Temperament Affects Rangeland Use Patterns and Reproductive Performance of Beef Cows

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Source: Rangelands, 38(5):292-296.
Published By: Society for Range Management
URL: http://www.bioone.org/doi/full/10.1016/j.rala.2016.07.002

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On the Ground

- The American beef industry is paying more attention to cattle temperament, but studies examining relationships between temperaments and grazing behavior or animal performance on rangelands are limited.
- We studied range beef cow temperaments using the behavioral syndromes framework. Cows classified into behavioral type groups on the basis of a suite of correlated behaviors showed contrasting rangeland use patterns and different reproductive efficiency. These differences resulted in temperament-related culling rates over time.
- We argue that the behavioral syndromes conceptual framework could be a valuable tool to advance current understanding about how cattle temperaments are related to grazing patterns and animal performance on rangeland.

Keywords: behavioral syndromes, grazing behavior, calf weight.

Rangelands 38(5):292–296
doi: 10.1016/j.rala.2016.07.002

The American Beef Industry is Paying More Attention to Cattle Temperament

Cattle temperament has become increasingly important to beef cattle producers. The USDA National Animal Health Monitoring System's survey of 2,700 cow-calf operations[1] found that 16.6% of operations had sold at least one cow due to temperament, and that cow-calf operations sold on average 3.6% of cows solely due to temperament in 2007, a 10.2% and 1.9% increase from their 1997 survey, respectively.[2] Another survey found that 31% of producers included disposition among their top three criteria for bull selection and 7% listed disposition as their number one criterion.[3]

Breed associations have noticed this preference for animals with a calmer temperament. In 1991, the Limousin Directions Breeders Symposium identified improving disposition as their number one breed priority.[4] Using the Beef Improvement Federation (BIF) temperament scoring system, which scores an animal on a scale of one through six from docile to very aggressive while being processed through a chute, the North American Limousin Foundation (NALF) became the first breed in the industry to develop a docility expected progeny difference (EPD) index.[4] Then, in 2008, the American Angus Association followed suit and included a docility EPD in their National Cattle Evaluation,[5] followed by the American Simmental Association in 2011.[6]

The increasing importance given to the temperament of cattle may be explained by the advancing average age of cowherd owners (59 years), the decrease in available farm labor, or the increasing cost of healthcare.[6] Another likely cause is the increasing evidence that docility affects animal performance in confinement. In feedlots, researchers have found that compared to calmer cattle, stressed animals exhibit reduced growth rates,[7] decreased ADG (average daily gain),[7–9] lower body condition score,[8] lower feed conversion efficiency,[7,8] lighter weights at slaughter,[10] lighter carcass weights,[7,10] tougher meat,[8,11,12] and higher proportions of dark cutting beef.[11] Temperament-related differences in performance of feedlot calves can result in a $62.19/head greater return on docile vs. aggressive animals.[13]

But Do Cattle Temperaments Really Matter in Rangeland Environments?

Studies examining relationships between cattle temperaments and grazing behavior or animal performance on rangelands are limited, but have generally concluded that regardless of the type of breed origin, whether ***Bos taurus*** or ***B. indicus***, and class of

animal, whether steers or cows, temperament is unrelated to animal terrain use[14] and animal performance.[14–16] For example, no relationship between temperaments of steers and cows, assessed via a chute rating score, and levels of fat deposition (steers) or pregnancy rates (cows) were found in rangeland-raised cattle in northern Queensland, Australia.[15] In Montana, researchers found that temperament of cows at calving assessed via a qualitative chute temperament score, were not related to terrain use patterns.[14] In northern Colorado, researchers recently reported no relationship between steer temperament, assessed twice via chute exit velocity scores, and average daily weight gains on shortgrass prairie.[16]

It is frequently assumed that animals with docile vs. more aggressive temperaments perform equally well on rangelands because per capita space allowance is not limiting (usually many acres per animal) and handling by humans is infrequent.[16] While this may be true, it is also possible that different temperament traits are relevant to animal performance in confinement vs. rangeland (see next section) or, more importantly, that measuring a single behavioral trait to infer animal temperament, as is often the case, is not sufficient.

Ecologists who investigate the biological significance of individual-based variation in animal behavior increasingly are using conceptual and analytical frameworks that take into account multiple co-varying behavioral traits.[17] To date, there has been limited to nil adoption of these approaches among livestock ethologists. Our objective in this article is to report work conducted by our team that assessed range beef cattle temperaments using the behavioral syndromes framework.[18]

Behavioral Syndromes: A Different Framework to Assess Animal Temperaments

Behavioral syndromes are defined as suites of correlated behaviors that are consistently different among individuals across situations (feeding behavior on range pastures and in the feedlot), context (boldness in feeding, anti-predator, and mating behavior), and time.[19] Behaviors included in a syndrome can be either inherited or learned and need not be constant throughout the lifetime of an individual. This notion sets behavioral syndromes apart from the closely-related concepts of personalities, coping styles, or temperaments, all of which consist of behaviors that are not necessarily correlated and that are assumed to be mostly controlled by inheritance.[20]

Interestingly, most temperament tests done on cattle focus almost exclusively on the first of five general temperament trait categories described in the literature: shyness–boldness; exploration–avoidance; activity; sociability; and aggressiveness.[21] While inferring temperament from shyness–boldness tests seems reasonable for feedlot animals whose contact with humans is frequent and living space is limited, in rangeland environments exploration–avoidance dimensions of livestock temperaments may be as important as shyness–boldness reactions, given the ever-changing nature of the foraging environment. The behavioral syndrome approach allows individuals to be classified into behavioral types on the basis of more than one of these five temperament trait categories,[22] making it a very useful tool to explore the connections between cattle temperament and performance on rangeland.

Behavioral ecologists have also shown that behavioral syndromes affect an animal's fitness because they can limit an individual's ability to adapt to varying environments.[17] Based on these ideas, we reasoned that if we could assess temperaments using the behavioral syndromes framework, i.e., measuring suites of correlated behaviors on each animal, we might be able to detect the elusive temperament–performance connections.

Temperament–Performance Connections Revealed by the Behavioral Syndrome Classification Approach[i]

Our team began this study in 2006 by conducting multiple tests with individually stalled pregnant or nursing young beef cows to determine the time it took each animal to consume a pound of cotton seed cake in confinement. We then selected the cows with the fastest and slowest supplement consumption rate (SCR), fitted them with GPS collars, and monitored their behavior in a 321-acre rangeland pasture for several weeks immediately after calving. We reasoned that if the behavioral syndrome idea were correct, differences in feeding style in the stalls (contrasting SCR) would have to translate into differences in the cows' approach to foraging on rangeland, which should eventually result in performance differences. We also hypothesized that we should be able to identify a physiological indicator that pointed to a potential mechanism that we could eventually rely on to explain temperament differences. So we also extracted multiple blood samples from each cow to measure individual serum cortisol levels. The team repeated this study two years in a row, with a different set of cows each year. A total of 36 cows were involved in the study, which was conducted at New Mexico State University Corona Range and Livestock Research Center located close to the geographic center of New Mexico.

We found that SCR was positively correlated with distance traveled from the water drinker, and negatively correlated with the amount of time cows spent loafing close to the drinker or under the juniper trees each day. We also found that cows with high SCR (fast eaters) had significantly higher serum cortisol levels than their low SCR (slow eaters) counterparts. We were able to separate cows into statistically different behavioral type groups on the basis of their pasture-use patterns or performance metrics (Table 1).

The first group, which included the fast eaters (high SCR) all of whom exhibited a 'go-getter' type of temperament spent about half as much time close to the drinker and explored a larger area of the pasture each day (+ 9 acres) compared with their slow eater (low SCR) 'laid-back' temperament type peers. Cows belonging to the 'go-getter' behavioral type,

[i] This section describes results from a study published by members of our team in 2012. We refer the reader to Wesley et al.[23] for a detailed account of experimental design, data analysis procedures, and results obtained.

Table 1. Behavior and performance of cows with different temperaments classified into behavioral types by Wesley et al.[23] using the behavioral syndromes framework

	BT_1 go-getters	BT_2 laid-back
SCR	Fast eaters	Slow eaters
Time loafing at water	Short	Long
Spatial search pattern	Dispersed	Concentrated
Calf weaning weights	Heavier	Lighter
Return to estrus after calving	Shorter	Longer
Blood cortisol when confined	High	Low
Frequency of BT in herd	Common	Rare

BT = behavioral types; SCR =supplement consumption rate in confinement.

tended to be slightly heavier, and after calving began gaining weight 25 days sooner and began cycling 18 days sooner. 'Go-getter' cows weaned calves that were on average 44 lb heavier than those of their 'laid-back' behavioral type group (Table 1). These weaning weight differences were not trivial in terms of economic value. With a national average of $203 per hundred pounds for 500 lb steers,[24] if sold at weaning, calves from the average 'go-getter' cow would bring $89 more than a calf from a 'laid-back' temperament type.

The team noticed something unexpected by the end of the two-year study. 'Laid-back' cows were relatively rare in the Corona Ranch herd. We reasoned that if it was true that cows with this temperament type were inferior performers they were possibly being culled from the herd at a higher rate because it is Corona Ranch's policy is to sell all cows that come up open in the fall. We judged this question to be sufficiently important to merit a follow-up case study to track the fate of the 'go-getter' and 'laid-back' cows in the years following the study. We also speculated that if 'laid-back' cows were being culled at higher rates, the average SCR of the herd should increase over time (i.e., with time we would end up with a herd of solid 'go-getters').

What Was the Fate of 'Go-Getter' and 'Laid-Back' Temperament Types in the Corona Ranch Herd?

To address our first question we examined the Corona Ranch herd records and retrieved calving and culling rates for the 'go-getter' and 'laid-back' cows over a five-year period (2006-2010). Cows in the initial study were 3 years old, so assuming that they would stay in the herd until they were 6 or 7 years of age, we selected 2010 as a reasonable cut-off date to explore temperament-dependent culling rates. We used this information to compute cumulative culling rates, which were calculated as the number of animals culled for the current year plus the number culled from all previous years divided by the number of initial animals in a given temperament group.

Over the five-year period, the mean number of calves born to the 20 'go-getter' and nine 'laid-back' cows in the years following that study was 15.6 ± 0.81 and 5.2 ± 0.62. The average number born to each group decreased each year due to culling of open cows. By 2010, only two of the original 9 'laid-back' cows (22%) and 10 of the original 20 original 'go-getter' cows (50%) remained in the herd (Fig. 1). Admittedly, the number of cows that remained in each group is insufficient to make statistically valid inferences from these observations. However, we think that these data provide anecdotic support for our earlier observation that cows with contrasting behavioral syndromes were being culled from the herd at different rates. Our next task will be to design and conduct a robust study to test this hypothesis.

Our second question, i.e., whether the average temperament type of the herd changed over time, was addressed by conducting a single SCR test, as described above, on all 138 adult cows of the Corona Ranch herd in spring 2012. We had learned in the study described above that SCR differences among temperament types were very stable through time,[23] so our classification of the entire adult cow herd in 2012 was done on the basis of a single SCR test per cow (138 tests all told). Once we had the data in hand, we graphically compared the frequency distribution of SCR for the 138 mature cows with that of the 54 young cows tested in 2006, and the 28 young cows tested in 2007. To develop these graphs, we defined ten bins (groups) using 1 g/s intervals for the entire SCR range (0–11 g/s). Number of cows in each bin category was transformed to herd percentage values (number of animals within each bin/total number of animals tested in a given year).

As expected, we found that over a seven-year period (2006-2012) frequency of SCR in the Corona Ranch herd appeared to shift towards a population composed predominantly of 'go-getters' (Fig. 2). All 54 young cows tested in 2006 had SCRs of less than 2.5 g/sec; the largest subgroup (70%) included cows that had SCRs of 0 to 1 g/s (slow eaters, possibly 'laid-back' temperament type). SCRs of the 28 young

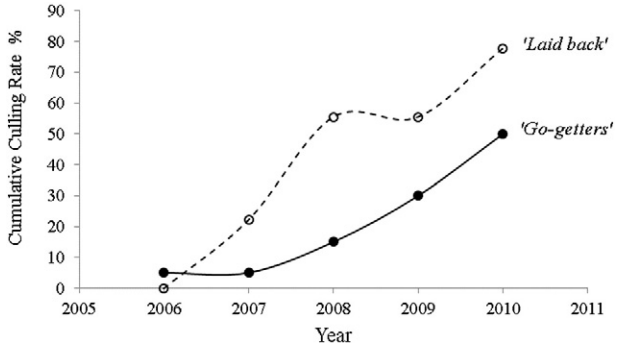

Figure 1. Cumulative culling rate for range beef cows at Corona Ranch classified into two behavioral types: BT_1 or go-getters (n = 20) and BT_2 (n = 9) or laid-back by Wesley et al.[23] Corona Ranch culls all cows that come up open in the fall.

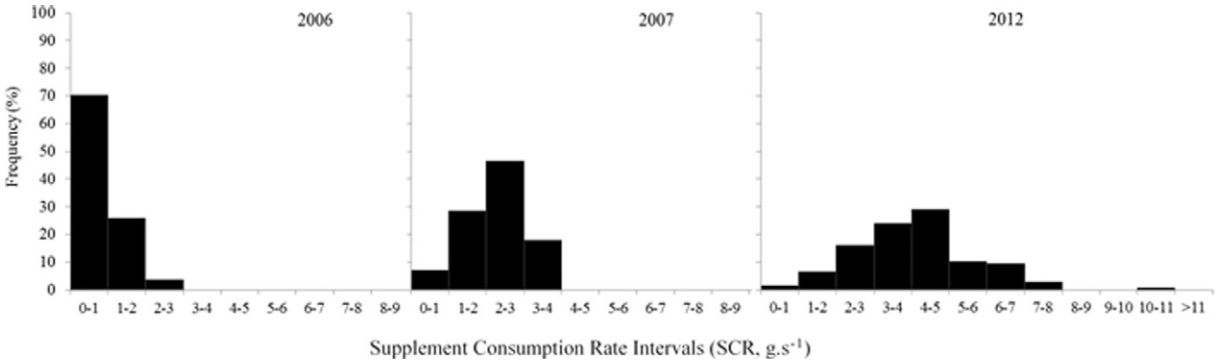

Figure 2. Frequency distribution of supplement consumption rate test results in 3-year-old cows in 2006 (n = 54) and 2007 (n= 28) vs. the entire adult cowherd (4 to 12 y; n = 138) in 2012. Cows with the lowest SCRs belonged to the laid-back behavioral type, whereas cows with high SCRs exhibited go-getter temperaments. The frequency of cows with higher SCR in the Corona Ranch herd tended to increase through time.

cows tested in 2007 were all below 3.7 g/s. By 2012, however, 67% of the herd exhibited SCRs greater than 3 g/s, and the most frequent subgroup (29%) was made up of cows with SCRs ranging from 4.01 to 5 g/s (fast eaters, presumably 'go-getter' temperament type). Our data appear to confirm our original suspicion, although it is also possible that as cows get older and gain weight, they become more skilled at consuming cotton seed cake cubes. Therefore, use of SCR as a behavioral type proxy has limitations that will need to be addressed in future research. Still, even considering these issues, we think that these pieces of circumstantial evidence collectively point to fact that cattle temperament types in the herd we studied are associated with reproductive performance, which appears to have resulted in temperament-dependent culling rates.

Where Do We Go From Here?

Reeves and Derner[16] stated that "there is still much to be learned about cattle temperament and its relationship to performance in a variety of settings." We agree and think that our results suggest that the behavioral syndromes conceptual framework could be a valuable tool to advance the current understanding about how cattle temperaments are related to grazing patterns and animal performance on rangeland. Since concluding the studies described in this article, we continued our investigation of behavioral syndromes working with the entire Corona Ranch black baldy herd of cows and with a ***Bos indicus*** beef breed grazing the somewhat harsher environment of the Chihuahuan Desert. We are encouraged by the data we have analyzed so far. Suites of correlated behaviors as well as connections among temperament, rangeland use patterns, and performance also appear to be present in these data, which we plan to submit to the review of peers before long.

Important questions that warrant further research revolve around how inheritance interacts with learning (either individual or socially-induced) to determine an animal's behavioral type. Can female offspring of 'laid-back' cows learn to become 'go-getters' as adults or should Corona Ranch seek to cull all of the less productive 'laid back' individuals at an early age?

Still, in our opinion, perhaps the more interesting question raised by our data is if cows with optimum temperaments for rangeland environments can produce calves with temperaments well suited for feedlots. Are these two production objectives compatible? Cows with the 'go-getter' temperament type, which appeared better adapted to grazing conditions at Corona Ranch, had significantly higher serum cortisol than their 'laid-back' counterparts.[23] In feedlot environments, high cortisol levels are associated with higher excitability and stress, which have been linked to poorer weight gains, higher morbidity rates, and lower meat quality. If temperament type is heritable, then is it possible that our best rangeland cows are producing mediocre feedlot candidates? Deciphering this possible paradox has the potential to impact emerging views about behavior-based genetic selection of rangeland cattle[25] and current calf backgrounding and receiving protocols.

Acknowledgments

We thank Drs. Derek Bailey, Amy Ganguli, and Robert Steiner for their helpful comments on an earlier version of this manuscript. An anonymous reviewer provided suggestions that helped improve our manuscript.

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