Disposition - Convenience Trait or Economically Important

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Abstract

Disposition or temperament of cattle is a measure of the animals' relative docility, wildness and handling ability during processing in the pen as well as in the handling facilities. Easily excitable animals compromise both their own safety and the safety of their handlers. The Beef Improvement Federation has a 1 to 6 disposition scoring system that is easy to use. The Tri-County Steer Carcass Futurity collects sires, dams, and birth dates from cow-calf producers who retain ownership; as well as collecting growth data, health treatments, disposition scores and complete carcass data on steers and heifers. In the last ten years we have collected data on 66,620 head of cattle from 23 states and Manitoba. Cattle are disposition scored at on-test, re-implant and first sort; the cattle in the 2nd harvest group are scored one additional time. The cattle, based on their average disposition score were grouped as docile, restless and aggressive.

Docile cattle compared to aggressive cattle gain less in the feedlot (3.17 vs. 2.91), produce fewer Choice carcasses (72.4% vs. 58.1%), more Select carcasses (23.3% vs. 36.2%) and the black hided cattle produce a higher percentage of CAB carcasses (29.1% vs. 14.3%). Morbidity rates are similar across disposition scores; however, death loss increases significantly as disposition scores increase. Non-replacement heifers have higher disposition scores than steer mates, as cow-calf producers select for more docile replacement heifers. Average profit for docile cattle was $46.63/head compared to $7.62/head for aggressive cattle.

Disposition or temperament is a moderately heritable trait that impacts feedlot gain, health, quality grade and ultimately profit in the feedlot. How beef cattle are handled impacts the amount of stress they feel during routine feedlot processing. The beef producers understanding of the animal's vision and hearing will help reduce handling stress for the beef cattle.

Reducing sounds, both human voices and clanging metal, are positive steps towards reducing stress on cattle and ultimately the people handling them. Properly designed working facilities with solid sides, well positioned gates and the proper widths for the size of cattle being processed provides a safer work environment for both cattle and people.

Introduction

Disposition or temperament of cattle is a measure of the animals' relative docility, wildness and handling ability during processing in the pen as well as in the handling facilities. As with most traits in beef production, part of the final product is inherited from the sire and dam and the other part is influenced by management and the environment the animal is developed in and exposed to.

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Easily excitable animals compromise their own safety and the safety of stockpersons in charge of raising them. Producers have recognized the importance of temperament in successful management (Gauly et al., 2001).

Is the value of good disposition cattle only in less gas used in the 4 wheeler to move the cattle from one pasture to another? Or does the disposition or temperament of cattle impact feedlot gain, carcass quality and other economically important traits?

How does one measure disposition?

The Beef Improvement Federation scoring system is:

Disposition Score = 1 to 6 chute scoring system

1 = Docile. Mild disposition, gentle, and handles quietly. Exits chute calmly.

2 = Restless. Quieter than average, but may be stubborn during processing. Some tail flicking. Exits the chute promptly.

3 = Nervous. Typical temperament is manageable, but nervous and impatient. Constant movement. Repeated pushing and pulling on headgate. Exits chute briskly.

4 = Flighty (wild). Jumpy and out of control, quivers and struggles violently. Continuous tail flicking. Frantically runs fence line and may jump when penned individually. Exhibits long flight distance and exits chute wildly.

5 = Aggressive. Similar to Score 4, but with added aggressive behavior, fearful, extreme agitation, continuous movement which may include jumping and bellowing while in chute. Exits chute frantically and may exhibit attack behavior when handled alone.

6 = Very aggressive. Extremely aggressive temperament, "killers". Pronounced attack behavior.

Another subjective system is a pen scoring system using similar criteria as the BIF chute scoring system. One method of evaluating temperament is exit velocity, which is the rate at which an animal covers a set distance usually 5 to 10 feet after exiting the chute. Infrared sensors are used to remotely trigger the start and stop of a timing apparatus. Exit velocity is an objective number that is more valuable in a research setting and requires an investment in equipment. Curley et.al. (2006) concluded, whereas the various methodologies for temperament assessment may measure slightly different aspects of animal behavior, they do relate to one another, and in the case of exit velocity and pen score to increased circulating glucocorticoids.

My experience training students and TCSCF employees to do disposition scores has found that most people are able to understand the BIF scoring system and accurately apply it to feedlot cattle after co-evaluating 100 head. However, producers' self-evaluation of their own cattle has left a lot to be desired. Visiting with producers whose cattle have been above average in disposition at the feedlot surfaces a few comments that are consistent. They were not aware their cattle were difficult to handle and assumed everyone else's cattle were that wild. One or two sires are identified as producing most of the undesirable disposition calves. Working cattle quietly and without hot shots had not been done in the past.

Australian work concluded temperament is highly repeatable and an animal's temperament changes little over time (Petherick 2002).

Is disposition an important economic trait?

From 2002 to 2009, 47,410 calves fed at eighteen Southwest Iowa feedyards were used to evaluate the effect of disposition during the feedlot period on feedlot gain and carcass quality. The steers and heifers were consigned to the Tri County Steer Carcass Futurity by cow calf producers representing 23 states/provinces, including: Georgia, South Carolina, Alabama, Florida, Virginia, Missouri, Indiana, Mississippi, Tennessee, Minnesota, Illinois, Kentucky, West Virginia, Maryland, Nebraska, North Carolina, Louisiana, Oklahoma, Kansas, North Dakota, South Dakota, Iowa and Manitoba. The cattle were weighed multiple times; upon arrival to the feedlot, after 28 to 35 days, at re-implant, and prior to harvest. A disposition score using the Beef Improvement Federation six point scoring system; 1=very docile and 6=aggressive, was assigned at on test weighing, re-implant time, and pre-harvest. A common diet and health program was utilized at each feedlot. Calves were sorted and harvested when they were visually evaluated to have .40 to .45 inches of fat cover.

The six point system was condensed to three classifications for analysis: 1 and 2 = docile, 3 and 4 = restless, and 5 and 6 = aggressive.

Item	Docile	Restless	Aggressive
No of Head	27,617	15,720	4,071
% of Total	58.2%	33.2%	8.6%
Arrival Weight	643	642	642
Overall ADG	3.22 [a]	3.15 [b]	3.01 [c]
Est. Feed to Gain	6.86 [a]	6.84 [b]	6.97 [c]
Est. Dry Matter Intake	22.11	21.55	20.98
Morbidity Rate	17.2%	18.4%	17.0%
Mortality Rate	0.95% [a]	1.06% [b]	1.69% [c]
% Prime	1.24% [a]	0.70% [b]	0.25% [c]
% Choice	68.68% [a]	64.49% [b]	51.94% [c]
% Select	27.90% [a]	32.05% [b]	42.57% [c]
% Standard	2.18% [a]	2.76% [b]	5.23% [c]
% CAB ®	20.65% [a]	15.21% [b]	9.08% [c]
Profit $/Head	$46.63 [a]	$26.16 [b]	$7.62 [c]

[a,b,c] Values within a factor without a common superscript differ (P<.05).

Quality and yield grade have become increasingly important to the beef feeding industry over the last decade. Today's beef producer has to continually balance feedlot performance with payment premiums and discounts associated with grid-based marketing systems. While calmer cattle perform better in a feedlot environment, producers still need to consider how temperament could affect the United State's Department of Agriculture grading of a beef animal's carcass. Temperament's influence on cattle quality and yield grades is important to any producer marketing their cattle to fit grids that reward low yield grade and middle Choice or higher quality grade.

Research from the Tri-County Steer Carcass Futurity program showed significant trends between temperament and cattle reaching the upper two-thirds Choice or higher ($P < .0002$). More docile cattle are more likely to reach the upper two-thirds Choice or higher quality grade than nervous to aggressive cattle. The reverse effect was seen on the lower quality grades. Nervous to aggressive cattle were more likely than docile cattle to reach the lower quality grades of Select and Standard. In the end, calmer cattle achieved a higher mean average quality grade than cattle with more excitable temperaments (Busby, 2005).

Nervous or aggressive cattle produced more Yield Grade 1's & 2's (70% vs. 58%) than the docile cattle (Busby, 2005).

In our first analysis (2002 – 2004), a greater percent of the docile cattle (19.2% vs. 16.2%) were treated as compared to the aggressive cattle. However, death loss was higher for the aggressive cattle (1.09% vs. 1.91%) when compared to the docile cattle. Why the differences in morbidity and mortality? The Tri-County Steer Carcass Futurity feedlots use the DART assessment for bovine respiratory disease management; where DART stands for Depression, Appetite, Respiratory index and Temperature. Signs of depression are head lowered, ears dropped, eyes dulled and stimulation to move. When walking the pens looking for depressed calves the aggressive calves are most likely in the back of the pen, head held high, ears up and eyes watching every move. One part of the appetite factor is evaluated by how the animal approaches the bunk as the feed truck drives by. The poor disposition cattle tend to stay away from the bunk until the feed truck is out of sight. In other words, 2 of the 4 factors used to assess bovine respiratory disease are impacted by the disposition of the animal. Another factor affecting why less aggressive cattle are pulled more often and have lower death loss, is the question the feedlot manager is asking each time they pull an aggressive animal; will sorting the animal out of the pen, driving it to the treatment area and administering treatment result in the animal responding to the treatment, the animal injuring itself or in the worst case an animal handler being injured. There are two options from a feedlot standpoint; 1 - avoid feeding cattle with poor dispositions, which may not be a viable option, 2 - discount the depression factor in the DART assessment guide.

Presenting the above data to the TCSCF feedlots has resulted in pull rates on cattle with high disposition scores increasing to similar levels as docile and restless cattle. However, the death loss continues to be almost twice as high as the docile cattle.

2002 to 2006 TCSCF Disposition Analysis

Further analysis of the TCSCF data (Reinhardt, et al 2009) along with 2 additional years of steer and heifer (n=21,096) data, adds additional insight into the differences between steers and non-replacement heifers, as well as the changes in feedlot management regarding poor disposition cattle.

Item	Docile Steers	Restless Steers	Aggressive Steers	Docile Heifers	Restless Heifers	Aggressive Heifers	Sex	D X Sex
No of Head	10,740	3,707	875	3,721	1,578	475		
% of Sex Total	70.1%	24.2%	5.7%	64.4%	27.3%	8.2%		
Arrival Wt	673	664	644	629	625	614	<0.001	0.03
ADG	3.56	3.45	3.37	3.26	3.19	3.06	<0.001	0.44
Final Wt	1,201	1,190	1,177	1,120	1,112	1,106	<0.001	0.08
No of Treatments	.27	.24	.29	.19	.15	.16	0.02	0.81
Mortality Rate	1.1%	1.3%	2.4%	1.0%	0.4%	1.0%	<0.01	0.02

Consignors have indicated they are culling heifers based on disposition. Our data confirms that decision, with 5.7% of the steers being aggressive compared to 8.2% of the non-replacement heifers being aggressive. Wilder cattle had significantly lighter arrival weights and steers were impacted more than heifers. Docile cattle had significantly higher average daily gains resulting in significantly heavier final weights. Death loss is significantly higher for aggressive cattle and aggressive steers die prematurely at a higher rate than heifers.

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No of Head	10,740	3,707	875	3,721	1,578	475		
Hot Carcass Wt	737	733	728	688	687	684	<0.001	0.26
Fat Cover	.43	.42	.39	.47	.46	.43	<0.001	0.36
REA sq in	12.4	12.3	12.2	12.1	12.1	12.0	<0.001	0.82
REA/cwt of Hot Carcass Wt	1.68	1.68	1.67	1.76	1.76	1.75	<0.001	0.05
% CH & +	16.6%	15.0%	8.6%	22.7%	18.3%	15.7%	<0.001	0.06
% CH -	51.8%	51.4%	47.8%	50.0%	56.0%	55.6%	0.004	<0.001
% Select	23.0%	24.5%	31.8%	16.8%	17.4%	21.2%	<0.001	0.57
% Std	1.2%	1.2%	1.8%	0.7%	0.6%	0.9%	<0.001	0.86
% YG 1 & 2	61.3%	65.5%	74.7%	55.1%	58.8%	67.8%	<0.001	0.80
% YG 4 & 5	1.6%	1.2%	0.3%	3.4%	3.5%	1.6%	<0.001	0.54

More docile steers and heifers produce significantly heavier carcasses, with more fat cover and larger ribeyes than the aggressive steers and heifers. More docile cattle produce higher quality carcasses with fewer YG 1&2's. Heifers produce significantly higher quality carcasses than steers with similar disposition scores.

Docile cattle had an average profit of $46.63/head compared to the restless cattle average profit of $26.16/head and aggressive cattle average profit of $7.62/head. Disposition is more than a convenience trait. Calves with poor dispositions gained less, had higher mortality rates, reduced quality grades, and reduced CAB® acceptance rates when compared to docile calves.

The above analysis agrees with earlier work demonstrating statistically lower ADG and profit for wild steers as compared to docile steers (Faber 1999).

Texas A&M evaluated the use of a mass medication (Excede) on arrival that was based on the temperament of the calves using their exit velocity (Paddock, et.al. 2007). They measured exit velocity on each steer at Day 0, 14 and 28. On Day 0, half of the steers received 1.5 ml/cwt of Excede and the other half were controls. The steers were fed in a GrowSafe system to measure individual feed intake. Only 1 steer out of 119 was clinically morbid during the 28 day trial. Calm or docile cattle showed no gain response to Excede. The excitable cattle treated with Excede spent 17 minutes/day more time eating than their no treat counterparts. The calm steers showed no gain response to Excede, whereas the excitable steers treated with Excede had higher dry matter intakes and average daily gains.

Toughness and dark cutting characteristics are two critical components behind raising feeder cattle. The negative consumer effects from toughness and dark cutting carcasses cut into producer profits by as much as $5.00 and $2.89 per head, respectively. Surveys conducted among restaurateurs and retailers have shown that these traits rank among the top 10 concerns when it comes to quality beef (Voisinet, 1997b).

Studies show that there is a significant relationship between dark cutting carcasses and animal behavior. Animal behaviors caused by mixing unfamiliar cattle together can result in fighting, mounting and other aversive behavior that can increase an animal's physical stress and increase the chance of producing a dark cutting carcass (Voisinet, 1997b).

Evaluating livestock temperament through the use of chute scores and comparing these results to individual carcass data, Voisinet et al. (1997b) studied the effects of temperament on toughness and dark cutting in B. indicus-cross feedlot cattle.

A four-point temperament score (chute scores) was used to assess each animal's disposition; and after being harvested at a large commercial beef packing plant, carcass characteristics were evaluated. USDA graders collected the information regarding dark cutting characteristics. Researchers determined toughness by cooking a strip loin from each animal and testing them on a Warner-Bratzler shear machine.

Results from the experiment showed that more excitable animals had more borderline dark cutters and tougher meat characteristics than animals with calm temperaments. 40% of the time, excitable animals had carcasses that exceeded the food service industry's acceptable threshold for tenderness. Steers with a temperament ranking of 1 to 3 averaged a steak beyond acceptable tenderness levels 13.7%. Dark cutting characteristics followed the same trend. Cattle with calm temperament scores had dark cutting carcasses 6.7% of the time, whereas 25% of the carcasses from highly excitable animals were dark cutting (Voisinet, 1997b).

One might assume that breed influenced the presence of dark cutters; however, previous research has not been consistent in determining a breed's relationship to dark cutting. A possible reason might be that animals with more excitable temperaments are more susceptible to stress

generated by routine handling practices that occur prior to slaughter. The increased susceptibility to stress could then lead to more borderline dark cutting beef cattle carcasses (Voisinet, 1997b).

Carcasses from more excitable animals have a greater tendency to produce less tender, borderline darker cutting carcasses. With this in mind, producers can make culling decisions within a breeding program and select for temperament as a possible option to decrease the number of carcasses that harvest lower quality meat at slaughter time.

What determines disposition?

Along with differences in calving ease, marbling, and average daily gain, there are differences in temperament and temperament can be largely influenced by the genetics used in breeding decisions (Gauly et al., 2001). A variety of factors can contribute to the temperament of the animal, but research shows that temperament is moderately heritable. Producers thus have some control over the temperament of cattle by selecting cattle based on behavior (Voisinet, 1997a).

Canadian workers (Nkrumah, et.al. 2007) looked at the genetic and phenotypic relationships of feeding behavior and temperament, with performance, feed efficiency, ultrasound and carcass merit of beef cattle. They estimated direct heritability for flight speed or exit velocity at .49. The results of their study indicate that even though feeding behavior may be phenotypically independent of temperament, the 2 classes of behavior may not be genetically independent. The positive genetic correlation between feeding duration and temperament may indicate a commonality in the genetics of the 2 traits; however, there may be an inverse relationship between the genetic factors that affect temperament and those directly related to feed consumption. This is not only evident from the negative correlation between exit velocity and head down time, but also from the phenotypic and genetic correlations between exit velocity and dry matter intake. The results suggested that the longer the animals spent at the bunk, the more feed they consumed. They concluded that feeding behavior and temperament may need to be included in the definition of beef cattle breeding goals and approaches. The goals and approaches include culling unmanageable cattle and introducing correct handling facilities; however, early life provisions of appropriate handling experiences are also useful.

The North American Limousin Foundation members in the early 1990's identified improving disposition as the number-one breed priority. They developed a temperament scoring system, as well as the industries first temperament or docility EPD. Rapid genetic progress was possible given the strong heritability of .40 that was estimated for the Limousin breed. In 1993, 73% of the Limousin cattle evaluated were scored as calm. In 2003, the percent of Limousin cattle evaluated as calm increased to 91% (Hyde 2003).

Studies have been conducted that compare the temperament scores of a variety of breeds. Research conducted in 1997 by Voisinet et al. found B. indicus cattle to be more aggressive than B. taurus breeds. Another study on the influence of breed and rearing conditions, conducted by Boivin et al. (1994), found that Salers and Limousin cattle had significant differences in mobility. However, other studies found no difference in temperament between cattle raised in similar environments (Gauly et al, 2001 and Goonewardene et al., 1999). Even observations between B. indicus-cross cattle were inconsistent in establishing a relationship between temperament and the percent of Brahman influence in a steer (Voisinet, 1997a).

There have been a variety of explanations to justify the mixed results. One of the comments made by the author was the limited population size and number of breeds evaluated (Gauly et al., 2001). A difference in sire temperaments within a breed was also listed as a possibility. Boivin et al. noticed that among Limousin-sired calves used in the study, one sire in particular had 8 out of 11 calves receive an aggressive temperament score, while other sires only had a mean of 2 in 11 calves receive an aggressive score (1994).

The larger, more diverse populations studied in the Iowa Tri-County Steer Carcass Futurity addressed the possible inconsistencies among earlier research.

The effect of sire breed on average disposition score of all calves where sire breed was identified.

Sire Breed	Number of Calves	Average Disposition Score
Hereford & Polled Hereford	651	1.297
Simmental	894	1.589
Red Angus	464	1.617
Angus	6,914	1.618
Gelbvieh	579	1.701
Charolais	561	1.834
Limousin	263	1.860
Brangus	479	2.243

11,619 sire identified steers were temperament scored with a 6-point system 3 or 4 different times from on-test and re-implant to being sorted and delivered to the meat processing plant. Of the known purebred cattle evaluated, Brangus were the most aggressive with a mean disposition score of 2.243 and Hereford & Polled Hereford were the most docile with a score of 1.297. The small score differentiation between breeds could possibly support earlier data that found no significant difference between certain breeds of cattle (Busby 2005).

Possible complications in our evaluation is that the cattle were all reared in different environments, which could have an impact on temperament and the ability to understand the full effects of breed on temperament. Producers involved in the Tri-County Steer Carcass Futurity program do not randomly select sires or breeds.

Canadian work compared beef heifers exposed to prerecorded human handling noise, metal clanging and no noise. For 5 consecutive days the heifer's heart rate and movement were measured while they were constrained in an electronic scale, in a chute complex. They concluded that by eliminating or reducing the sounds of metal clanging and particularly the sounds of humans shouting, the level of fear cattle experience during handling should be reduced (Waynert 1999).

Detecting temperament and selecting for calmness

The moderate heritability of temperament coupled with an increased producer interest on the effects it can have on profitability and animal welfare, have made selecting animals based on behavior more popular. Producers have a variety of opportunities to identify the temperament of cattle. One way to evaluate an animal's temperament can be watching how it reacts to various stimuli (Lanier, 2000).

In a study involving six livestock auction markets, Lanier et al. (2000) realized that cattle flinched or immediately motioned to sudden sounds, motions, touches or any combination of stimuli. Observers in the study evaluated animals' attentiveness to stimuli and also scored animal temperament. Through the evaluation, they found cattle with higher temperaments to be more receptive to the environment around them (Lanier, 2000).

The data collected was quite interesting. They found that cattle with temperament scores of 3 or 4 were less likely to defecate in the auction ring. This could possibly be linked to more excitable animals defecating before reaching the auction ring. Auctioneer's continual sale call did not startle animals as much as sudden intermittent sounds like a ring man yelling out a bid or a child making noise in the stands. Sudden movements like an auctioneer raising an arm or a child running by the front of the sale pen was also noticed by cattle more frequently than slow movements. The reasons for this could lie in the fact that cattle were historically animals of prey. Their senses give them a heightened response to sudden movements like a predator might have (Lanier, 2000).

In August 2005, the ISU Armstrong Research Farm received 252 head of yearling cattle from 3 auction barns. As the steers were being unloaded it was noted one source of cattle did not have good dispositions. Our protocol is to weigh cattle 2 consecutive days to determine on test weights. The steers were disposition scored on the first day using the BIF scoring system. In the table below steers that were disposition scores 1 and 2 are docile, disposition scores 3 and 4 are restless and disposition scores 5 and 6 are aggressive.

Item	Docile	Restless	Aggressive
Head	152	59	41
Ave. Disposition Score	1.6	3.4	5.3
Wt on Day 1	945	894	856
Wt on Day 2	943	880	833
Average Wt	944	887	845
Wt Change from Day 1 to Day 2	-1.3	-14.2	-23.5
% Shrink	-0.1%	-1.6%	-2.8%

(Unpublished data)

The above observations suggest excitable feeder calves may leave considerable weight behind and support Lanier's (2002) observation that excitable cattle did not defecate in the auction ring.

Producers could possibly evaluate cattle reaction times to stimuli as a method to assess cattle temperament when selecting breeding stock without needing to see actual handling or chute scores. Cow/calf producers do consider temperament as an important selection trait. Surveys have found that disposition ranked second, only to birth weight, as the most important trait in bull selection. If producers desire to have calm cattle that are easy to work with, studying cattle's sensitivity to stimuli could offer an easy method of determining temperament (Lanier, 2000).

Handling facilities

A 1997 study conducted by the Biosystems and Agricultural Engineering Department at Oklahoma State University, described conditions associated with handling injury cases on 150 cattle on 100 Oklahoma cow-calf operations. The study showed that more than 50% of injuries

in these situations were due to human error, while equipment and facilities accounted for about 25% of the perceived causes. In most cases, a better understanding of how an animal may respond to human interaction and to its immediate surroundings will help keep the animal handler from becoming an injury victim (Hubert 1998).

Human error is the primary cause of many types of accidents. These errors in judgment and action are due to a variety of reasons, but occur most often when people are tired, hurried, upset, preoccupied or careless. Remember that human physical, psychological and physiological factors greatly affect the occurrence of life threatening accidents. Using this information in combination with proper cattle handling techniques can reduce you and your cattle's risk to injury.

An animal's senses function like those of a human; however, most animals detect and perceive their environments very differently as compared to the way humans detect and perceive the same surroundings. While cattle have poor color recognition and poor depth perception, their hearing is extremely sensitive relative to humans. Knowing these characteristics, we can better understand why cattle are often skittish or balky in unfamiliar surroundings.

Cattle have panoramic vision, meaning they can see in all directions except directly behind without moving their head. Additionally, cattle have poor depth perception, especially when they are moving with their heads up. In order to see depth, they have to stop and put their heads down. For this reason, unfamiliar objects and shadows on the ground are the primary reasons for cattle balking and delaying the animals behind them. This is why it is important that handling and working facilities be constructed to minimize shadows.

Cattle have a tendency to move towards the light. If working cattle at night, use frosted lamps that do not glare in the animals faces. Position these lights in the area where you are moving cattle, such as a trailer or barn.

Moving a group of cattle takes some knowledge and understanding of the animal's "flight zone." The flight zone is an animal's personal space. When a person penetrates the flight zone, the animal will move. Conversely, when you retreat from the flight zone, the animal will stop moving. Understanding the flight zone is the key to easy, quiet handling of your cattle.

The size of an animal's flight zone depends on the animal's temperament, the angle of the handler's approach and the animal's state of excitement. Work at the edge of the flight zone at a 45 to 60 degree angle behind the animal's shoulder. Cattle will circle away from you. The flight zone radius can range from 5 to over 25 feet for feedlot cattle and as far as 300 feet for some range cattle. If you are within their flight zone, the animal moves away or retreats.

Cattle follow the leader and are motivated to follow each other. Each animal should be able to see others ahead of it. Make single file chutes at least 20 to 30 feet long. In crowding pens, consider handling cattle in small groups up to 10 head; the cattle need room to turn. Use their instinctive following behavior to fill the chute. Wait until the single file chute is almost empty to fill the chute. Leaving one animal in the single file chute serves as bait for the next group. A crowding gate is used to follow the cattle, not to shove against them.

Pens serve several purposes, including catching, holding cattle being worked and sorting cattle into groups. When designing and constructing pens for working facilities, consider the following:

- Provide at least 20' x 20' per head for mature cattle.
- Size pens for a maximum of 50 head of mature cattle.
- Larger, wider pens can make effective sorting difficult for a single worker.

- Pens too small or narrow can result in workers entering the animal's flight zone. The smallest pen dimensions should be no less than 16 feet.
- Too few pens can make separating animals difficult. This can also put handlers at risk, as they must physically enter pens with large numbers of agitated animals.
- Use proper gate placement to facilitate animal movement from pen to pen and to other areas. Poor animal movement puts workers at risk by having to force the movement. If there are too few gates, some animals can become separated. Thus, when animals enter the alley, separated herdmates will follow along the inside of the pen. This is often referred to as "backwash". There may be problems guiding these pen-bound animals back to the exit gate as their herdmates move away from them down the alley.
- Placing gates in a herringbone style avoids a 90 degree angle corner in the pen.

Keep the design of sorting facilities and alleyways simple. For most operations, a single alley is used for sorting, as well as moving cattle to and from the working area. Alley width should be 12 to 14 feet with a 10-foot minimum. Wider alleys can make it easier for cattle to escape around you. Pens that are too narrow fail to give the animals enough room to maneuver.

The crowding area should be designed and located so that cattle can be easily moved into this area from a common sorting alley that is fed by adjacent holding pens. A circular crowding area with totally enclosed sides and crowding gate is effective because the only escape route visible to the cattle is through the working or loading chute exits. The crowding gate should also be solid and designed to prevent animals from reversing the gate's direction. Do not overload the crowding area. A catwalk around the outside of the crowding pen allows workers to maneuver animals toward the chute while avoiding direct animal contact. Position the catwalk 36 inches below the top of the fence.

Ideally, the single file or working chute should be curved with totally enclosed sides. Cattle move more freely because they cannot view the handlers or the squeeze chute until they approach the chute's rear gate. Sloped sides in the working chute restrict the animal's feet and legs to a narrow path, which in turn reduces balking and helps prevent an animal from turning around. Sloping sides work well in most cow-calf operations because different sizes of cattle can be worked efficiently in the same chute. Recommended width for the bottom of the chute is 16 inches, while the top should be about 28 inches. For large-framed cattle over 1200 pounds, the top dimension should be increased 2 inches. To accommodate large-framed bulls, it may be necessary to increase the top width by 4 inches or more. For adjustable straight sided alleyways, the range in width should be from 18 inches to 32 inches. Emergency release panels are highly recommended. With solid-sided chutes, backstops are normally suspended or mounted from above. Backstops should be adjusted to block an animal six to eight inches below the top of the tailhead.

Handling facility comparison

From 2002 to 2007, 1,070 groups of steers and heifers totaling 96,685 head have been processed at 15 different SW Iowa feedlots through the Tri-County Steer Carcass Futurity program. The total time required to process the group, no. of head, no. of people and what process or processes were done were recorded. All working systems had tubs. 13 of 15 systems (1056 out of 1070 groups) had solid sides in alleys directly behind the chute. Time for

equipment repairs was not included in the summary. Facilities with the tub, alley and chute under roof were considered to be inside facilities. All feedlots had completed the Feedlot Animal Welfare Audit and the quality of processing work is considered to be acceptable and similar across all facilities.

The table below shows the number of feedlots, groups and cattle in each category.

System	Outside	Inside
Manual Chute	4 Feedlots 267 groups 25,379 Hd	4 Feedlots 295 groups 25,763 Hd
Hydraulic Chute	2 Feedlots 28 groups 2,751 Hd	2 Feedlots 48 groups 4,571 Hd
Silencer® Chute	2 Feedlots 97 groups 8,225 Hd	2 Feedlots 333 groups 29,996 Hd

Labor costs were $10/hour for everyone. 28% of the labor was TCSCF or ISU staff. TCSCF and/or ISU staff recorded data, removed home tags, applied TCSCF tags and determined harvest dates. Processing tasks were split into 4 categories: 1 – Arrival: vaccination, implant, weigh and 31% of the groups were tagged; 2 – Re-implant: implant, weigh and disposition score; 3 – Sorting: weigh, disposition score, mud score and sort for harvest; 4 – Weigh only: weigh and disposition score.

Item	Arrival	Re-implant	Sorting	Weigh Only
Total Feedlot Staff	3.2 Staff	3.1 Staff	3.1 Staff	3.0 Staff
Total Staff *	5.16 Staff	4.88 Staff	4.95 Staff	4.28 Staff
Seconds/Hd	51.3 sec.	34.6 sec.	37.5 sec.	34.4 sec.
Head/hour	70 Hd	104 Hd	96 Hd	105 Hd
Total staff time/Hd	4.26 min.	2.48 min.	3.03 min.	2.28 min.
Labor cost/Hd	$0.740	$0.468	$0.508	$0.412

* May include TCSCF and ISU staff and feedlot veterinarian

The arrival processing of vaccinating and implanting required significantly more labor per head than the other tasks. Tagging significantly increased the processing time by 11 seconds per head and the labor requirement by 60 seconds or a minute per head. Re-implant, sorting and weigh only, were not statistically different from each other. Working larger groups of cattle reduced processing time. For every additional 20 head, processing time per head was reduced 1 second. Eight of the working facilities were outside and 7 were inside or under roof. All tasks are combined for this table.

Item	Outside	Inside
Total Feedlot Staff	3.3 Staff	3.0 Staff
Total Staff *	4.92 Staff	4.66 Staff
Seconds/Hd	40.9 sec.	38.2 sec.
Head/hour	88 Hd	94 Hd
Total staff time/Hd	3.23 min.	2.59 min.
Labor cost/Hd	$0.565	$0.498

The differences in total staff time/head were different at P=.16 level. My observation is that more time is spent designing the holding pens, tub and alley into and away from the inside facilities, before the investment of building is made.

Eight of the feedlots had manual chutes, three had hydraulic chutes and four had silencer chutes. The manual and silencer chutes were equal across inside and outside facilities; however, only one feedlot had a hydraulic chute inside and two feedlots had hydraulic chutes outside. All tasks are combined for this table.

Item	Manual	Hydraulic	Silencer®
Total Feedlot Staff	3.1 Staff	2.8 Staff	3.1 Staff
Total Staff *	4.90 Staff	4.18 Staff	4.66 Staff
Seconds/Hd	42.1 sec.	41.6 sec.	34.8 sec.
Head/hour	86 Hd	87 Hd	103 Hd
Total staff time/Hd	3.29 min.	2.55 min.	2.43 min.
Labor cost/Hd	$0.580	$0.485	$0.454

The total staff time/head was significantly less for the Silencer® compared to the manual and hydraulic. The difference in total staff time/head between the manual and hydraulic was different at P=.30.

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