



BEEF CATTLE RESEARCH UPDATE

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Effects of Transportation Stress on Cattle

Several recently published studies from Canada and Kansas State University have assessed the effects of transportation stress on the health, welfare, and performance of cattle. The findings for these studies are reported below.

Factors Affecting Cattle during Long-Haul Transport in North America

Canadian researchers identified and quantified several factors affecting weight loss (shrink) and animal welfare in cattle during commercial long-haul transport (≥ 249 miles).^{1,2,3,4} This study documented current commercial practices in Alberta, Canada through surveys delivered to truck drivers (6,152 journeys transporting 290,886 animals). In this survey, 89% of the journeys were cattle transported to the United States. Most drivers had either limited (31% with < 2 years) or extensive (35% > 10 years) experience hauling cattle. The average distance travelled was 672 miles (maximum of 1,591 miles). The time animals spent on truck averaged 15.9 hours with a maximum of 45 hours. However, only 5% of all journeys were greater than 30 hours. The most frequent cause of delay was at the Canada-United States border crossing due to paperwork and veterinary inspections. Border delays occurred on 77% of all journeys (averaged 1.3 hours). A total of 35.6% of all journeys occurred in the summer, 37.6% in fall, 17.3% in winter, and 9.5% in spring. Ambient temperature reported for all journeys ranged from -44 to 113°F with a mean value of 64°F . However, only 21.5% of all journeys experienced maximum temperatures equal to or greater than 86°F and 1.3% equal to or greater than 104°F . These high temperatures were reported during journeys traveling south during summer months. Temperature range within a journey indicated that animals could experience as much as a 115°F of difference in temperature due to the diverse environments from the north to the south. However, temperature ranges greater than 86°F occurred in only 2% of all journeys. In addition, average temperature of the journey during the coldest month (January) was 23°F and 73°F during the hottest (Jul y).

Some of the key factors affecting shrink (expressed as % of Body Weight, BW) in this study were:

- Feeder cattle exhibited greater shrink than fat cattle (7.9 vs. 4.9%, $P < 0.01$), and experienced longer total transport durations (14.9 vs. 12.4 hours, $P < 0.01$) due to border crossing protocols which require mandatory animal inspection.
- Shrink was greater ($P < 0.001$) for feeder cattle loaded at ranches/farms and feedyards compared with those loaded at auction markets.
- Cattle loaded during the afternoon and evening shrank more than those loaded during the night and morning ($P < 0.05$).
- Shrinkage was less in cattle transported by truck drivers having 6 or more years of experience hauling livestock compared with those with 5 years or less ($P < 0.05$).
- Shrink increased with both temperature (% of BW/ $^{\circ}\text{F}$; $P < 0.001$) and time on truck (% of BW/hour; $P < 0.001$).
- Temperature and time on truck had a multiplicative effect on each other because shrink increased most rapidly in cattle transported for both longer durations and at higher temperatures ($P < 0.001$).

In this study, information collected in the survey related to animal welfare included the number of dead, non-ambulatory (downer) and lame animals during each journey. Some of the notable findings were:

- Overall, 0.012% of assessed animals became lame, 0.022% non-ambulatory and 0.011% died onboard.

- Calves and cull cattle were more likely to die and become non-ambulatory during the journey, while feeders were intermediate, and fat cattle appeared to be the most able to cope with the stress of transport ($P \leq 0.01$).
- The likelihood of cattle becoming non-ambulatory, lame, or dead increased sharply after animals spent over 30 hours on truck ($P < 0.001$).
- The likelihood of animal death increased sharply when the midpoint ambient temperature fell below 5°F ($P = 0.01$) while the likelihood of becoming non-ambulatory increased when temperatures rose above 86°F ($P = 0.03$).
- Animals that shrank 10% or more during transport had a greater ($P < 0.001$) likelihood of dying and becoming non-ambulatory or lame.
- Animals were more likely to die at smaller space allowances ($P < 0.05$) which occurred more frequently in the belly and deck compartments of the trailers, and also at high space allowances in the deck.
- The proportion of total compromised animals decreased with more years of truck driving experience ($P < 0.001$).
- Mortality was greater in cattle loaded at auction markets compared with feed yards and ranches ($P < 0.01$).

These researchers concluded that cull cattle, calves and feeder cattle appear to be more affected by transport compared with fat cattle going to slaughter because of greater shrink. They noted that several factors should be considered when developing guidelines to reduce cattle transport stress and shrink including type of cattle, ambient temperature, transport duration, driving quality, and time and origin of loading. They also reported that the most important welfare concerns during long distance transport included the total journey duration, too low or high space allowances, too high or too low ambient temperature, and the experience of the truck drivers.

Associations between Distance Traveled from Sale Barns to Feedlots on Overall Health and Performance

Kansas State University researchers analyzed data on 14,601 groups of cattle that arrived at 21 U.S. commercial feedlots from 1997 to 2009 in an effort to determine potential associations between distance traveled during transportation with feedlot health and performance.⁵ Cattle groups included in the analysis were restricted to those classified as either male or female (not mixed) with an average arrival weight of at least 500 lb, with at least 20 head, and with information available on cattle origin (region of country). In this dataset, male cattle were not classified as steers or bulls. The primary transportation factor of interest was the distance traveled during the journey to the feedlot. In this analysis, the distance traveled was divided into five categories (≤ 155 miles, 156 to 310 miles, 311 to 466 miles, 467 to 621 miles, and >621 miles). The descriptive statistics for the data analyzed in this study are shown in Table 1.

Table 1. Descriptive statistics for study population.

Item	Mean	Median	Range
Distance traveled, miles	434	343	0 to 1918
Arrival weight, lb	733.8	741.1	500 to 900
Days on feed	159.4	156.0	137 to 177
Groups size at arrival, # of cattle	171.2	153.	95 to 239
BRD* morbidity, %	4.9	1.1	0 to 5.9
Mortality of any cause, %	1.3	0.8	0 to 1.6
Hot carcass weight, lb	811.0	818.3	345 to 1003
Average daily gain, lb	3.1	3.1	0.4 to 5.3

*Bovine respiratory disease complex
Source: Cernicchiaro et al., 2012a.

Some of the findings reported in this study include:

- Distance traveled (DTV) was significantly associated ($P < 0.05$) with bovine respiratory disease complex (BRD) morbidity, overall mortality, carcass weight, and daily gain.
- The incidence risks of heavier cattle (>600 lb) for BRD morbidity and overall mortality was significantly reduced ($P < 0.05$) across different DTV categories compared with lighter cattle (500 to 599 lb) traveling the same distance.
- The risk of BRD morbidity and overall mortality across the different DTV categories was significantly greater ($P < 0.05$) for males than females. These researchers suggested the increase in morbidity and mortality risks for males may be the result of an additive effect of stresses from transport and castration. Since the cattle were not classified as steers or bulls, they were unable to account for potential health risks associated with castration.
- As the distance traveled increased, the risk of BRD morbidity also increased.
- The risk of BRD morbidity was significantly greater ($P < 0.05$) in cattle arriving during summer (July through September) months after traveling distances longer than 466 miles compared with cattle arriving during winter months traveling the same distance.
- Increasing DTV affected the overall mortality risk in all seasons with cattle arriving during summer months experiencing a dramatic increase with DTV greater than 310 miles.

These authors concluded that distance traveled was a significant predictor of BRD morbidity and overall mortality risks; however, distance may be a proxy of other predictors such as placement on the truck, handling of cattle during loading and unloading, ventilation and fume levels, stocking density, food and water deprivation, commingling, sanitation of the vehicles, climatic conditions (e.g., temperature and humidity), or driving conditions, which may be the actual stressors. They suggested that knowledge of the distance traveled during transportation could allow a more precise prediction of cattle feedlot health and performance.

Effects of Body Weight Loss during Transit from Sale Barns to Feedlots on Overall Health and Performance

Kansas State University researchers analyzed data from 13 commercial feedlots (16,590 cattle groups) in the central and southern high plains of the U.S. to quantify how body weight loss (shrink) was associated with BRD morbidity and overall mortality risks, carcass weight and average daily gain in feeder cattle groups arriving in these feedlots during 2000 to 2008.⁶ Cattle groups included in the analysis were restricted to those classified as either male or female (not mixed) with an average arrival weight of at least 500 lb, with at least 20 head, and with available information on group pay weight and initial weight upon arrival. The primary transportation factor of interest was the percent shrink of the cattle. In this analysis, shrink was divided into four categories (≤ 0 , 0 to 2.5, 2.6 to 5.0, and $>5\%$). The descriptive statistics for the data analyzed in this study are shown in Table 2.

Table 2. Descriptive statistics for study population.

Item	Mean	Median	Range
Shrink during transit, %	2.4	3.0	-5.8 to 14.8
Arrival weight, lb	673.8	667.7	500 to 900
Days on feed	143.3	150.0	20 to 288
Groups size at arrival, # of cattle	148.1	111.0	20 to 1968
BRD morbidity, %	10.0	5.8	0 to 100
Mortality of any cause, %	1.3	0.9	0 to 25.6
Hot carcass weight, lb	721.5	746.0	
Average daily gain, lb	2.6	2.9	0 to 7.7

Source: Cernicchiaro et al., 2012b.

Some of the findings reported in this study include:

- Cattle in heavier weight classes (600 to 699, 700 to 799, and > 799 lb kg) displayed similar levels of BRD morbidity and overall mortality risks across all shrink categories, but lighter (500 to 599 lb) cattle showed greater morbidity risk at greater shrink levels (2.6 to 5.0% and > 5.0%) compared with decreased shrink.
- Male cattle experienced significantly ($P < 0.05$) greater BRD morbidity and overall mortality risks than female cattle across all shrink categories with increasing risk as shrink increased.
- Cattle arriving in fall and summer months showed a significantly ($P < 0.05$) greater BRD morbidity and overall mortality risks across all shrink categories compared with cattle arriving in winter experiencing the same shrink percentage.
- However, for cattle arriving in spring, the BRD morbidity risk was greater for shrink of < 0% and 0 to 2.5%.
- Heavier weight cattle at arrival (> 600 lb) showed significantly ($P < 0.05$) greater hot carcass weights (HCW) and average daily gains (ADG) across all shrink percentages compared with lighter BW cattle (500 to 599 lb) experiencing the same percentages of shrink during transit.
- Male cattle had significantly ($P < 0.05$) greater HCW for shrink greater than 0% and significantly greater ADG across all shrink categories compared with female cattle experiencing the same shrink.
- For cattle arriving in spring, HCW and ADG values were significantly ($P < 0.05$) greater in cattle with less than 2.5% shrink during transport compared with cattle arriving during winter months with the same shrink levels.
- During summer and fall months, however, HCW and ADG values significantly ($P < 0.05$) decreased in cattle experiencing less than 0% and 2.6 to 5.0% shrink compared with cattle arriving during winter months that experienced the same shrink.

These researchers concluded that information at feedlot arrival including the shrink experienced from ranch or sale barn to feedlot, seasonal fluctuations, distance hauled, arrival weight, and cattle gender may help identify cattle at greater risk of morbidity, mortality or performance losses. This would allow feedlots to modify cattle procurement practices, health and economic risk management plans, or protocols for managing the cattle at feedlot arrival as needed allowing for a more precise prediction of health and performance of the cattle.

¹ González, L. A., K. S. Schwartzkopf-Genswein, M. Bryan, R. Silasi and F. Brown. 2012. Benchmarking study of industry practices during commercial long haul transport of cattle in Alberta, Canada. *J. Anim. Sci.* 90:3606-3617.

² González, L. A., K. S. Schwartzkopf-Genswein, M. Bryan, R. Silasi and F. Brown. 2012. Space allowance during commercial long distance transport of cattle in North America. *J. Anim. Sci.* 90:3618-3629.

³ González, L. A., K. S. Schwartzkopf-Genswein, M. Bryan, R. Silasi and F. Brown. 2012. Factors affecting body weight loss during commercial long haul transport of cattle in North America. *J. Anim. Sci.* 90:3630-3639.

⁴ González, L. A., K. S. Schwartzkopf-Genswein, M. Bryan, R. Silasi and F. Brown. 2012. Relationships between transport conditions and welfare outcomes during commercial long haul transport of cattle in North America. *J. Anim. Sci.* 90:3640-3651.

⁵ Cernicchiaro, N., B. J. White, D. G. Renter, A. H. Babcock, L. Kelly and R. Slattery. 2012a. Associations between the distance traveled from sale barns to commercial feedlots in the United States and overall performance, risk of respiratory disease, and cumulative mortality in feeder cattle during 1997 to 2009. *J. Anim. Sci.* 90:1929-1939.

⁶ Cernicchiaro, N., B. J. White, D. G. Renter, A. H. Babcock, L. Kelly and R. Slattery. 2012b. Effects of body weight loss during transit from sale barns to commercial feedlots on health and performance in feeder cattle cohorts arriving to feedlots from 2000 to 2008. *J. Anim. Sci.* 90:1940-1947.

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