

A retrospective evaluation of animal mortality in US feedlots: rate, timing, and cause of death

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Abstract

Feedlot closeout records from January 2005 through September 2014 were summarized. A total of 484,193 lots involving 73,067,534 cattle were used to illustrate mortality. Mortality rate and average days-on-feed at death by placement weight, sex, and cause of death (respiratory, digestive, and acute interstitial pneumonia) were calculated from these records. Mortality averaged 1.56 and 1.43% in heifers and steers, respectively. Mortality trends were seasonal; respiratory mortality was highest in late fall and early winter, digestive mortality was highest in late spring, and AIP mortality was greatest during summer months. Mortality during the first 30 days of the feeding period averaged 0.40% and 0.35% for heifers and steers, respectively. Mortality in the mid-portion of the feeding period, the last 31 to 60 days, and the last 30 days of feed averaged 0.70%, 0.20%, and 0.26% for heifers and 0.70%, 0.18%, and 0.21% for steers, respectively. These data suggest animal mortality is not isolated to the receiving period and occurs at comparable rates thereafter.

Key words: cattle, mortality, feedlots, BRD, digestive, AIP

Résumé

Des rapports de clôture provenant de parcs d'engraissement durant la période de Janvier 2005 à Septembre 2014 ont été synthétisés. Les données ont servi à illustrer la mortalité impliquant 484 193 lots et 73 067 534 bovins. Le taux de mortalité et le nombre moyen de jours d'alimentation avant la mort ont été calculés en fonction du poids, du sexe et de la cause de mortalité (respiratoire, digestive ou pneumonie interstitielle aiguë). Le taux moyen de mortalité était de 1.56% pour les taures et de 1.43% pour les bouvillons. Il y avait une tendance saisonnière dans la mortalité : la mortalité associée à des causes respiratoires était plus élevée tard en automne et en début d'hiver, la mortalité associée à des causes digestives était plus fréquente tard au printemps alors que la mortalité causée par la pneumonie interstitielle aiguë plafonnait durant les mois d'été. Le taux moyen de mortalité durant les 30 premiers jours d'engraissement était de 0.40% pour les taures et de 0.35% pour les bouvillons. Chez les

taures, le taux moyen de mortalité était de 0.70% durant la partie médiane de l'engraissement, de 0.20% durant l'avant dernier mois et de 0.26% durant les 30 derniers jours. Pour les bouvillons, les figures équivalentes étaient de 0.70%, 0.18% et 0.21%. Ces données suggèrent que la mortalité des animaux s'étend au-delà de la période de réception et ce à des taux qui sont aussi élevés.

Introduction

Mortality is an important economic parameter associated with cattle feeding, and a key driver of profitability following cattle purchase and sale price, feed costs, and veterinary medicine costs.^{11,15,23} A 2011 survey estimated non-predator mortality economic losses at more than 2.35 billion dollars/year in confined and non-confined cattle operations.²⁴ The largest mortality contributors were due to respiratory, digestive, calving, and weather-related losses which accounted for 28.0, 13.4, 13.1, and 13.0% of the total, respectively. Within confined cattle feeding operations, respiratory death loss is the greatest economic culprit.^{5,21} A 38% increase in cattle mortality, from 1.03 to 1.42% during the 1994 through 1999 period, was reported.¹⁴ Respiratory and digestive mortality accounted for approximately 57 and 23%, respectively, of the mortality in this summary. Anecdotal reports suggest mortality has increased in recent years, yet limited information is available to confirm this trend. In addition, reports have associated the use of beta-agonists with an increase in late-term death loss.¹² However, limited data exist which describe expected mortality levels during the final phase of the feeding period. The objective of this paper is to describe current mortality trends in feedyards, determine the frequency of late-term deaths, and relate animal mortality trends to productivity.

Materials and Methods

Mortality data were derived from a commercial database^a used in the feedlot industry. The database consists of feedlot production records generated from 1997 to present. Animal-level mortality information on date and cause of death were added to the database in 2005. As such, only

feedlot closeouts from January 1, 2005 through September 30, 2014 were considered. Several inclusion/exclusion criteria were additionally applied. Lots of cattle were confined to the central Great Plains of the US, and included data from Texas, New Mexico, Oklahoma, Kansas, Colorado, Nebraska, Wyoming, Montana, North Dakota, South Dakota, Minnesota, Iowa, Missouri, and Illinois. Lots with extreme placement and final weights were excluded, defined as placement weights less than 400 lb (181 kg) and greater than 1,100 lb (499 kg) for all lots, and final weights less than 950 lb (431 kg) and 1,000 lb (454 kg) or greater than 1,550 lb (703 kg) or 1,650 lb (748 kg), for heifers and steers, respectively.

Approximately 62% of closeouts had detailed information. Average days-on-feed at the time of death was calculated for placement weight, sex, and cause of death. Timing of death loss was divided into 4 categories: 1) the first 30 days of the feeding period; 2) the middle portion of the feeding period, defined as 31 days-on-feed to 61 days prior to harvest; 3) 60 to 31 days prior to harvest; and 4) the final 30 days of the feeding period. Cattle deaths were classified by feedlot personnel in the following categories based on cause: respiratory (bovine respiratory disease (BRD and pneumonia)), digestive (bloat, acidosis, and coccidiosis), acute interstitial pneumonia (AIP), and other (urogenital, central nervous system, bullers, mechanical, injury).

Lot placement weight, final live weight, weight gain (lb), days-on-feed, and dead-in average daily gain were also obtained and summarized on a monthly basis. These were used as general descriptors for trends in animal performance and health.

Feedlots represented in the present dataset are not a random sample representative of the entire US population of feedlots; thus, the records and inference are considered to be for this population, rather than treated as a sample of all US feedlots. The trends described are population trends, and do not have an associated sampling error or variability estimate for averages or proportions. The variability between closeouts is used to illustrate the differences in performance within the population. Summaries of population death loss were created by taking the total death loss divided by the total head placed. Monthly mortality rates were calculated by

expressing the number of animal deaths that occurred within a given month as a percentage of cattle on feed, which is the inventory for that same month.

Results and Discussion

The numbers of cattle lots and head included in the analysis are reported in Table 1, while the number of cattle lots and head, indexed by 100 lb (45.4 kg) placement weights and sex, are reported in Table 2. The final dataset consisted of 484,193 lots with 73,067,534 head of cattle. Steer lots and number of head comprised 54.7% and 56.4% of the data, respectively, whereas heifer lots and number of head comprised 45.3% and 43.6%, respectively. Heifer placement rate was considerably higher than heifer placement rates reported from 1995 through 1999.¹⁴ Likely, lack of available forage and high cattle prices in recent years resulted in an increase in heifer placements during this time period. Average placement weights for steers and heifers were 754 and 695 lb (342 and 315 kg), respectively. The highest frequency of

Table 1. Number of cattle lots and head by sex and year.*

Year	Heifers		Steers	
	Lots	Head	Lots	Head
2005	21,488	3,113,807	26,985	4,096,301
2006	21,967	3,171,046	28,857	4,384,613
2007	23,750	3,344,178	28,798	4,369,027
2008	24,157	3,463,205	29,456	4,594,064
2009	22,248	3,178,105	25,973	3,861,791
2010	23,299	3,401,132	27,032	4,219,412
2011	23,268	3,434,339	26,215	4,190,225
2012	22,021	3,308,095	25,521	4,120,450
2013	22,684	3,374,243	28,061	4,497,384
2014	14,300	2,079,481	18,113	2,866,606
All	219,182	31,867,631	265,011	41,199,903

*Data obtained from Benchmark® closeouts from January 1, 2005 through September 30, 2014.

Table 2. Distribution of cattle lots and head by placement weight and sex.*

Placement weight, lb	Heifers				Steers			
	Lots, n	%	Head, n	%	Lots, n	%	Head, n	%
400 to 599	42,964	19.6	5,979,756	18.8	30,988	11.7	4,718,290	11.5
600 to 699	68,551	31.3	9,543,625	29.9	51,975	19.6	7,513,161	18.2
700 to 799	72,541	33.1	11,220,625	35.2	80,430	30.3	12,399,517	30.1
800 to 899	27,177	12.4	4,127,153	13.0	72,854	27.5	12,086,753	29.3
900 to 1099	7,949	3.6	996,472	3.1	28,763	10.9	4,482,182	10.9
All	219,182		31,867,631		265,011		41,199,903	

*Data obtained from Benchmark® closeouts from January 1, 2005 through September 30, 2014.

placement weights existed in 700 to 799 lb (318 to 362 kg) steers and heifers. Steers in this weight class represented 30.3% of lots and 30.1% of cattle, while heifers in this weight class represented 33.1% of lots and 35.2% of cattle.

Mortality rates by month of feedlot closeout, with 50th and 90th percentiles for steer and heifer lots closed between 2005 and 2014, are reported in Figure 1. Combined steer and heifer mean yearly mortality rate was 1.49%. Yearly mortality rate increased 27.6% (1.34 vs. 1.71%) in steers and 30.5% (1.41 vs 1.84%) in heifers between January 2005 and September 2014. Mortality was greater for heifers (1.56%) than steers (1.43%). This difference was most notable between 2009 and 2014, when yearly steer and heifer mortality averaged 1.49% and 1.68%, respectively. It is possible that drought conditions forced potential replacement heifers with lowered immune status into feedyards, which contributed to the higher mortality.

Mortality rates follow a consistent seasonal pattern, with monthly feedlot closeout mortality being highest among lots closed in late spring and summer months, and lowest in late fall and early winter months (Figure 1). These patterns correspond with fall and winter cattle placements. Cattle placed in the fall experienced greater BRD-associated mortality, while spring and summer mortality increased due to higher digestive death loss.^{8,25} Mortality was markedly higher during years 2011 through 2014 than years prior. The 50th and 90th percentiles for mortality followed similar seasonal patterns, suggesting broad-based shifts in mortality during this time frame. Surprisingly, the 90th percentile for monthly mortality in steers and heifers often exceeded 5.5 and 6% on closeouts during the summer months of these years. It is

possible that persistent drought conditions and record heat, in combination with seasonal mortality trends in death loss observed during these years, contributed to the increase in mortality.

Mortality by actual month of death, expressed as a percentage of feedlot occupancy, is presented in Figure 2. Data are presented in 3-year intervals because of the substantially higher differences observed from 2011 through 2013. Data for calendar year 2014 were excluded from this analysis to allow for complete year-on-year comparisons. As a general rule, monthly mortality was lowest annually from April through June each year, increased through fall and early winter, and peaked during December. Mortality from 2005 through 2007, and 2008 through 2010, trended similarly, averaging 0.205% of feedlot occupancy monthly, while mortality from 2011 through 2013 averaged 0.26% of occupancy monthly — 127% that of the rate of the prior 6-year period. Comparatively, monthly mortality averaged 0.268% of feedlot occupancy in a previously reported analysis conducted from 1990 through 1993.²⁵ The increase in mortality observed from 2011 through 2013 was attributable to increases in respiratory, digestive, and AIP death loss.

Respiratory death loss (Figure 3) averaged 0.091% of monthly occupancy from 2005 through 2007, 0.097% from 2008 through 2010, and 0.127% of monthly occupancy from 2011 through 2013. Collectively, respiratory mortality comprised 47% of total mortality and averaged 0.117% of monthly occupancy. This compares to respiratory mortality of 0.128% of occupancy reported previously.²⁵ Seasonality of respiratory death loss was predictable, with highest mortality occurring during late fall

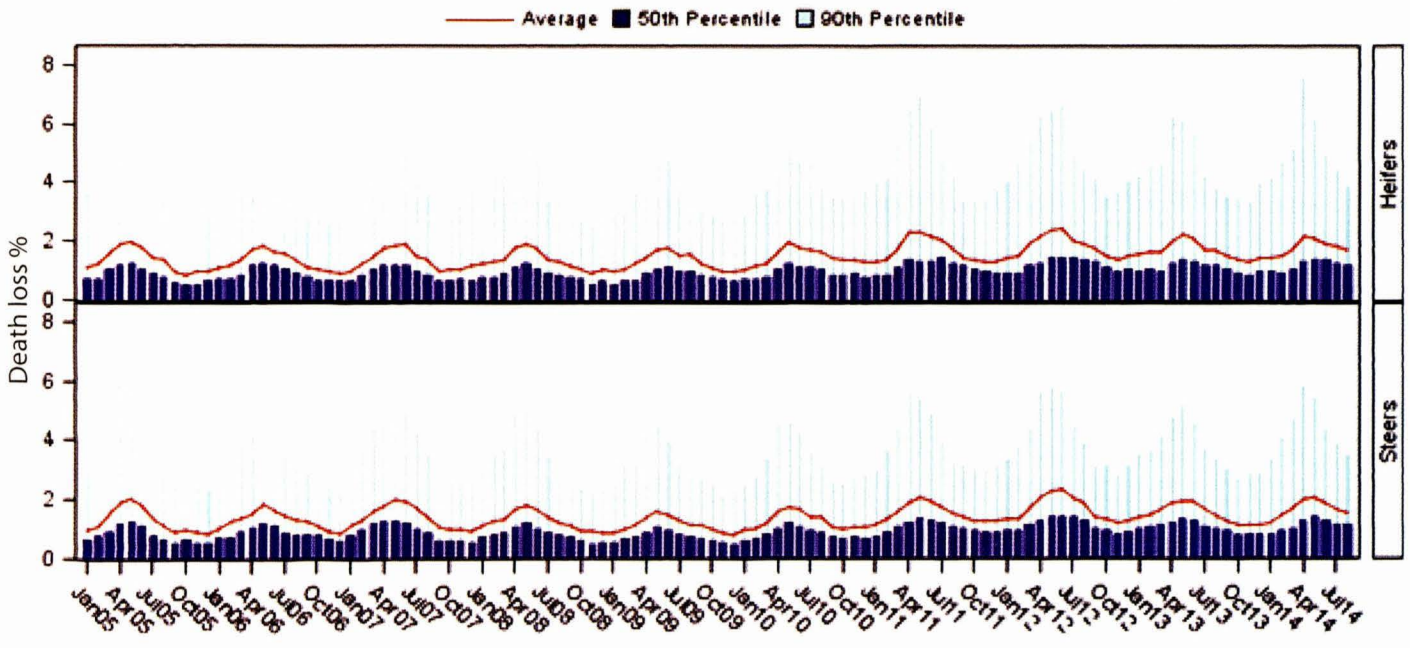


Figure 1. Mortality in steer and heifer feedlot closeouts from January 1, 2005 through September 30, 2014.

and early winter months, consistent with other reports.^{3,17,19} Average days-on-feed at death for respiratory deaths was day 62 (Table 3). Previous reports suggested average days-on-feed for respiratory death was considerably earlier.^{3,5,10,26} Part of the discrepancy could be explained by the fact that feedlot closeout information was compared to defined research studies with a set number of days. Alternatively, usage of antibiotics with longer durations of activity may have led to extended days-on-feed prior to death in recent years.

Digestive death loss (Figure 4) averaged 0.042% of monthly occupancy from 2005 through 2007, 0.039% of monthly occupancy from 2008 through 2010, and 0.049% from 2011 through 2013. Peak digestive death loss varied by season and year. From 2005 through 2007, digestive death loss was highest from December through March, while it was highest from March through July during 2008 through 2010. During 2011 through 2013, digestive death loss was highest from April through July, but remained elevated during the summer and fall months compared to prior years. Digestive mortality represented approximately 19.5% of total death loss, which is less than estimates reported previously.^{5,10,21,25} Average days at death from digestive causes were 98 and 99 days for heifers and steers, respectively. Not surprising, average days at death from digestive causes were longer in animals placed on feed at lighter weights.

Mortality from AIP (Figure 5) averaged 0.008% of monthly occupancy from 2005 through 2007 and 0.009% of monthly occupancy from 2008 through 2010. Mortality due to AIP from 2011 through 2013 was more than 2-times higher than the previous 6 years, averaging 0.019% of monthly occupancy. AIP mortality was consistently higher during summer months, which was most notable from 2011 through 2013. During this time AIP mortality averaged 0.027% of occupancy from May 1 through September 30. Feedlot AIP mortality has been reported to be 0.03 to 0.15% of cattle received.⁹ Most research suggests AIP mortality peaks during the hottest

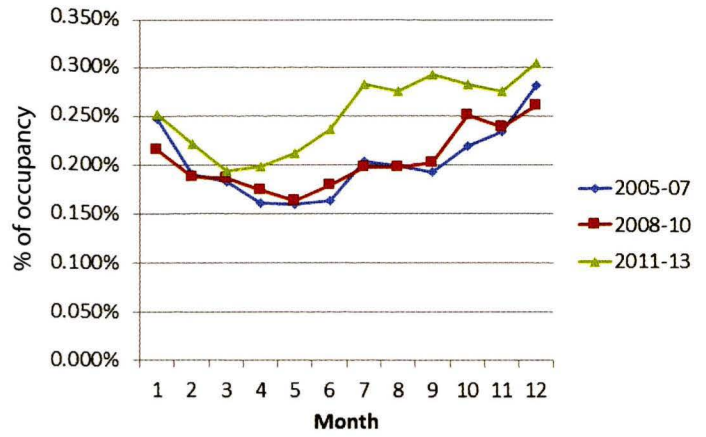


Figure 2. Monthly mortality, expressed as a percentage of feedlot occupancy, in steers and heifers from January 1, 2005 through December 31, 2013.

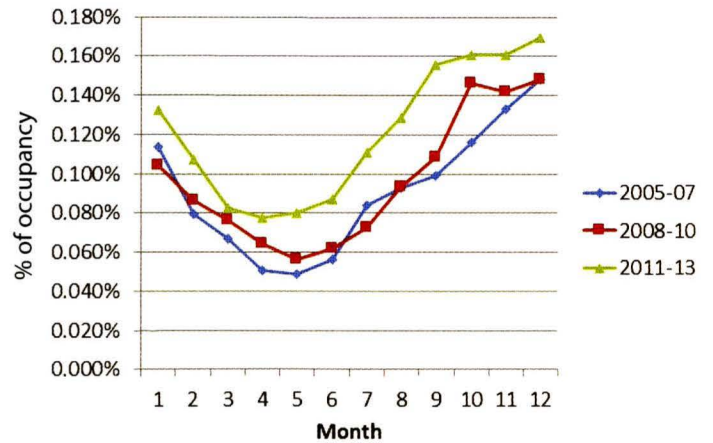


Figure 3. Monthly respiratory mortality, expressed as a percentage of feedlot occupancy, in steers and heifers from January 1, 2005 through December 31, 2013.

Table 3. Average days-on-feed and average days-on-feed at death for steers and heifers by placement weight and cause of death (± standard deviation).

Weight, lb	Heifers				Steers			
	Days-on-feed	Days-on-feed at death			Days-on-feed	Days-on-feed at death		
		Respiratory	Digestive	AIP		Respiratory	Digestive	AIP
400 to 599	219 ± 32.1	66 ± 56.7	121 ± 65.9	142 ± 61.2	241 ± 35.4	69 ± 58.9	132 ± 72.1	139 ± 71.8
600 to 699	174 ± 23.5	61 ± 48.1	99 ± 51.9	115 ± 48.1	196 ± 23.6	61 ± 50.3	109 ± 56.3	115 ± 60.6
700 to 799	148 ± 19.4	58 ± 43.3	86 ± 43.8	101 ± 37.5	168 ± 19.2	60 ± 46.5	94 ± 49.1	105 ± 48.2
800 to 899	133 ± 18.0	57 ± 40.7	82 ± 40.0	94 ± 33.6	146 ± 16.7	59 ± 42.9	82 ± 42.7	91 ± 41.3
900 to 1099	115 ± 20.8	44 ± 50.3	71 ± 37.4	72 ± 34.4	128 ± 17.1	55 ± 37.7	76 ± 38.2	80 ± 35.5
All	167 ± 38.2	62 ± 50.3	98 ± 53.7	112 ± 48.5	172 ± 39.3	62 ± 50.6	99 ± 55.5	105 ± 54.0

and driest months of the year, affects heavier cattle that are close to market, and occurs more frequently in heifers.^{1,13,28} This was supported in our data, since monthly AIP mortality rate in steers and heifers was 0.008 and 0.017% of occupancy from 2005 through 2013, respectively.

Mortalities of steers and heifers by placement weight are reported in Table 4. Mortalities were higher in lighter-weight cattle for both sexes. These results are supported by the findings of others, who reported that increased body weight at placement was associated with reduced rates of morbidity and mortality.^{3,17} This is likely attributable to increased risk of BRD in lighter animals and greater days-on-feed. It is interesting that regardless of placement weight, death loss during the first 30 days of the feeding period comprised approximately 25% of total death loss. The mid-feeding period, as defined within this article, represented the

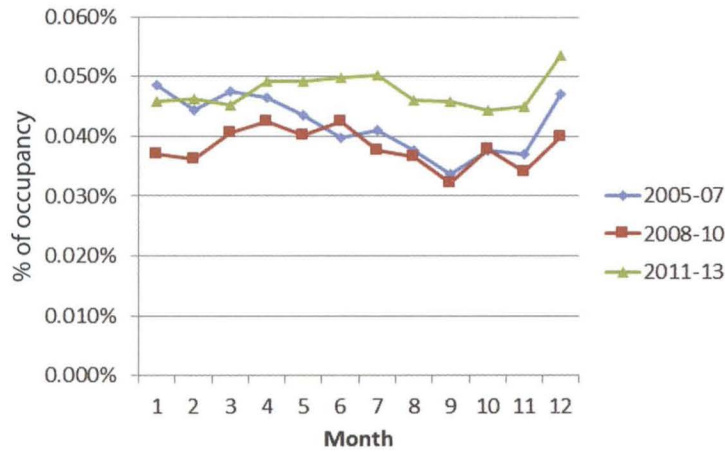


Figure 4. Monthly digestive mortality, expressed as a percentage of feedlot occupancy, in steers and heifers from January 1, 2005 through December 31, 2013.

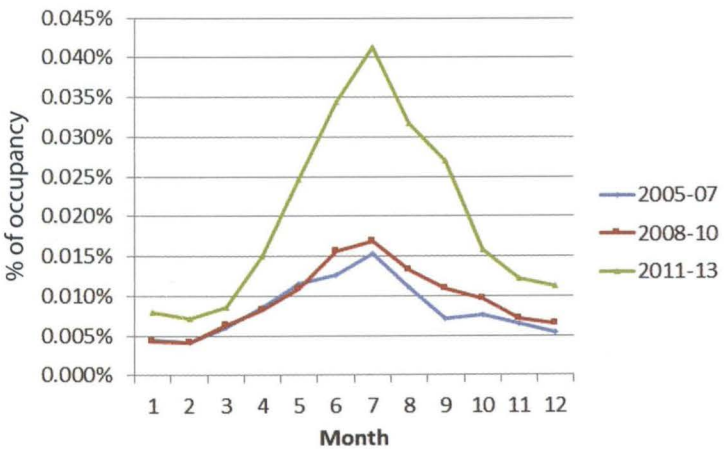


Figure 5. Monthly acute interstitial pneumonia mortality, expressed as a percentage of feedlot occupancy, in steers and heifers from January 1, 2005 through December 31, 2013.

greatest percentage of death loss, ranging from 63 and 56% of total mortality in steers and heifers weighing less than 600 lb (272 kg) at arrival to 27 and 20% of mortality for steers and heifers placed on feed weighing greater than 900 lb (408 kg). It is important to note this period also represented the greatest and most variable of amount of time evaluated. In steers and heifers weighing less than 600 lb (272 kg) at arrival, the mid-feeding period comprised 63 and 59% of the time on feed, respectively, where the mid-feeding period for steers and heifers placed on feed at greater than 900 lb (408 kg) represented 30 and 22% of the time of feed. As such, the contribution to mortality during this period is likely a reflection of days-on-feed. Mortality during 60 to 31 days prior to harvest and mortality during the last 30 days-on-feed averaged 0.18 and 0.21% in steers and 0.20 and 0.26% in heifers, respectively. Each of these periods contributed approximately 7% of total death loss for steers and heifers weighing less than 600 lb (272 kg), but approximately 25% of total death loss for steers and heifers weighing more than 899 lb (408 kg). Further, mortality in each feeding period increased in each weight class and sex from 2005 through September 2014 (Figure 6); however, the relative contribution or percent of deaths of each portion of the feeding period stayed remarkably constant from 2005 through September 2014 (Figure 7). Limited data characterizing mortality patterns at the end of the feeding period exist. One of the objectives of this paper was to define mortality rate during the last 30 days (typically the time when a beta-agonist is fed) and immediately prior (61 to 30 days prior to harvest) for comparative purposes. It has been recently suggested beta-agonist usage contributes to an increase in death loss using population datasets,¹² while others reported no difference in mortality between control and ractopamine-fed steers in 32 controlled studies.¹⁶ In their data, mortality for control and ractopamine-fed steers averaged 0.185% and 0.125%, respectively, during the final 28 to 42 days of the feeding period.¹⁶ These values are lower than the 0.21% for steers during the last 30 days-on-feed observed in this population. (Table 4).

Mortality and Performance

A unique attribute of this dataset is that it allows mortality and production trends to be compared side-by-side. Figures 8 and 9 present monthly mean values for close-out mortality, placement weight, out weight, lb of added gain, days-on-feed, and dead-in daily gain for steers and heifers, respectively, from January 2005 through September 2014. Clear seasonal patterns exist in the data. Feedlot closeouts in the spring of each year showed greater mortality, had lower placement weights, lower daily gains, lower final weights, and more days-on-feed. In contrast, fall closeouts had lower mortality, higher placement weights, higher daily gains, higher final weights, and fewer days-on-feed. On a year-over-year basis, mortality increased 0.04%/year while placement weight increased 1.7 lb (0.77 kg)/year; final weight increased

Table 4. Overall and period mortality of steers and heifers by placement weight.

Sex	Placement weight (lb)	Death loss % within feeding period*				
		Overall	First 30 days	Mid-feeding period	60 to 31 days before harvest	Last 30 days
Heifers	400 to 599	2.63	0.69	1.48	0.20	0.25
	600 to 699	1.72	0.44	0.79	0.21	0.27
	700 to 799	1.15	0.28	0.42	0.20	0.25
	800 to 899	0.89	0.21	0.26	0.18	0.24
	900 to 1099	0.97	0.31	0.20	0.21	0.24
	All	1.56	0.40	0.70	0.20	0.26
Steers	400 to 599	2.72	0.65	1.70	0.17	0.20
	600 to 699	1.97	0.50	1.07	0.18	0.22
	700 to 799	1.35	0.33	0.62	0.18	0.22
	800 to 899	0.94	0.22	0.36	0.17	0.20
	900 to 1099	0.72	0.17	0.20	0.16	0.18
	All	1.43	0.35	0.70	0.18	0.21

*Period of mortality; first 30, mortality occurred during the first 30 days of the feeding period; mid-feeding period: mortality occurred between 31 days-on-feed and 61 days prior to harvest; 60 to 31 days before harvest, mortality occurred between 60 to 31 days before harvest; last 30 days, mortality occurred during the last 30 days-on-feed.

7.1 lb (3.2 kg)/year; days-on-feed decreased 0.05 days/year; and daily gain increased 0.02 lb (0.009 kg)/day/year (Figure 8) in steers. In heifers, mortality increased 0.06%/year while placement weight increased 2.4 lb (1.09 kg)/year; final weight increased 5.5 lb (2.49 kg)/year; days-on-feed decreased 0.70 day/year; and daily gain increased 0.02 lb (0.009 kg)/day/year (Figure 9). This improved productivity is consistent with others who have reported improvements in performance over extended periods of time.^{2,6} In one study,⁶ the authors reported 23 and 57% improvements in feed efficiency and daily gain, respectively, from 1955 to 2004. Many have cited improved genetics,^{2,6,20,22} better nutrition,^{2,6} improved grain yields,⁶ and use of pharmaceutical technologies^{2,4,6,27} as reasons for the improved productivity. Recently, some have argued increased animal productivity in swine and poultry may compromise animal welfare and increase mortality concerns.^{7,18} This relationship has not been established in cattle, given the complexities of the beef enterprise. Nevertheless, the improvements in animal productivity observed in this dataset are remarkable and demonstrate the ability of livestock producers to efficiently produce beef.

Conclusion

Considerable variation in lot mortality exists within feedyards. Many factors including sex, placement weight, season of year, cause of mortality, and timing of death within a feeding period affect these values. These data support the hypothesis that animal mortality has increased in recent years. Likewise, animal productivity has increased due to improved genetics, improved livestock husbandry practices, increased use of technologies and animal health products, and

changing market signals. Thus, it is important for livestock producers to understand animal mortality and production parameters when calculating economic returns.

Endnotes

^aBenchmark® Performance Program, AgSpan, Overland Park, KS

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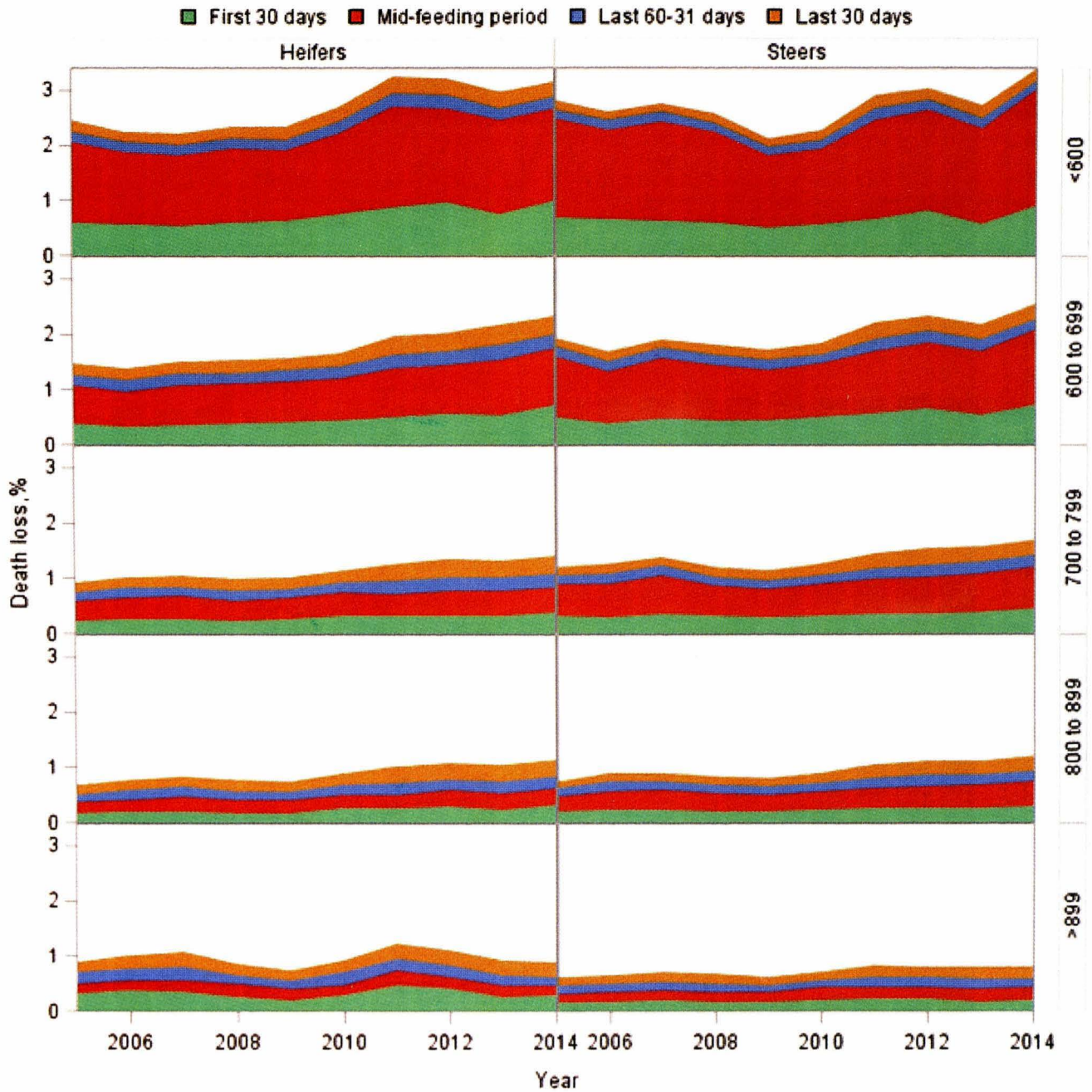


Figure 6. Cumulative mortality, by time of death within the feeding period, in steers and heifers from January 1, 2005 through September, 30, 2014.*
 *Period of mortality: first 30 days, mortality occurred during the first 30 days of the feeding period; mid-feeding period, mortality occurred between 31 days-on-feed and 61 days prior to harvest; last 60 to 31 days, mortality occurred between 60 to 31 days before harvest; last 30 days, mortality occurred during the last 30 days-on-feed.

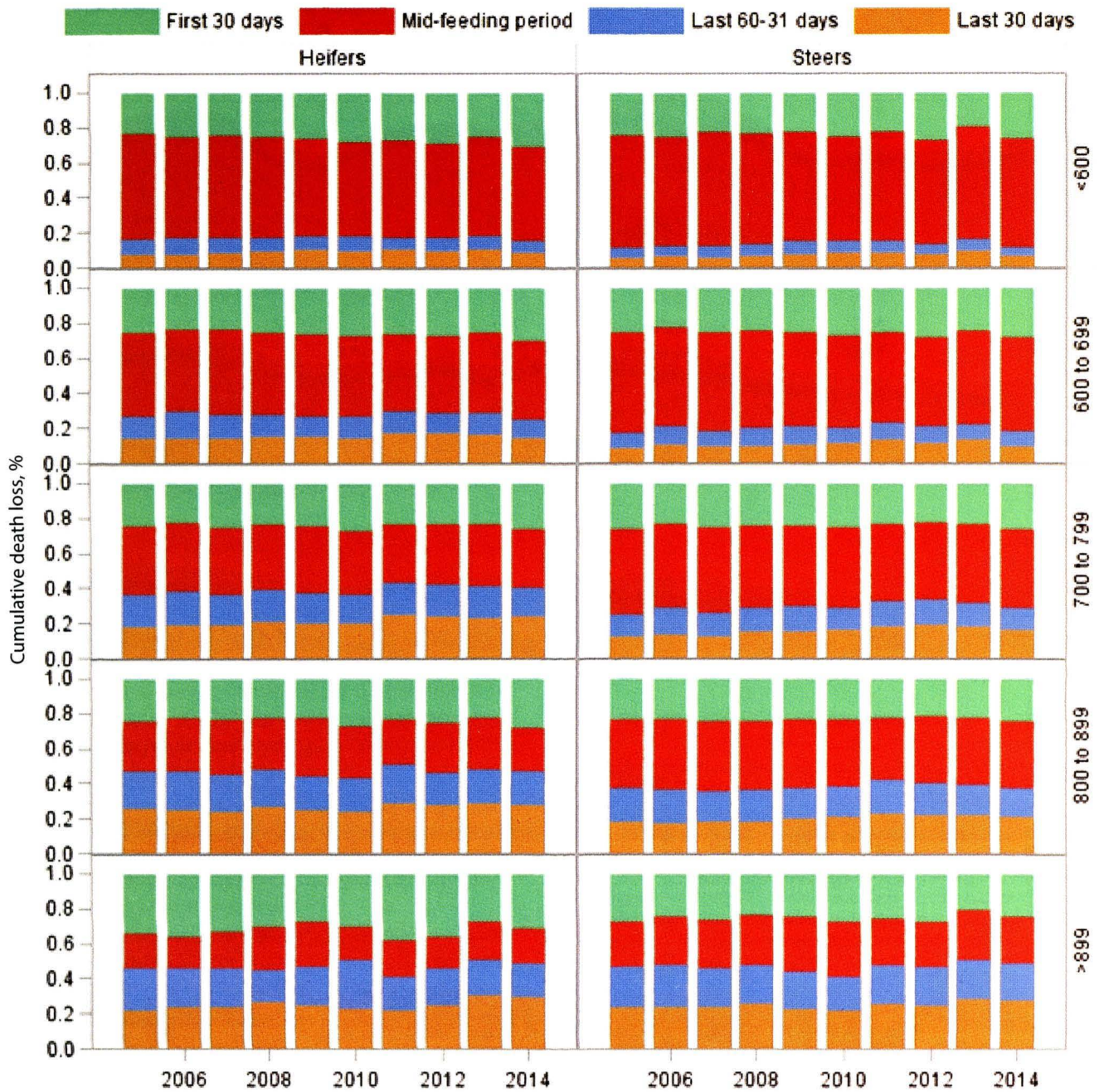


Figure 7. Mortality, expressed as a percentage, by time of death within the feeding period in steers and heifers from January 1, 2005 through September 30, 2014.*

*Period of mortality: first 30 days, mortality occurred during the first 30 days of the feeding period; mid-feeding period, mortality occurred between 31 days-on-feed and 61 days prior to harvest; last 60 to 31 days, mortality occurred between 60 to 31 days before harvest; last 30 days, mortality occurred during the last 30 days-on-feed.

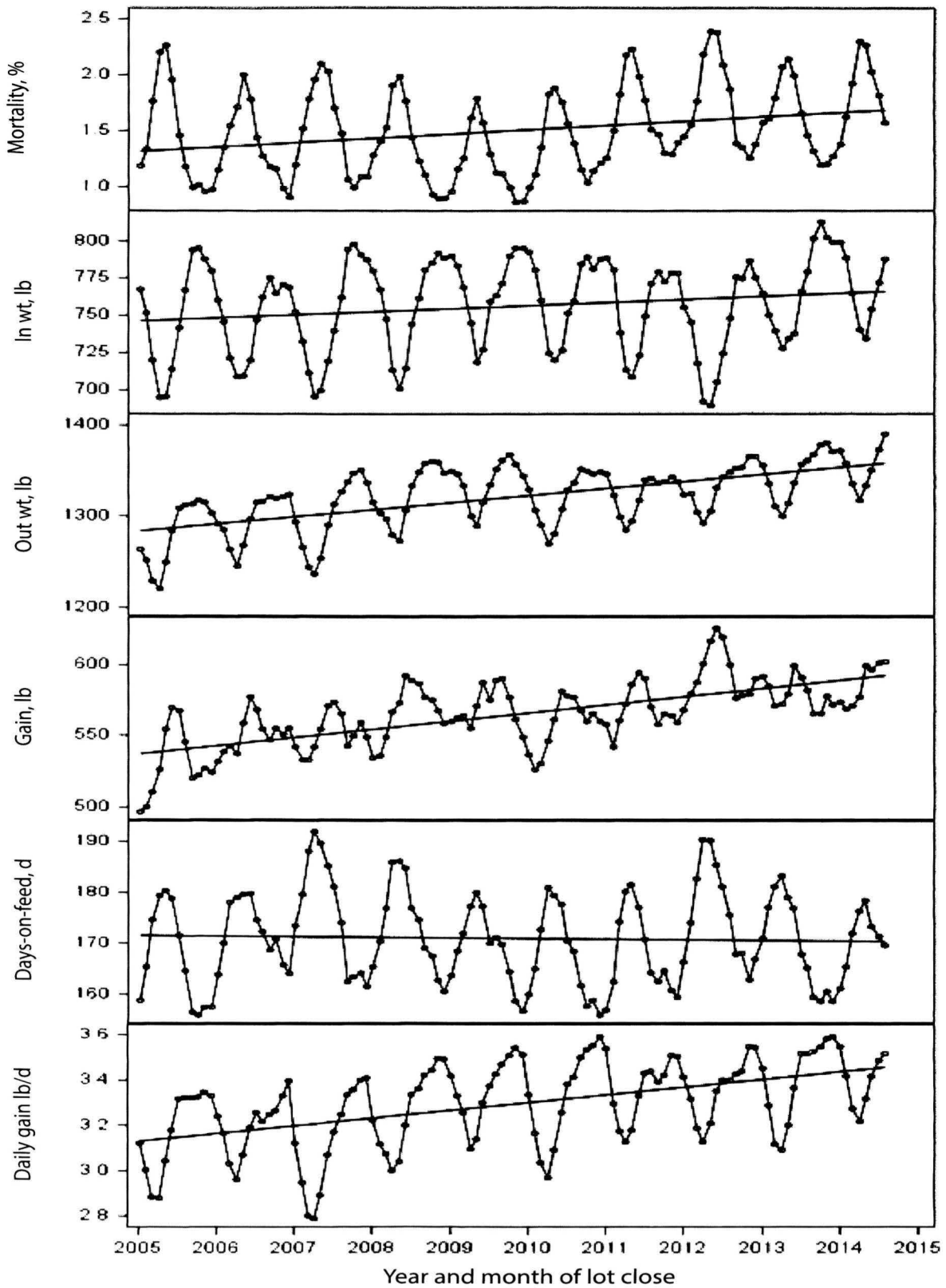


Figure 8. Animal mortality and performance parameters of steer feedlot closeouts from January 1, 2005 through September 30, 2014.

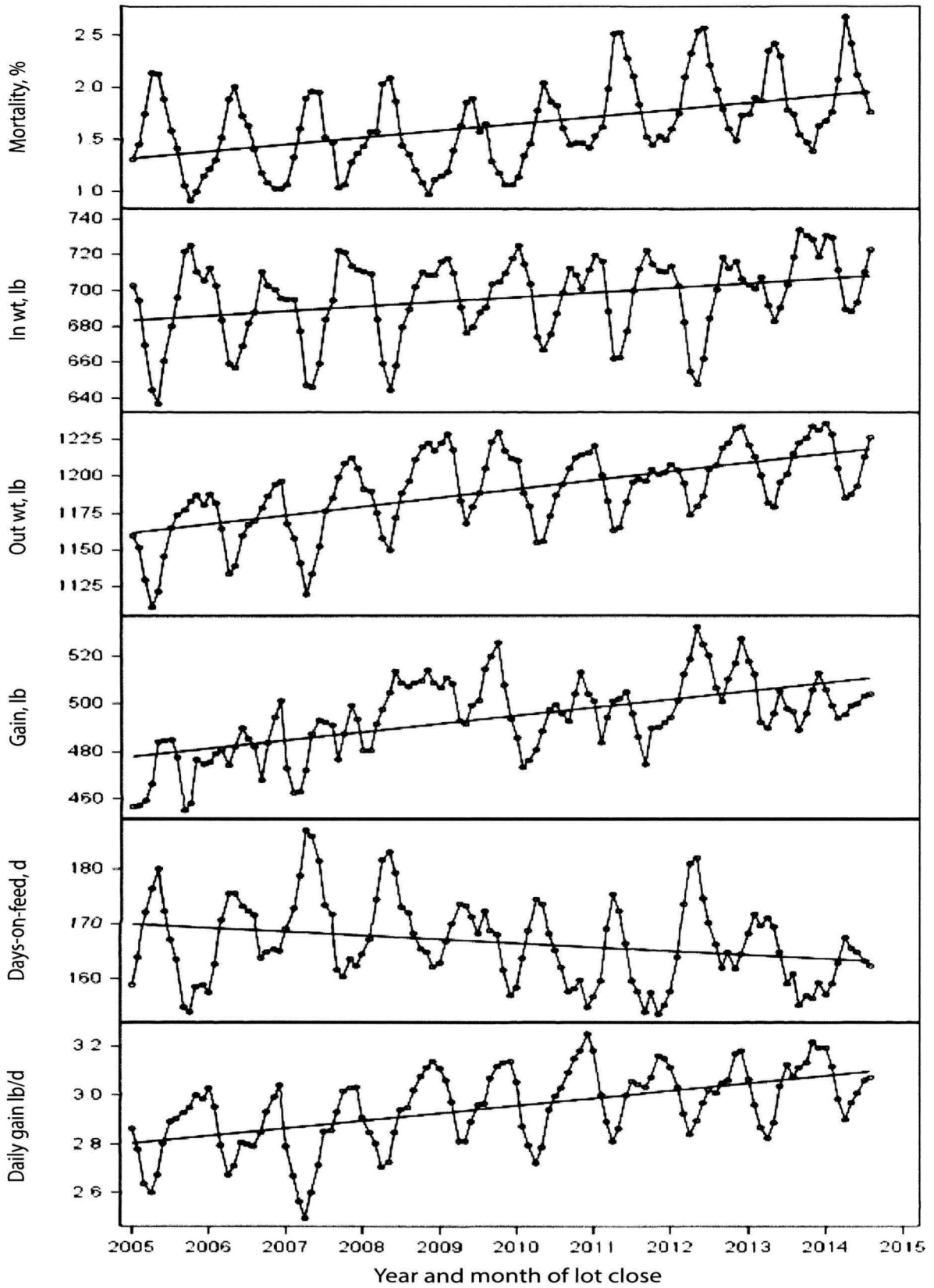


Figure 9. Animal mortality and performance parameters of heifer feedlot closeouts from January 1, 2005 through September 30, 2014.

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