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Maximizing Use of an Extension Beef Cattle Data Set: Part 3—Weights and Growth

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Abstract

Previously, we described calving distribution and reproductive rates from CHAPS20Y, an Extension beef cattle data set. In this article, we describe CHAPS20Y data on birth weight, weaning weight, pounds weaned per cow exposed, calf age at weaning/weighing, average daily gain, weight per day age, frame score, and cow age, weight, and condition. Yearly mean weights and growth are consistent over the 20-year period, with variation among herds. Breed, management, and environmental differences may explain some of the variation. Our analysis of the CHAPS20Y data provides Extension professionals with expanded knowledge of beef cattle weights and growth and, accordingly, improved ability to help producers more effectively manage their herds.

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Introduction

We used data from Cow Herd Appraisal Performance Software (CHAPS) to create CHAPS20Y, a 20-year data set spanning from 1994 through 2013, as an Extension tool for understanding trends in beef production (Ramsay, Hulsman Hanna, & Ringwall, 2016). In Parts 1 and 2 of this series, we described CHAPS20Y calving distribution and reproductive rate data (Ramsay, Hulsman Hanna, & Ringwall, 2017a, 2017b). In this article, we describe data related to

- birth weight;
- weaning weight (actual and adjusted);
- calf age at weaning/weighing (days), hereafter referred to as calf age;
- average daily gain (ADG);
- weight per day age (WDA);

- pounds weaned per cow exposed to bull(s), hereafter referred to as pounds weaned;
- frame score;
- cow age (years);
- cow weight; and
- cow condition.

Knowledge gained from examining CHAPS20Y weight and growth data will allow Extension professionals to help producers set and achieve herd management goals. Herein, we present yearly means, 20-year averages, and linear trends over time.

Describing Weight and Growth Data

Weight and Growth Calculations

The CHAPS program calculates values for weight and growth variables according to Beef Improvement Federation (2010) guidelines and recommendations put forth by Ringwall and Berg (1990). Those variables and the applicable calculations are shown in Figure 1.

Figure 1.
Calculations for Weight and Growth Variables

Adjusted 205-Day Weight

$$\frac{(actual\ weight - birth\ weight)}{calf\ age} \times 205 + birth\ weight + dam\ adustment\ factor$$

If birth weight is missing, birth weight = 70.
Dam adjustment factor*:

If sex is heifer and dam age	= 2, add 54
	= 3, add 36
	= 4, add 18
	>10, add 18
If sex is bull or steer and dam age	= 2, add 60
	= 3, add 40
	= 4, add 20
	>10, add 20

*Dam adjustment factor, for all sexes, equals 0 if dam age is 5–10 years.

Pounds Weaned

$$\frac{sum\ of\ calf\ weaning\ weights\ in\ herd}{(total\ exposed\ females - pregnant\ females\ culled\ within\ 365\ days)}$$

Average Daily Gain (ADG)

$$\frac{(weaning\ weight - birth\ weight)}{calf\ age}$$

Weight Per Day Age (WDA)

$$\frac{weaning\ weight}{calf\ age}$$

Frame Score (hip height measured in inches)

Steers and bulls:

$$-11.548 + 0.4878\ (hip\ height) - 0.289\ (calf\ age) + 0.00001947\ (calf\ age)(calf\ age) + 0.0000334\ (hip\ height)(calf\ age)$$

Heifers:

$$-11.7086 + 0.4723\ (hip\ height) - 0.239\ (calf\ age) + 0.0000146\ (calf\ age)(calf\ age) + 0.0000759\ (hip\ height)(calf\ age)$$

Cow Condition

1 (severely emaciated) to 9 (obese)

Calf Weights

Figures 2–4 show CHAPS20Y birth and weaning weight data. Yearly mean birth weights ranged from 81 to 90 lb, with a 20-year average of 86 lb. Yearly mean actual weaning weights ranged from 518 to 580 lb, with a 20-

year average of 551 lb. Adjusted 205-day weights ranged from 580 to 646 lb, with a 20-year average of 621 lb. Pounds weaned ranged from 453 to 512 lb, with a 20-year average of 490 lb. Bull weaning weights ranged from 564 to 624 lb, with a 20-year average of 598 lb. Heifer weights ranged from 504 to 560 lb, with a 20-year average of 533 lb. And, finally, steer weights ranged from 525 to 593 lb, with a 20-year average of 563 lb.

Figure 2.

Yearly Mean Birth Weights with 20-Year Average Trend Line

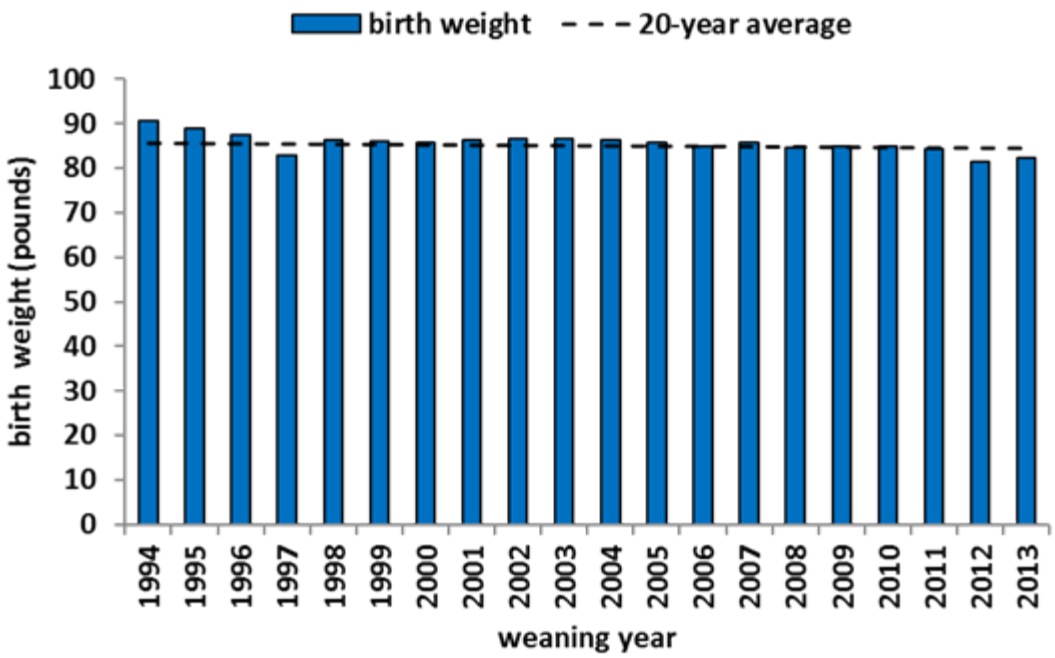


Figure 3.

Yearly Mean Actual and Adjusted 205-Day Weaning Weights and Pounds Weaned per Cow Exposed (Pounds Weaned) with 20-Year Average Trend Lines

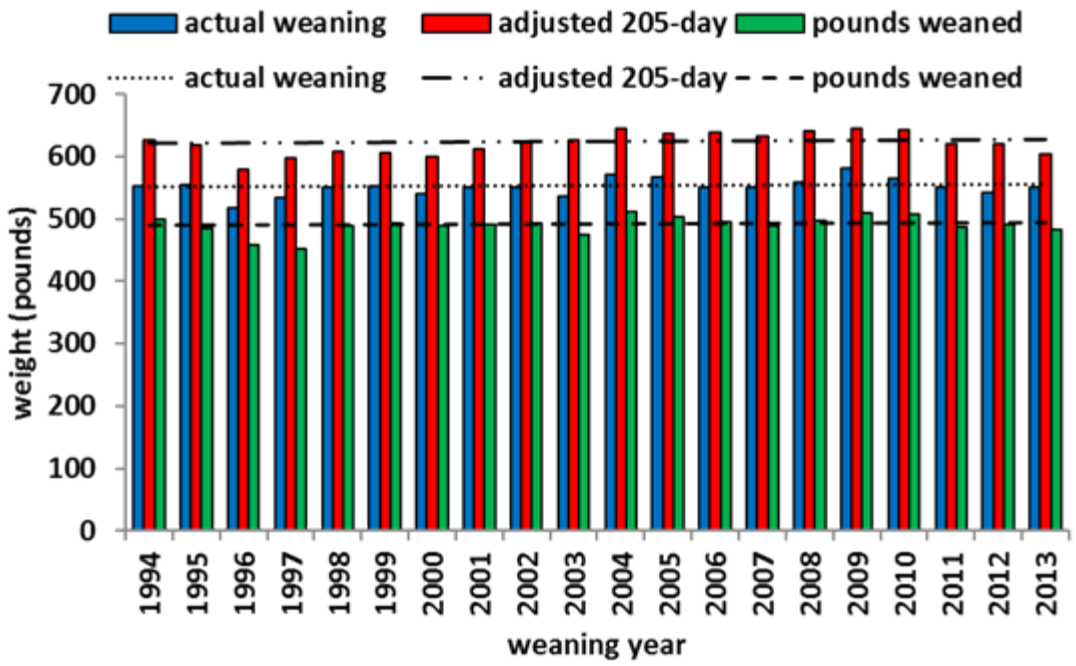
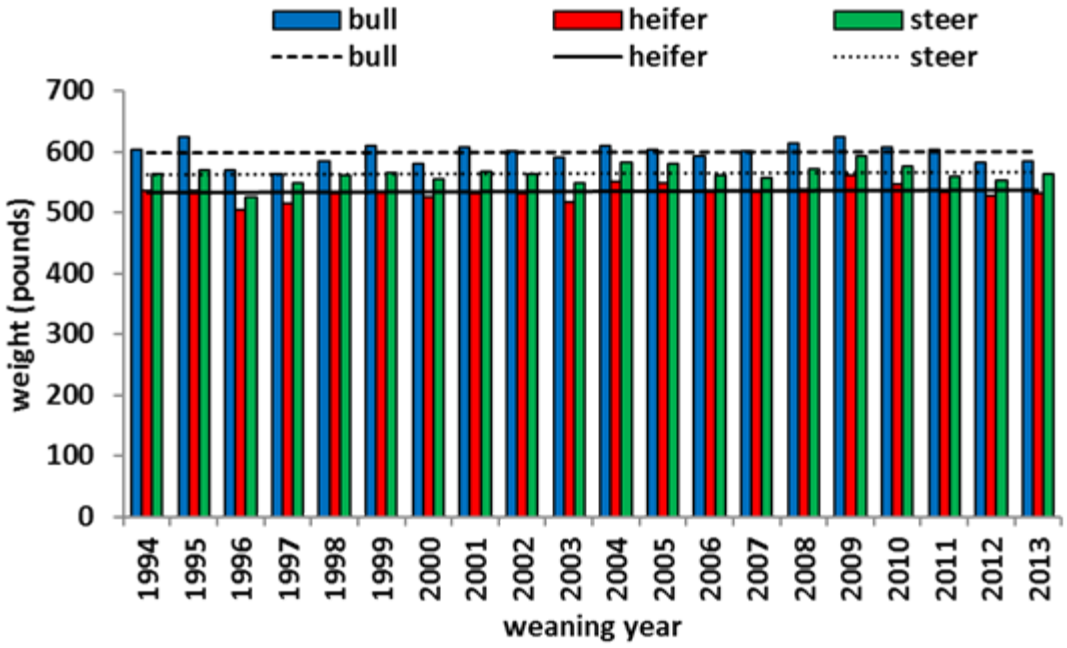


Figure 4.

Yearly Mean Bull, Heifer, and Steer Weaning Weights with 20-Year Average Trend Lines



Calf Age and Growth

Data related to calf age and growth are shown in Figures 5–7. Yearly mean calf ages ranged from 182 to 198 days, with a 20-year average of 191 days. Yearly mean ADGs ranged from 2.3 to 2.6 lb, with a 20-year average of 2.5 lb, and WDAs ranged from 2.7 to 3.0 lb, with a 20-year average of 2.9 lb. Frame scores ranged from 5.3 to 6.1, with a 20-year average of 5.7.

Figure 5.

Yearly Mean Calf Ages at Weaning/Weighing with 20-Year Average Trend Line

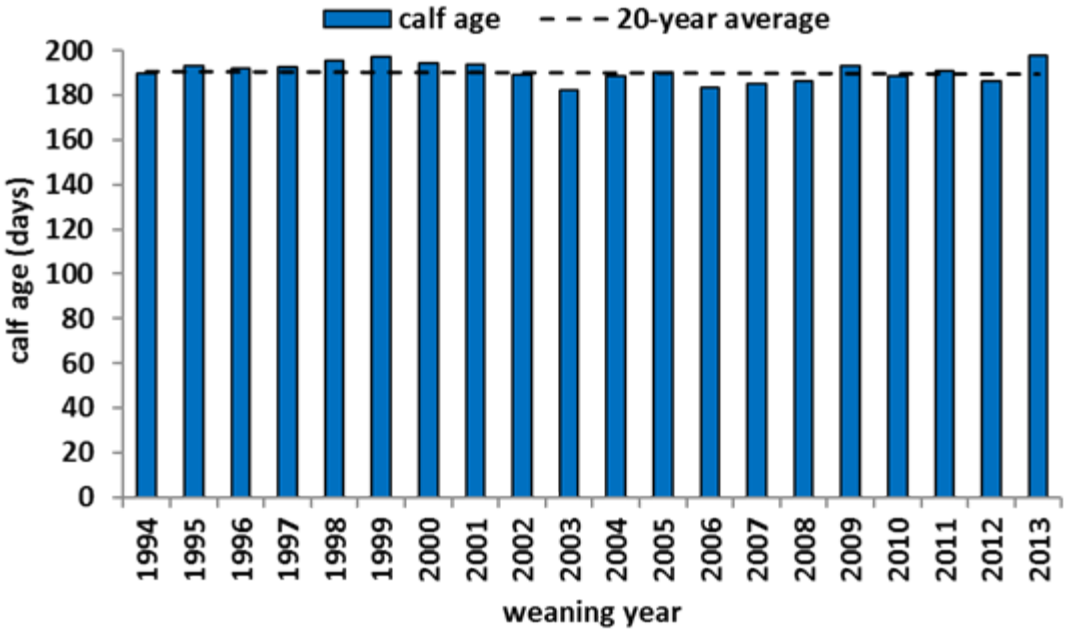


Figure 6.

Yearly Mean Average Daily Gains (ADGs) and Weights per Day Age (WDAs) with 20-Year Average Trend Lines

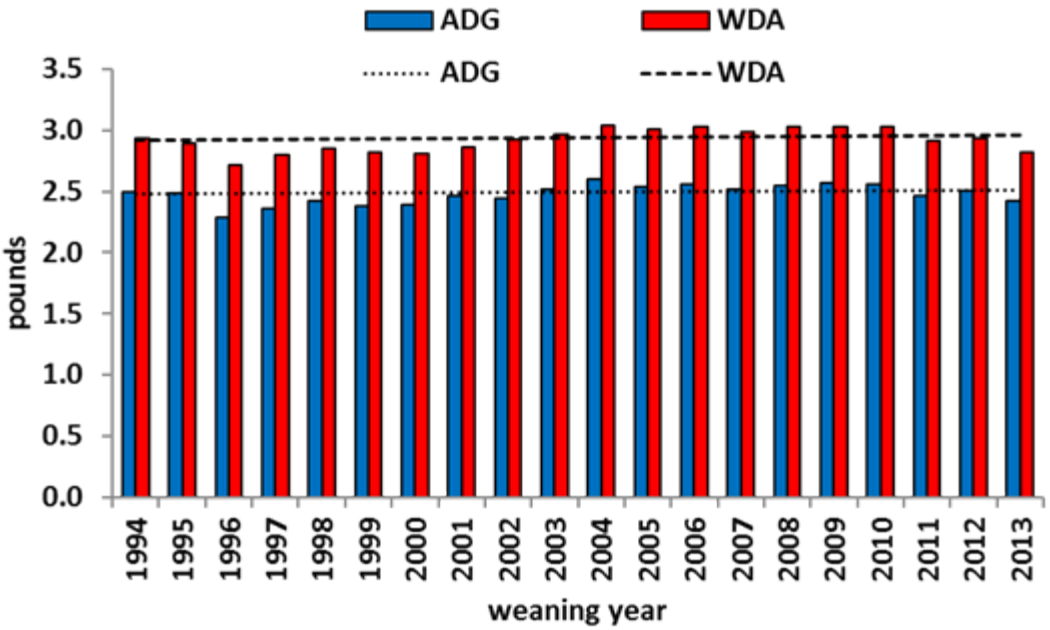
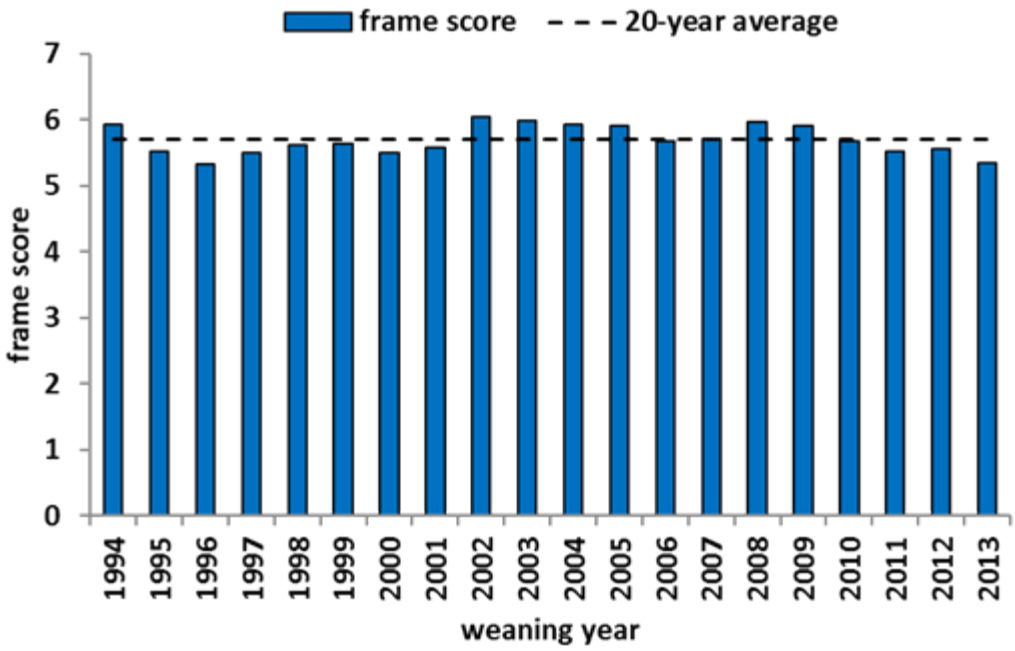


Figure 7.

Yearly Mean Frame Scores with 20-Year Average Trend Line



Cow Age, Weight, and Condition

Figures 8 and 9 show data for cow age, weight, and condition. Yearly mean cow ages ranged from 5.3 to 5.8 years, with a 20-year average of 5.6 years. Yearly mean cow weights ranged from 1,315 to 1,479 lb, with a 20-year average of 1,412 lb, and cow conditions ranged from 4.8 to 6.5, with a 20-year average of 5.8.

Figure 8.

Yearly Mean Cow Ages (Years) with 20-Year Average Trend Line

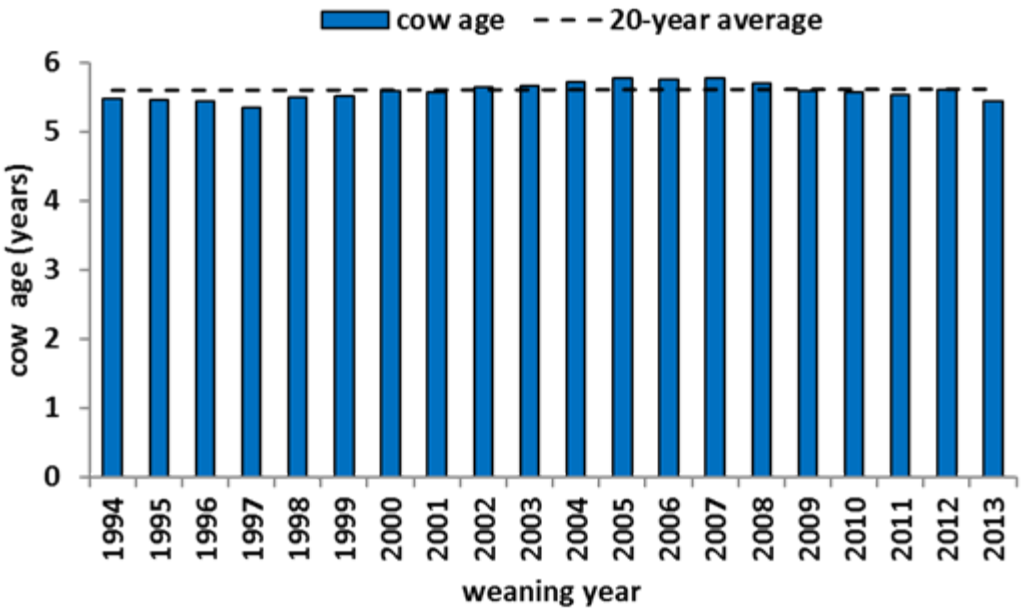
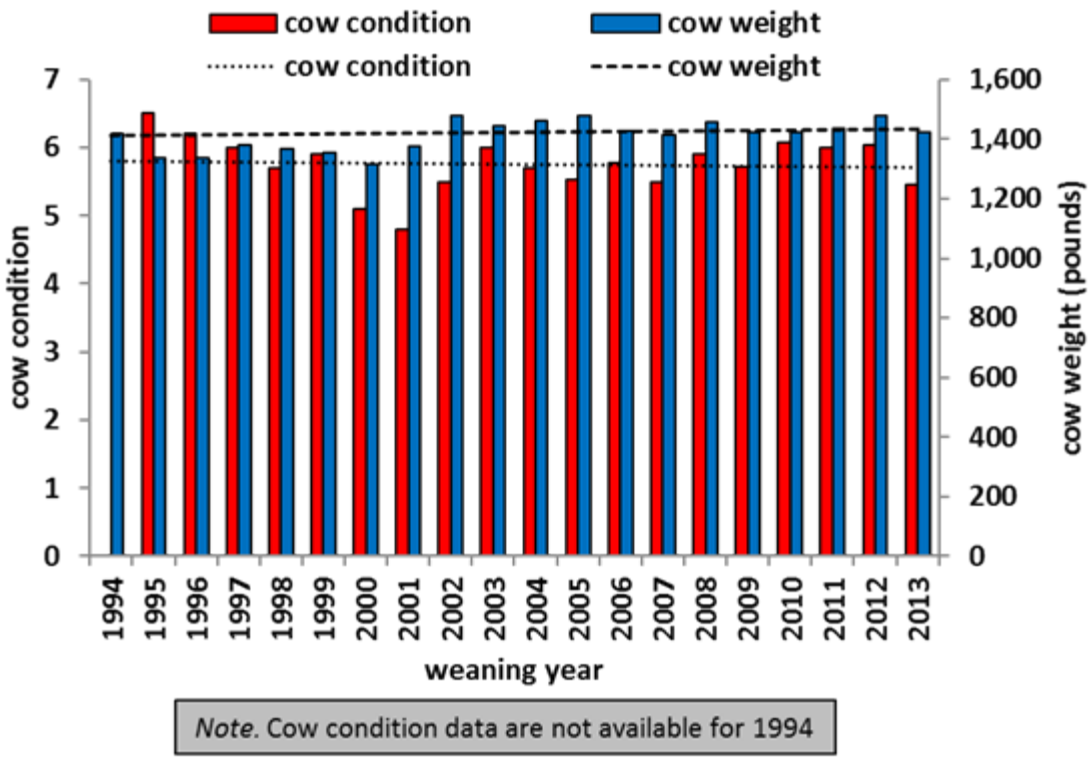


Figure 9.

Yearly Mean Cow Conditions and Weights with 20-Year Average Trend Lines



Note. Cow condition data are not available for 1994

Variation in Herd Numbers

Not all producers providing data for CHAPS measure birth weights, bull and steer weights, frame scores, and cow weights and condition scores. Table 1 shows numbers of herds for which these weight and growth data were available as compared to the numbers of herds for which other types of data, discussed here and in Parts 1 and 2 of this series, were available.

Table 1.

Numbers of Herds Used to Calculate Yearly Means for Birth Weight, Bull and Steer Weight, Frame Score, and Cow Weight and Condition, and Other Types of Data

Year	Birth weight	Bull weight	Steer weight	Frame score	Cow weight	Cow condition score	Other data
1994	22	7	31	10	1	0	33
1995	24	8	38	10	3	1	39
1996	27	8	41	12	3	1	43
1997	34	12	44	14	4	1	49
1998	34	12	46	12	4	1	51
1999	34	14	52	13	3	1	54

2000	39	15	52	12	6	1	56
2001	36	16	54	14	7	3	59
2002	38	15	56	12	5	2	59
2003	40	13	61	13	3	1	64
2004	45	16	62	11	7	3	65
2005	49	20	64	10	6	3	70
2006	49	21	61	9	7	4	65
2007	48	18	62	8	7	3	68
2008	49	16	60	11	7	4	66
2009	40	13	56	9	7	4	62
2010	38	12	54	8	6	4	58
2011	37	14	51	9	5	3	56
2012	30	14	45	7	5	3	49
2013	25	11	36	5	3	2	40

Yearly Minimums and Maximums

To demonstrate herd-to-herd variation in the CHAPS20Y data set, we present yearly herd minimums and maximums for birth weight (Table 2), weaning weight and pounds weaned (Table 3), bull, steer, and heifer weight (Table 4), calf age, ADG, and WDA (Table 5), frame score (Table 6), and cow age, weight, and condition (Table 7).

Table 2.
Minimum and Maximum
Birth Weights (Pounds)

	Birth weight	
Year	**Min.**	**Max.**
1994	78	100
1995	77	102
1996	75	101
1997	70	97
1998	75	99
1999	75	97
2000	76	96
2001	76	96

2002	77	96
2003	75	99
2004	75	100
2005	68	98
2006	65	98
2007	70	97
2008	70	97
2009	71	99
2010	71	99
2011	68	98
2012	64	92
2013	73	91

Table 3.
Minimum and Maximum Actual and Adjusted 205-Day Weaning Weights (Pounds) and Pounds Weaned

	Actual weaning weight		Adjusted 205-day weight		Pounds weaned per cow exposed	
Year	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
1994	431	674	526	730	384	613
1995	414	721	541	696	336	641
1996	397	690	485	658	305	605
1997	390	755	441	681	283	647
1998	448	680	455	701	345	652
1999	427	685	456	694	364	625
2000	418	658	448	681	317	629
2001	449	654	466	691	362	588
2002	420	689	488	707	374	656
2003	433	652	492	743	356	625
2004	416	740	511	737	360	663
2005	483	675	500	726	285	618
2006	424	710	515	741	380	666

2007	435	708	502	754	364	647
2008	419	687	499	795	363	630
2009	453	777	488	749	338	720
2010	440	726	511	730	349	666
2011	453	673	516	718	313	618
2012	424	649	516	743	368	602
2013	463	668	502	712	320	642

Table 4.
Minimum and Maximum Bull, Steer, and Heifer Weaning Weights (Pounds)

	Bull weight		Steer weight		Heifer weight	
Year	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
1994	454	713	419	698	423	649
1995	573	711	431	737	395	706
1996	532	639	401	737	390	650
1997	404	654	410	787	372	716
1998	455	697	305	699	420	664
1999	454	708	439	680	413	708
2000	456	673	431	687	407	633
2001	493	688	457	692	436	622
2002	435	686	449	709	404	669
2003	400	683	445	686	420	618
2004	431	710	419	767	413	693
2005	444	718	459	703	465	649
2006	425	744	423	727	408	687
2007	507	694	448	733	411	681
2008	526	752	433	723	400	655
2009	537	689	470	798	451	752
2010	485	690	430	765	423	688
2011	533	691	421	682	445	662
2012	439	702	440	681	416	628

2013	524	659	477	691	445	646

Table 5.

Minimum and Maximum Calf Ages at Weaning/Weighing (Days), Average Daily Gains (ADG) (Pounds), and Weights per Day Age (WDA) (Pounds)

	Calf age		ADG		WDA	
Year	**Min.**	**Max.**	**Min.**	**Max.**	**Min.**	**Max.**
1994	148	238	2.1	3.0	2.4	3.5
1995	152	243	2.1	2.8	2.5	3.3
1996	146	235	1.8	2.7	2.2	3.1
1997	149	265	1.6	2.7	2.1	3.3
1998	159	250	1.8	2.9	2.1	3.3
1999	156	244	1.7	2.7	2.1	3.3
2000	154	235	1.9	2.8	2.0	3.3
2001	150	233	2.0	2.8	2.2	3.3
2002	150	240	2.0	2.9	2.3	3.4
2003	139	224	1.9	3.1	2.3	3.7
2004	136	238	2.1	3.0	2.4	3.5
2005	151	232	1.9	2.9	2.3	3.4
2006	133	240	1.9	3.1	2.4	3.6
2007	134	268	2.0	3.1	2.2	3.5
2008	137	241	2.0	3.3	2.3	3.7
2009	154	271	1.9	3.0	2.2	3.5
2010	139	255	1.8	3.0	2.3	3.5
2011	150	265	1.7	2.9	2.4	3.4
2012	157	227	1.8	3.1	2.4	3.5
2013	158	259	1.8	2.9	2.3	3.3

Table 6.

Minimum and Maximum Frame Scores

	Frame score	
Year	Min.	Max.
1994	4.3	7.6
1995	4.4	6.3
1996	4.7	6.1
1997	3.7	7.3
1998	4.4	6.4
1999	4.4	6.4
2000	4.5	6.1
2001	4.6	6.1
2002	4.8	7.9
2003	4.6	7.5
2004	4.9	6.8
2005	5.0	6.7
2006	5.0	6.3
2007	4.8	6.5
2008	4.1	8.1
2009	4.3	6.5
2010	4.9	6.4
2011	4.2	6.6
2012	5.2	5.9
2013	4.4	6.0

Table 7.

Minimum and Maximum Cow Ages (Years), Cow Weights (Pounds), and Cow Conditions

	Cow age		Cow weight		Cow condition	
Year	Min.	Max.	Min.	Max.	Min.	Max.
1994	3.2	6.6	1,421	1,421		
1995	3.9	6.8	1,266	1,407	6.5	6.5
1996	3.9	6.6	1,218	1,457	6.2	6.2
1997	3.8	6.5	1,316	1,456	6.0	6.0

1998	4.0	7.0	1,293	1,442	5.7	5.7
1999	3.6	7.0	1,279	1,492	5.9	5.9
2000	4.0	7.9	1,195	1,487	5.1	5.1
2001	3.5	7.5	1,304	1,497	4.3	5.5
2002	4.0	8.1	1,279	1,599	4.9	6.1
2003	4.0	7.6	1,231	1,618	6.0	6.0
2004	2.7	8.0	1,335	1,589	5.3	6.2
2005	2.8	7.8	1,272	1,599	5.0	6.1
2006	2.9	7.9	1,243	1,609	5.4	6.0
2007	4.2	8.5	1,218	1,559	5.2	5.9
2008	4.3	8.2	1,276	1,591	5.1	6.5
2009	4.4	8.2	1,169	1,598	5.0	6.7
2010	4.6	8.3	1,252	1,581	5.2	7.0
2011	4.4	7.8	1,290	1,574	5.3	7.0
2012	4.6	7.5	1,351	1,681	5.1	7.1
2013	2.8	6.8	1,339	1,527	5.1	5.8

Using CHAPS20Y Weight and Growth Data to Increase Extension Knowledge

Weights, growth, and ages were consistent across the years addressed by CHAPS20Y, as indicated by the horizontal trend lines throughout the figures, but we identified wide ranges between herd minimums and maximums. Herein we outline some possible causes of these variations.

Calf Weight and Growth

CHAPS20Y weights and growth figures varied up to twofold between herds. Pre- and postnatal calf nutrition is important in determining calf weights and growth potential (Greenwood & Cafe, 2007) and may explain some of the variation in the data. CHAPS20Y producers used numerous breeds, and breed affects weights and growth potential (Gregory, Cundiff, & Koch, 1991; Szabó et al., 2006). Weather, which varied across years and herd locations, also affects weights and growth. Cooler growing seasons increase growth rate from birth to weaning (MacNeil & Vermeire, 2012), whereas elevated temperatures can cause maternal heat stress, decreasing birth weight (Hansen, 2009). Moreover, calf age at weaning affects weight gains and yields. Research has shown that steer calves weaned early gain more body weight over time, resulting in greater ADGs and WDAs (Llewellyn et al., 2013).

Cow Age, Weight, and Condition

Cow age affects cow weight and condition. Younger and older cows have special nutritional requirements

related to attaining or maintaining weight and condition (Ringwall, 2014). Cow weight and condition, in turn, affect calf weight and growth. Cows that are 5 to 8 years old tend to produce and wean heavier calves than younger or older cows do (Renquist, Oltjen, Sainz, & Calvert, 2006).

Reduced Herd Data

The reduced number of producers who measured all weight benchmarks reflects the time, expense, and difficulty of record keeping (Ringwall, 2015). However, Extension professionals should encourage producers to measure these benchmarks because they affect growth and reproduction. Calves with above-average birth weights have greater survival, growth, and reproductive potential than calves with below-average birth weights (Funston, Larson, & Vonnahme, 2010). In addition, reproductive performance is optimal in cows with a condition score of at least 5 (Herd & Sprott, 1998).

Conclusion

The CHAPS20Y tool has yielded data that we have used to increase the Extension knowledge base. We have outlined some of the factors affecting weights and growth, providing information Extension professionals can use to help beef producers set and achieve herd management goals.

Acknowledgments

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References

Beef Improvement Federation. (2010). *Guidelines for uniform beef improvement programs* (9th ed.) (revised September 2016). Retrieved from http://beefimprovement.org/content/uploads/2013/07/BIFGuidelinesFinal_updated0916.pdf

Funston, R. N., Larson, D. M., & Vonnahme, K. A. (2010). Effects of maternal nutrition on conceptus growth and offspring performance: Implications for beef cattle production. *Journal of Animal Science*, *88*, E205–E215. Retrieved from https://dl.sciencesocieties.org/publications/jas/abstracts/88/13/E205

Greenwood, P. L., & Cafe, L. M. (2007). Prenatal and pre-weaning growth and nutrition of cattle: Long-term consequences for beef production. *Animal*, *1*, 1283–1296. Retrieved from http://journals.cambridge.org/action/displayAbstract?fromPage=online&aid=1358284&fileId=S175173110700050X

Gregory, K. E., Cundiff, L. V., & Koch, R. M. (1991). Breed effects and heterosis in advanced generations of composite populations for birth weight, birth date, dystocia, and survival as traits of dam in beef cattle. *Journal of Animal Science*, *69*, 3574–3589. Retrieved from https://www.animalsciencepublications.org/publications/jas/pdfs/69/9/3574

Hansen, P. J. (2009). Effects of heat stress on mammalian reproduction. *Philosophical Transaction of the Royal Society B*, *364*, 3341–3350. Retrieved from http://rstb.royalsocietypublishing.org/content/364/1534/3341.short

Herd, D. B., & Sprott, L. R. (1998). Body condition, nutrition and reproduction of beef cows. Retrieved from

http://animalscience.tamu.edu/wp-content/uploads/sites/14/2012/04/nutrition-body-condition-nutrition.pdf

Llewellyn, D., Schlickau, E., Marston, T., Harborth, K., Breiner, R., Unruh, J., & Dikeman, M. (2013). Influence of early weaning beef cows on the performance of male progeny and the need for winter protein supplementation. *Agricultural Sciences*, *4*, 701–708. Retrieved from http://file.scirp.org/pdf/AS_2013122510122484.pdf

MacNeil, M. D., & Vermeire, L. T. (2012). Effect of weather patterns on preweaning growth of beef calves in the northern Great Plains. *Agricultural Sciences*, *3*, 929–935. Retrieved from http://dx.doi.org/10.4236/as.2012.37113

Ramsay, J. M., Hulsman Hanna, L. L., & Ringwall, K. A. (2016). Maximizing use of Extension beef cattle benchmarks data derived from Cow Herd Appraisal Performance Software. *Journal of Extension*, *54*(3), Article 3TOT5. Available at: https://www.joe.org/joe/2016june/tt5.php

Ramsay, J. M., Hulsman Hanna, L. L., & Ringwall, K. A. (2017a). Maximizing use of an Extension beef cattle data set: Part 1—Calving distribution. *Journal of Extension*, *55*(3), Article 3TOT5. Available at: https://www.joe.org/joe/2017june/tt5.php

Ramsay, J. M., Hulsman Hanna, L. L., & Ringwall, K. A. (2017b). Maximizing use of an Extension beef cattle data set: Part 2—Reproductive rates. *Journal of Extension*, *55*(4), Article 4TOT6. Available at: https://www.joe.org/joe/2017august/tt6.php

Renquist, B. J., Oltjen, J. W., Sainz, R. D., & Calvert, C. C. (2006). Effects of age on body condition and production parameters of multiparous beef cows. *Journal of Animal Science*, *84*, 1890–1895. Retrieved from https://dl.sciencesocieties.org/publications/jas/abstracts/84/7/0841890

Ringwall, K. A. (2014). BeefTalk: Age and weight are cow herd dynamics. Retrieved from https://www.ag.ndsu.edu/news/columns/beeftalk/beeftalk-age-and-weight-are-cow-herd-dynamics/

Ringwall, K. A. (2015). BeefTalk: Are cattle records worth the effort? Retrieved from https://www.ag.ndsu.edu/news/columns/beeftalk/beef-talk-are-cattle-records-worth-the-effort/

Ringwall, K. A., & Berg, P. M. (1990). CHAPS II: Cow Herd Appraisal Performance Software user guide. Retrieved from https://library.ndsu.edu/repository/handle/10365/22560

Szabó, F., Nagy, L., Dákay, I., Márton, D., Török, M., & Bene, Sz. (2006). Effects of breed, age of dam, birth year, birth season and sex on weaning weight of beef calves. *Livestock Science*, *103*, 181–185. Retrieved from http://www.livestockscience.com/article/S1871-1413(06)00030-8/abstract