 3 4 5 6 7 8 9

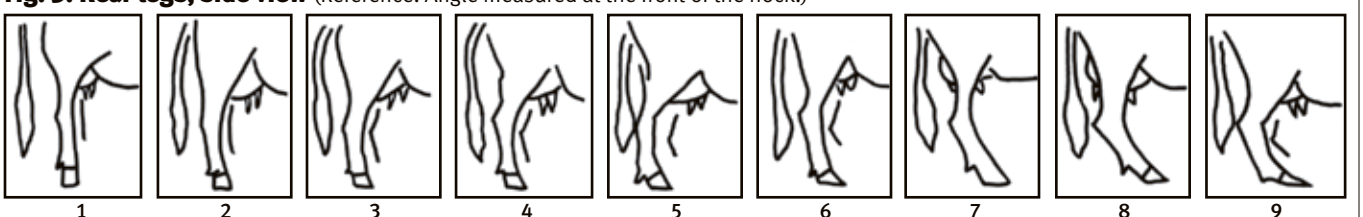
1 – open divergent; 5 – good; 9 extreme scissor claw

Fig. 2: Front feet angle and rear feet angle (Reference: Strength of pastern, depth of heel and length of foot.)

1 2 3 4 5 6 7 8 9

1 – steep (stubbed toe); 5 – good; 9 – shallow heel

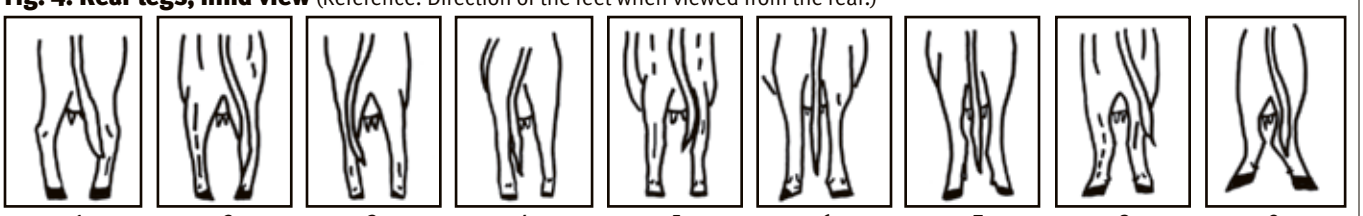
Fig. 3: Rear legs, side view (Reference: Angle measured at the front of the hock.)



1 2 3 4 5 6 7 8 9

1 – straight (post-legged); 5 – good; 9 – sickle-hocked

Fig. 4: Rear legs, hind view (Reference: Direction of the feet when viewed from the rear.)



1 2 3 4 5 6 7 8 9

1 – bow-legged; 5 – good (parallel); 9 – cow-hocked

For more information contact Carel Teseling, Angus Australia's breed development and information manager at *carel@angusaustralia.com.au.*

Consider Structural Integrity CONTINUED FROM PAGE 68

years ago, but we haven't necessarily figured out how to feed them," Anderson says.

"Professional nutritionists work with the best information available, but it's based on data from animals grown and finished for market. That's about growing as much muscle as you can, and doing it fast. With breeding animals, you need a skeletal structure that will hold it all together for a much longer period of time. You need to develop seedstock for optimum longevity."

Anderson says the many bulls fed diets designed to drive rapid muscle development may actually be deficient in certain minerals. Typically, minerals are added to their rations, but the high levels of carbohydrates, protein and fat may interfere with mineral absorption.

"Particularly trace minerals and vitamins, too, are needed for skeletal system development — for bones, tendons, ligaments and cartilage, but also feet. Minerals and vitamins are important to development of tough hooves," Anderson explains. "The animals need more trace minerals and vitamins than they're able to get from many of these diets."

On the edge of acidosis

University of Florida animal scientist Todd Thrift is convinced that structural integrity is a product of genotype-environment interaction. In other words, when a breeding bull breaks down structurally, it's likely due to a combination of factors.

"We've selected cattle for more growth and tried to make them marble better. In the process, perhaps some soundness issues have been overlooked. A lot of bulls are fed nearly like feedlot steers — at the edge of acidosis — and made too fat. And maybe we're making them less adaptable," Thrift suggests.

Genetics and nutrition during development can contribute to adaptability, but Thrift believes the physical environment does, too. He cites differences he has seen in bulls, representing the same genetics, when they were developed on the rock-strewn landscape of West Texas vs. the softer soils of East Texas.

"Bulls in the West have big hard feet, while the feet on bulls in the East are smaller and softer. I believe the differences were, in large part, due to their environments. I see a lot of merit in buying bulls adapted to your own kind of country," Thrift says.

So, when a bull's structural integrity comes into question, it's possible that the problem is genetic. It might be related to nutrition during development, or maybe he couldn't adapt to his working environment. Perhaps for all of these reasons, he wasn't well-prepared for what he was supposed to do.

AJ

Editor's Note: *This article has been updated from an original October 2011 article. Troy Smith is a freelance writer and cattleman from Sargent, Neb.*