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## Maximizing Use of an Extension Beef Cattle Data Set: Part 2—Reproductive Rates

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## Maximizing Use of an Extension Beef Cattle Data Set: Part 2— Reproductive Rates

### Abstract

Previously, we described CHAPS20Y, a historical data set, and trends in CHAPS20Y calving distributions. In this article, we describe reproductive rates, including total females exposed to bull(s), pregnancy, pregnancy loss, calving, calf death loss, weaning, culling, and replacement percentages. Yearly mean exposed females increased from 1994 through 2013, consistent with a greater replacement percentage versus culling percentage. Yearly mean reproductive percentages varied over time. Factors such as weather, body condition, temperament, nutrition, and health likely contributed to this variation. CHAPS20Y is a tool Extension professionals can use to understand beef reproductive rates and help producers set and achieve their herd management goals.

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## Introduction

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

- total numbers of females exposed to bull(s), hereafter referred to as total exposed females;
- pregnancy, calving, and weaning percentages;
- pregnancy loss and calf death loss percentages; and
- culling and replacement percentages.

Herein we describe CHAPS20Y reproductive rate data to provide background for other Extension professionals

who are working to help beef producers set and achieve herd management goals. We present yearly means, 20-year averages, and linear trends over time.

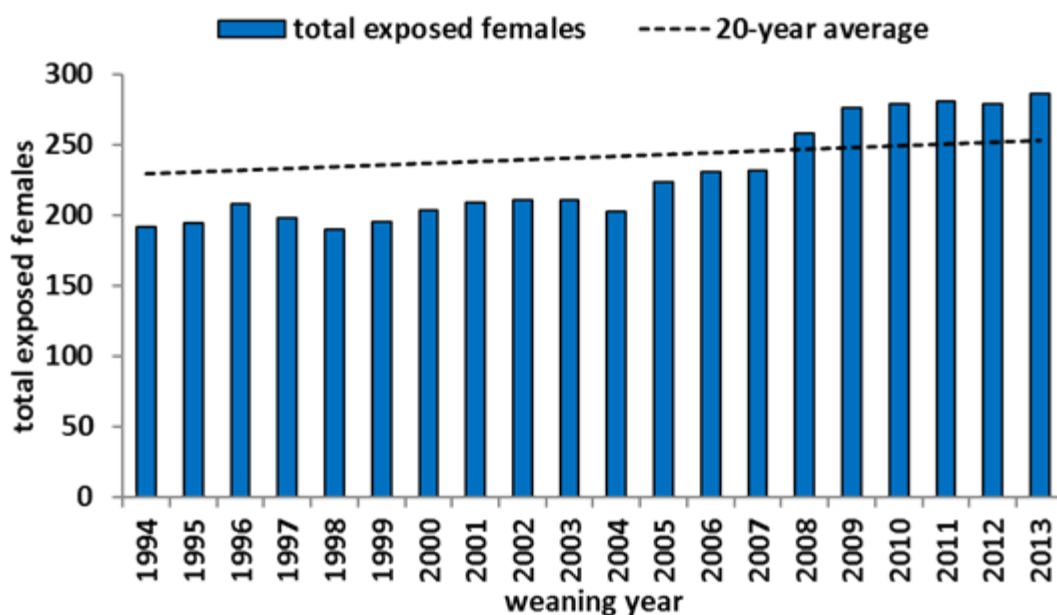
## Describing Reproductive Rate Data

### Total Exposed Females

CHAPS defines total exposed females as the number of females exposed to at least one bull plus any pregnant culled females for a selected date range—from one breeding season to the next—which spans approximately 1 year (Ramsay et al., 2016). For CHAPS20Y, the yearly mean total exposed females ranged from 192 to 286, with a 20-year average of 228 (Figure 1).

**Figure 1.**

Yearly Mean Number of Females Exposed to Bull(s) with 20-Year Average Trend Line



### Reproductive Percentages

The CHAPS program calculates percentages related to various aspects of reproduction (reproductive percentages) according to Beef Improvement Federation (2010) guidelines and recommendations put forth by Ringwall & Berg (1990). For most of the calculations, CHAPS uses an "adjusted total exposed females" value, which is the number of total exposed females minus the number of pregnant culled females. In calculating reproductive percentages for each herd, CHAPS uses the following equations (multiplying the results of each equation by 100):

$$\text{Pregnancy \%} = \frac{(\text{total exposed females} - \text{females not calving})}{\text{adjusted exposed females}}$$

$$\text{Calving \%} = \frac{(\text{total exposed females} - \text{females not calving} - \text{females aborted})}{\text{adjusted exposed females}}$$

$$\text{Weaning \%} = \frac{(\text{calves with weaning weight} + \text{calves not weighed} - \text{foster calves})}{\text{adjusted exposed females}}$$

$$\text{Pregnancy loss \%} = \frac{\text{females aborted}}{\text{adjusted exposed females}}$$

$$\text{Calf death loss \% (cows exposed)} = \frac{\text{calves that died}}{\text{adjusted exposed females}}$$

$$\text{Calf death loss \% (number born)} = \frac{\text{calves that died}}{(\text{adjusted exposed females} - \text{females not calving} - \text{females aborted})}$$

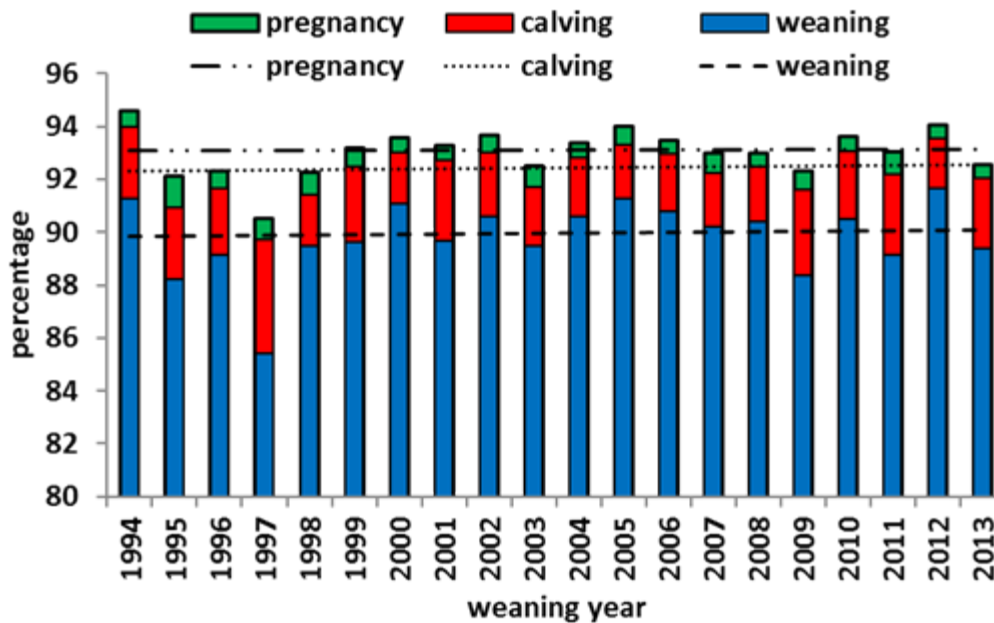
$$\text{Culling \%} = \frac{\text{females culled during year}}{\text{total exposed females}}$$

$$\text{Replacement \%} = \frac{(\text{replacement heifers} + \text{purchased females})}{\text{adjusted exposed females}}$$

Yearly cumulative mean pregnancy, calving, and weaning percentages for CHAPS20Y are displayed in Figure 2. Pregnancy percentages ranged from 90.5% to 94.6%, with a 20-year average of 93.0%. Calving percentages ranged from 89.7% to 94.0%, with a 20-year average of 92.3%. Weaning percentages ranged from 85.4% to 91.6%, with a 20-year average 89.8%.

**Figure 2.**

Yearly Mean Pregnancy, Calving, and Weaning Percentages with 20-Year Average Trend Lines

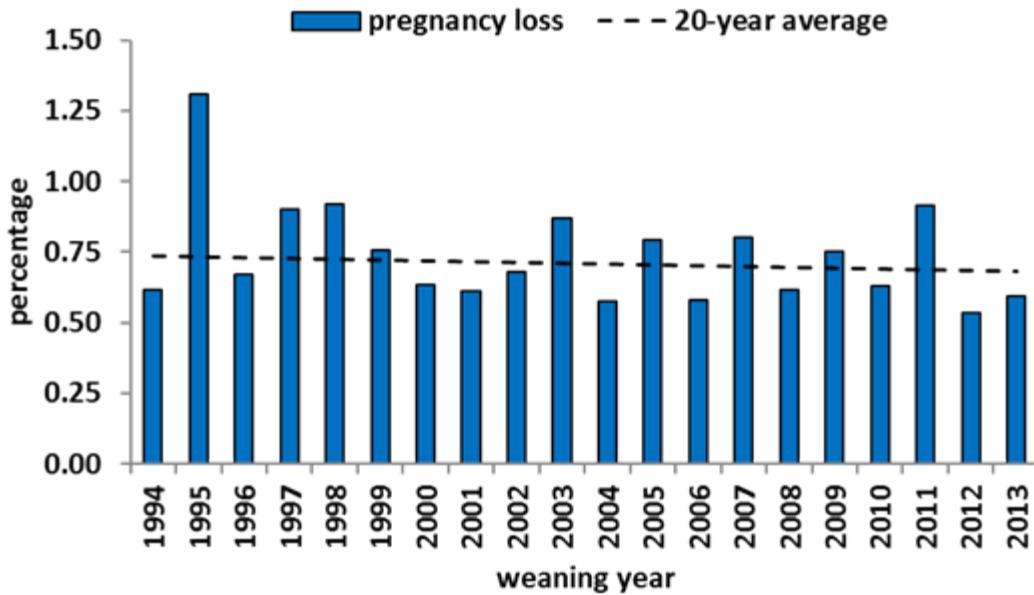


As shown in Figure 3, yearly mean pregnancy loss percentages ranged from 0.5% to 1.3%, with a 20-year average of 0.74%. Figure 4 shows that yearly mean percentages of calf death losses relative to the number of exposed females ranged from 2.7% to 5.1%, with a 20-year average of 3.4%, and that yearly mean percentages of calf death losses relative to the number of calves born ranged from 3.0% to 5.8%, with a 20-

year average of 3.7%.

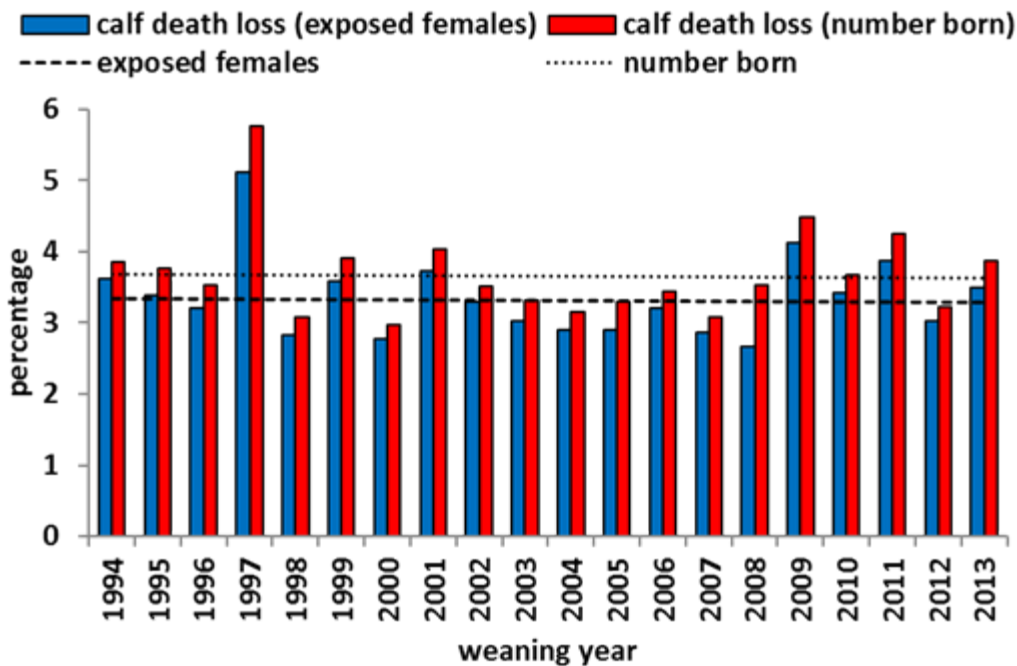
**Figure 3.**

Yearly Mean Pregnancy Loss Percentages with 20-Year Average Trend Line



**Figure 4.**

Yearly Mean Calf Death Loss Percentages (Relative to the Number of Exposed Females and the Number of Calves Born) with 20-Year Average Trend Lines

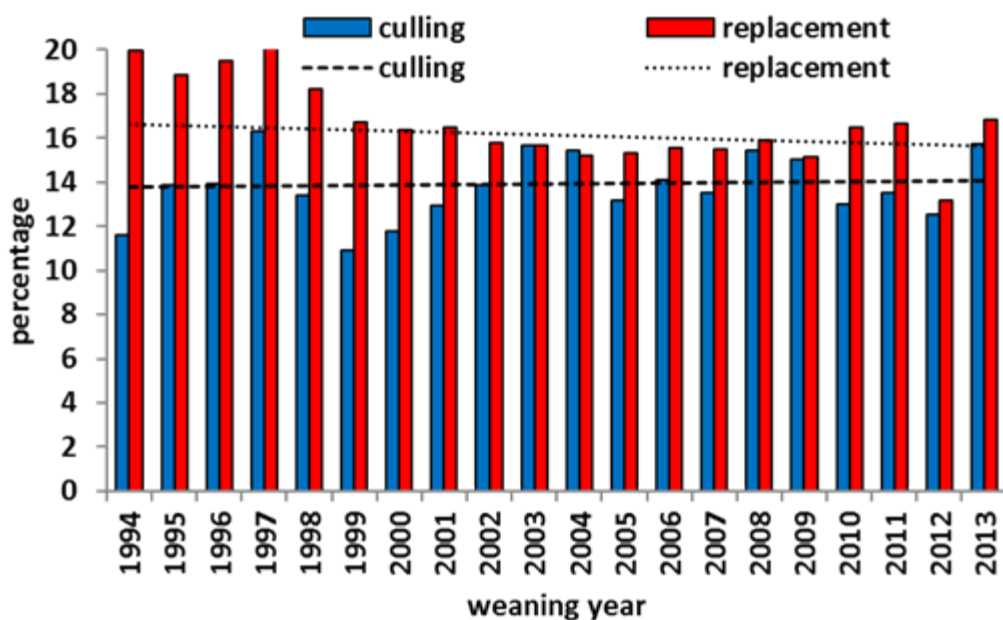


Yearly mean culling percentages and replacement percentages are shown in Figure 5. Culling percentages

ranged from 10.9% to 16.3%, with a 20-year average of 13.8%, and replacement percentages ranged from 13.2% to 20.3%, with a 20-year average of 16.7%.

**Figure 5.**

Yearly Mean Culling and Replacement Percentages with 20-Year Average Trend Lines



## Yearly Minimums and Maximums

To demonstrate herd-to-herd variation in the CHAPS20Y data set, we present yearly herd minimums and maximums for total exposed females (Table 1); pregnancy, calving, and weaning percentages (Table 2); pregnancy loss and calf death loss percentages (Table 3); and culling and replacement percentages (Table 4).

**Table 1.**

Minimum and Maximum Total Females Exposed to Bull(s)

Year	Total exposed females	
	Min.	Max.
1994	70	428
1995	76	403
1996	71	490
1997	60	498
1998	52	577
1999	61	560
2000	58	555
2001	73	597

2002	63	605
2003	62	596
2004	61	580
2005	54	978
2006	55	1,071
2007	61	907
2008	60	902
2009	62	1,023
2010	58	984
2011	61	1,008
2012	51	964
2013	66	1,088

**Table 2.**

Minimum and Maximum Pregnancy, Calving, and Weaning Percentages

Year	Pregnancy		Calving		Weaning	
	Min.	Max.	Min.	Max.	Min.	Max.
1994	85	99	82	98	82	97
1995	86	98	78	97	68	96
1996	79	99	79	99	75	99
1997	78	100	78	99	68	99
1998	80	99	77	99	77	97
1999	75	99	75	98	70	99
2000	77	100	77	100	76	100
2001	87	100	86	99	78	97
2002	82	100	81	100	80	100
2003	78	100	76	100	73	100
2004	66	100	66	100	66	100
2005	85	100	84	100	80	100
2006	78	100	76	100	76	99
2007	79	100	76	100	76	100
2008	80	100	80	100	75	100

2009	72	100	72	100	65	100
2010	79	100	78	100	77	100
2011	80	100	77	100	68	100
2012	86	100	86	100	83	100
2013	76	100	76	100	69	100

**Table 3.**

Minimum and Maximum Pregnancy Loss and Calf Death  
Loss Percentages

Year	Pregnancy loss		Calf death loss <sup>a</sup>		Calf death loss <sup>b</sup>	
	Min.	Max.	Min.	Max.	Min.	Max.
1994	0	3	0	7	0	8
1995	0	12	0	12	0	15
1996	0	3	0	9	0	10
1997	0	6	1	25	1	30
1998	0	4	0	6	0	7
1999	0	3	0	11	0	12
2000	0	3	0	8	0	8
2001	0	4	0	11	0	12
2002	0	4	0	10	0	10
2003	0	13	0	10	0	11
2004	0	5	0	12	0	13
2005	0	8	0	10	0	13
2006	0	3	0	13	0	14
2007	0	11	0	9	0	9
2008	0	6	0	8	0	9
2009	0	8	0	21	0	21
2010	0	4	0	12	0	13
2011	0	11	0	12	0	14
2012	0	4	0	10	0	11
2013	0	5	0	11	0	12

<sup>a</sup>Total exposed females. <sup>b</sup>Total number of calves  
born.



**Table 4.**

Minimum and Maximum Culling and Replacement Percentages

Year	Culling		Replacement	
	Min.	Max.	Min.	Max.
1994	4	27	3	42
1995	5	35	7	45
1996	4	31	6	50
1997	5	40	8	66
1998	0	25	6	30
1999	0	31	1	39
2000	5	30	5	38
2001	5	29	1	33
2002	3	30	5	37
2003	1	45	1	30
2004	3	57	5	45
2005	1	57	2	64
2006	2	74	1	68
2007	0	52	1	57
2008	5	53	0	30
2009	3	38	0	24
2010	0	30	0	50
2011	4	32	0	40
2012	0	41	0	23
2013	6	78	0	33

## Using CHAPS20Y Reproductive Rate Data to Increase Extension Knowledge

We have demonstrated that an increase in total exposed females in CHAPS20Y herds occurred over time. Replacement percentages were greater than culling percentages for all years. Both pregnancy loss and replacement percentages showed slight decreases over time. All reproductive percentages varied from year to year, and herd minimums and maximums varied to a greater extent. In this section, we outline possible causes of these trends and variations.

## Total Exposed Females and Culling and Replacement Percentages

In CHAPS20Y herds, yearly mean total exposed females increased 33% over the 20-year period. Similarly, from 1990 to 2010, the size of all CHAPS herds increased 38%, from 141 to 228 (Ringwall, 2011). Each year CHAPS20Y replacement percentages exceeded culling percentages, contributing to increases in herd size. This follows a trend of producers' expanding herd sizes during favorable market conditions (Estes, 2015).

Weather affects culling and replacement percentages. During droughts, producers may cull more and replace less to minimize feed costs (Ringwall, 2012). In 2012, drought conditions occurred in the northern plains (National Oceanic and Atmospheric Administration, 2013), where most CHAPS20Y herds are located (Ramsay et al., 2016). CHAPS20Y culling percentages increased during this period. Cows are also culled because of poor reproductive performance, health, and disposition, as well as due to age and physical problems (Powell, 2013).

## Pregnancy, Calving, and Weaning Percentages, Including Death Losses

Pregnancy, calving, and weaning percentages are interrelated measures of reproductive success affected by pregnancy loss and calf death loss. Poor weather may explain some of the variation in CHAPS20Y pregnancy loss and calf death loss. In 1997, a spring storm caused a spike in calf death losses among CHAPS herds (Ringwall, 2015). During the winter of 1996–1997, the northern plains received up to 200% of normal precipitation, including 100 in. of snow (Macek-Rowland, Burr, & Mitton, 2001). Calf deaths increase as precipitation increases and temperature decreases (Azzam et al., 1993).

Dam condition, temperament, nutrition, and health also affect reproduction. Cows with higher than average body fat have higher pregnancy rates and reduced pregnancy losses compared to thinner cows (Herd & Sprott, 1998), whereas aggressive cows have reduced reproductive rates (Cooke, Bohnert, Cappelozza, Mueller, & DelCurto, 2012). Proper nutrition and herd health are important for optimizing reproduction (Perry, Daly, & Melroe, 2009). Health and vaccination history affect pregnancy loss and calf death loss (Waldner & Kennedy, 2008; Wenzel & Hanosh, 2011). All these factors likely contributed to herd-to-herd and year-to-year variation in CHAPS20Y reproductive rates.

## Conclusion

Using CHAPS20Y as a tool of the trade, we have added to the Extension knowledge base and broadened Extension thinking on beef cattle reproductive rates. Additionally, we have identified some of the factors affecting reproductive rates. Extension professionals can use this information to help producers manage their herds to achieve their goals.

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