

Using Culling/Replacement Strategy to Improve Profit

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Introduction

Recently there has been increased discussion among dairy producers concerning the cost of cull rates on profitability. Many dairy producers feel that their culling rates are out of control and they are at a loss as to how to decrease it. No doubt, replacing culled cows is a substantial cost to dairy producers (Table 1). It is estimated that replacement costs average about 20 percent of the overall operating cost on a dairy (1). This is typically the 2nd or 3rd highest cost on the dairy, behind feed and similar to labor. With the current value of replacements being between \$1500 and \$2000, replacement costs are higher than in the past. Every time a cow is culled, the dairy producer incurs a cash cost. The cash cost of the cull is simply the price of the replacement animal minus the salvage value of the culled cow. For example, if a heifer value is \$1600 and the cows salvage value is \$400, the cash cost is \$1200. One way to decrease this replacement cost is to lower cull rates. Culling and replacement strategies are economic decisions. Therefore, the "optimum" cull rate in every herd will vary depending on factors including replacements available, capital available, milk price, and cull cow value.

Table 1. Replacement costs with different cull rates and production levels.

Turnover rate ¹	Heifer value ²	Cull cost ³	Replacement cost ⁴	18,000 ⁵	20,000 ⁵	22,000 ⁵	24,000 ⁵
				----- cost per cwt -----			
35	1300	900	315	1.75	1.58	1.43	1.31
40	1300	900	360	2.00	1.80	1.64	1.50
45	1300	900	405	2.25	2.03	1.84	1.69
50	1300	900	450	2.50	2.25	2.05	1.88
55	1300	900	495	2.75	2.48	2.25	2.06
60	1300	900	540	3.00	2.75	2.45	2.25
35	1600	1200	420	2.33	2.10	1.91	1.75
40	1600	1200	480	2.67	2.40	2.18	2.00
45	1600	1200	540	3.00	2.70	2.45	2.25
50	1600	1200	600	3.33	3.00	2.73	2.50
55	1600	1200	660	3.67	3.30	3.00	2.75
60	1600	1200	720	4.00	3.60	3.27	3.00
35	1900	1500	525	2.92	2.63	2.39	2.19
40	1900	1500	600	3.33	3.00	2.73	2.50
45	1900	1500	675	3.75	3.38	3.07	2.81
50	1900	1500	750	4.17	3.75	3.41	3.13
55	1900	1500	825	4.58	4.13	3.75	3.44
60	1900	1500	900	5.00	4.50	4.09	3.75

¹ Percent of cows leaving the herd divided by the average herd size.

² Value of a replacement animal whether heifer or cow.

³ Replacement value - \$400 cull cow salvage value.

⁴ Profit/cow needed to recover cull cost.

⁵ Profit/cwt needed to recover cull cost.

Culling/Replacement Economics

The ultimate goal of a culling/replacement strategy should be to maximize the profit of each stall in the barn. To do this there are fundamentally three questions to ask regarding dairy cow culling decisions. These questions are (7):

1. Is your barn filled to capacity? The first goal should be to fill the barn to capacity. The lost profit from having an empty stall is typically \$600-800 dollars per cow (7).
2. Once the barn is full, the goal is to maximize profit per stall. A cow should be culled when her replacement is expected to generate more lifetime profit than she will.
3. What is your overall cull rate? Is it too high or too low? What benchmark are you comparing it too?

The answer to questions #3 and #2 are completely independent of each other. For example, you could easily decrease culling rate by just not selling any cows. However, it surely isn't more profitable to keep a cow that's open 400 days, milking 25 lbs. with a high SCC than to replace her with a high producing healthy cow. If your herd cull rate is too high, you must determine the reason(s) cows are breaking and fix those management deficiencies. Selling cows without fixing the management deficiencies will only decrease profitability. If cows are not replaced when it is profitable to do so, profitability will decrease along with the cull rate.

Defining Cull Rates

When comparing cull rates with benchmarks it is important to compare similar information. There is no standard method of calculating cull rates; therefore, several different formulas are used. Turnover rate is also often used in conjunction with cull rate. Cull rate is defined as the percent of cows leaving the herd divided by the average herd size. For example, a 100-cow dairy freshens 40 new heifers and sells 40 cows. The cull rate for this herd is $40/100=40\%$. Whereas the turnover rate is the percent of cows starting a lactation that are culled or $40/(100+40)=28.6\%$. In this paper, I will use cull rate unless otherwise indicated as turnover rate. They are often used interchangeably in literature.

Are cull rates increasing?

It appears that nationally cull rates are increasing slightly. A summary of California herds indicate that herd turnover rates have increased from 31.7% in 1981 to 36.4% in 2000 (12). The latest NAHMS 2002 (14) survey indicates that annual cull rates have increased from 24.0% in 1996 to 25.5% in 2001. Death rates have also increased according to the NAHMS survey. Cow mortality has increased from 3.8% in the January 1996 inventory to 4.8% of the January 2002 inventory (14). This increase is across all herd sizes. Michigan

DHIA (9) records show and increase in cull and death rates (Table 2). There might be several reasons for the increase including the stress of higher production, increased time on concrete, decreased cow care, and increased inbreeding. The increase in death rate might be partially due to the decreased ability to send downer cows to slaughter.

Table 2. Cull and death rates in Michigan DHIA herds¹.

Item	1990	1995	2001
	----- % -----		
Cull rate	33	36	41
Death rate	2.7	4.2	6.9

¹Ferris and Ross, 2003 (9).

There are several well-circulated myths as why cull rates are high. One well held notion that “pushing” cows for higher production causes an increase in cull rates. Godden et al. (10) showed that there was no relationship between rolling herd average (RHA) and early lactation (0-60 days) cull rates. However, their research showed that over the entire lactation (0-750 days) cull rates were lower for low producing herds, then increased slightly and plateaued for moderate and higher producing herds (Figure 1). Their research also showed that within a herd, higher production is protective against culling in the next lactation (Figure 2) (10). They found no correlation between cull rates with herd size or bST use. Other researchers have found similar results. Michigan DHIA records (8) show that high producing herds (>24,000 RHA) had cull rates of 37.5% while herds below 21,000 RHA had cull rates of 38.3%.

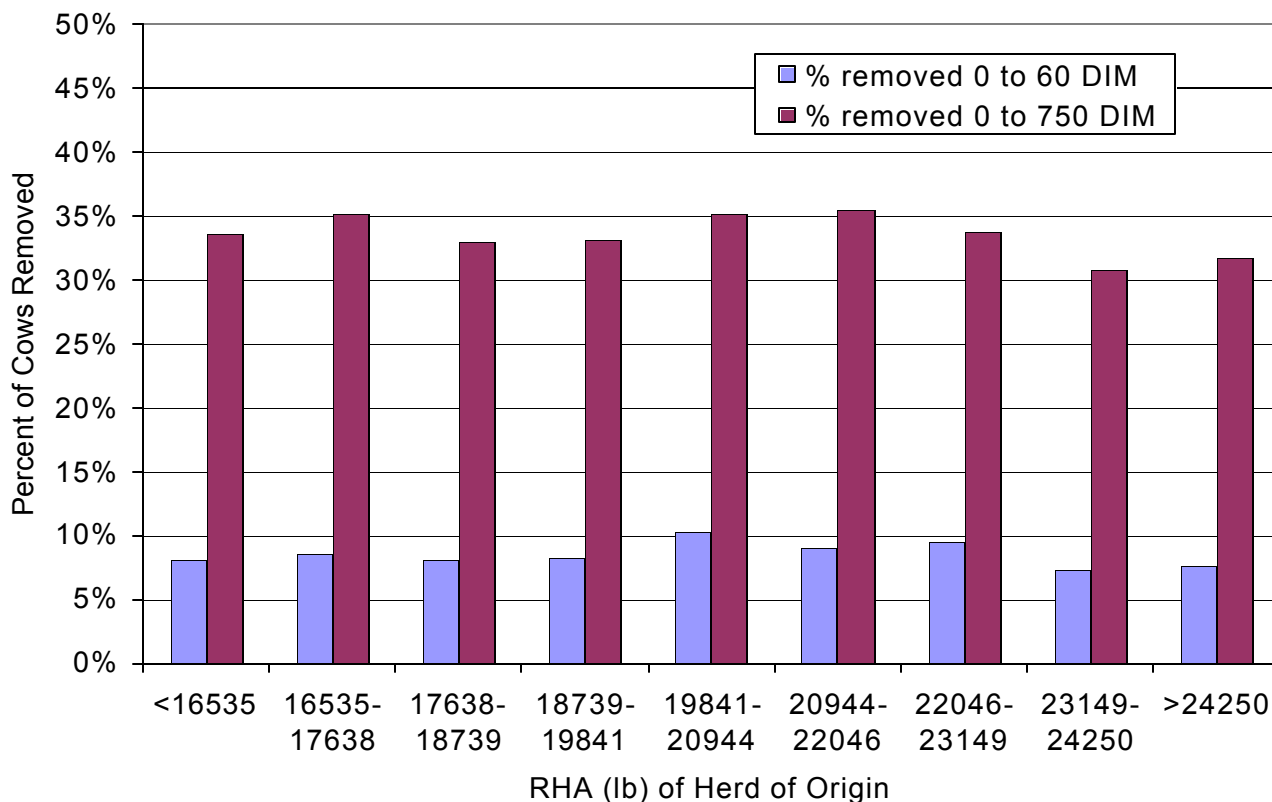


Figure 1. Proportion of cows removed from herd between 0 to 60 DIM and between 0 to 750 DIM by RHA (lb).

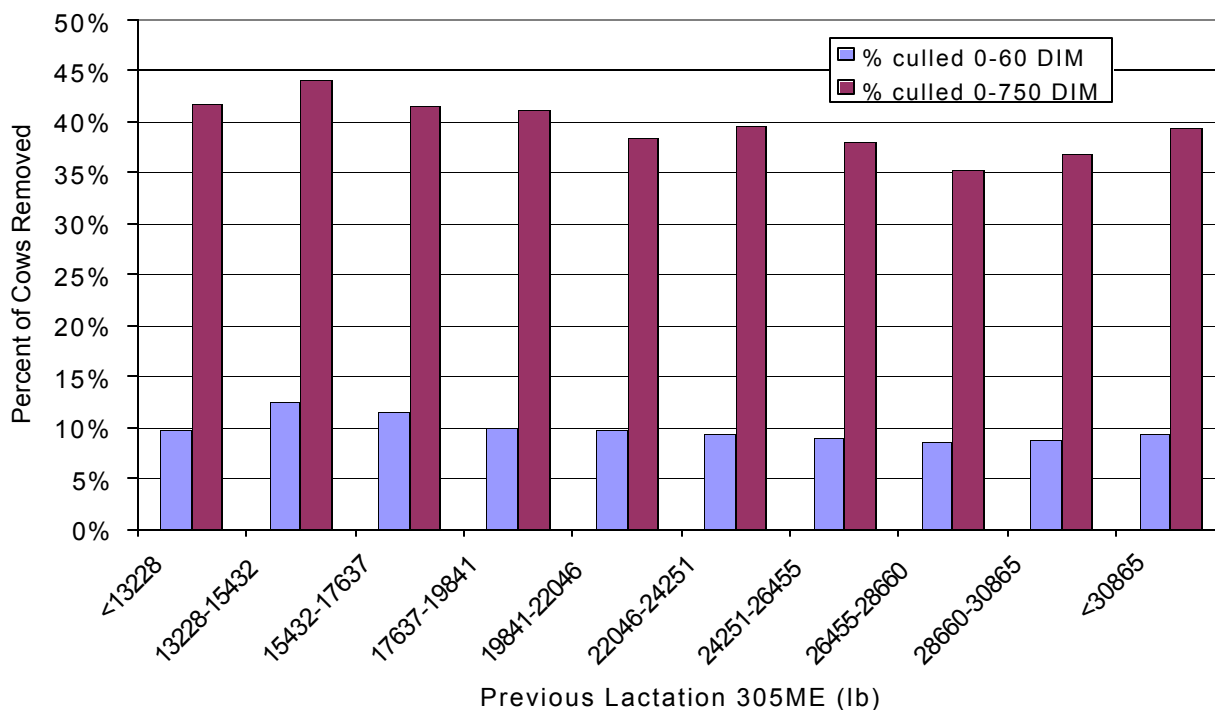


Figure 2. Proportion of cows removed vs. previous lactation production.

Why cows leave herds. There has been a plethora of studies done over the years indicating "normal" culling rates and why cows are culled. Most of these studies have determined average cull rates are between 25-40%. Recent DHI data showed that Midwest Holstein herds have an average annual turnover rate of 38% and a death rate of 6% (3). Table 3 summarizes 9 different research reports of why cows were culled. One of the disturbing trends is that voluntary culling has decreased over time. Culling for reproductive reasons is approximately the same and culling for mastitis and feet and legs has increased. In more current research, Beaudeau (1) estimated that the reason at least one-half of all cows leave herds is related to disease. This would suggest that cow care or biosecurity is poorer than in the past.

Table 3. Reason cows are culled.

Reason	NAHMS 2002 ¹	NAHMS 1996 ²	Older studies ³	Range
	----- % -----			
Voluntary	19.3	21.3	39.1	22.5 - 49.0
Reproduction	26.5	25.3	22.1	15.8 - 34.9
Mastitis	26.9	25.1	15	7.8 - 25.1
Disease/Injury	6.0	4.1	12	5.2 - 20.0
Death	4.8	3.8	5.8	0.6 - 11.8
Disposition	0.9	0.9	0.7	0.5 - 0.9
Feet and legs	16.3	14.2	3.6	1.8 - 14.2
Other	4.1	3.9	8.5	3.4 - 12.8

¹ % of cows culled – NAHMS, 2002 (14).

² % of cows culled - NAHMS, 1996 (13)

³ % of cows culled - Adapted from Fetrow, 1988 (5) (Studies from 1962-1986).

When and which cows leave herds. There is a big difference in the economic cost of culls depending on when during the lactation cycle they are culled and whether the culls are voluntary or involuntary culls. Cows that leave herds in early lactation are much more costly than cows that leave after milking 500 days and making 35,000 lbs. of milk. Godden et al. (10) data showed that 8.6% of cows calving left before 60 days in milk and 33.7% of cows were removed before 750 days in milk. Buelow (2) indicated that well managed herds consistently have less than 5% of cows leave within 30 days of calving and 10% or less leave during the first 100 DIM. The reason that virtually all of these cows leave the herd can be traced to cow management during the transition (3 weeks prior to and 3 weeks after calving) period. Careful attention to adequate bunk, waterer and resting space, cow comfort, heat abatement and clean dry bedding are all critical. During this period is when immune function is lowest and stress is highest. Careful observation of animals several times a day is critical to early diagnosis and treatment of disease (3).

Disease increases the likelihood that a cow will be culled (Table 4). Cows having milk fever, retained fetal membranes, displaced abomasum, ketosis, cystic ovaries and mastitis were at greater risk of getting culled than cows without these diseases. Reneau (11) reported that cows with mastitis are 2 to 3 times more likely to be culled than the herd average cull rate.

Table 4. Lactational incidence and risk of culling for certain diseases.¹

Disease	Lactational incidence ----- % -----	Culling risk ²
Milk fever	0.9	47.1
Retained fetal membranes	9.5	31.7
Displaced abomasum	5.3	26.9
Ketosis	5.0	32.5
Metritis	4.2	17.1
Ovarian cysts	10.6	20.9
Mastitis	14.5	32.7
No treatment	61.7	21.5

¹ Grohn, et. al., 1998 (11)

² Percentage of cows with a particular disease that are culled during lactation.

Even though total cull rate has increased only slightly, several summaries indicate dairy producers are making fewer decisions about which cows in their herds are getting culled (Table 2). Wisconsin researchers (17) show that after expansion herds culled fewer low producing cows and more high producing cows as a percentage of culls. They also looked at management factors that affected the relative risk of culling high and low producing cows (Table 5) (7). Their data would suggest that providing increased high quality cow care and improving cow comfort will lead to increased voluntary culling and decreased involuntary culling.

Table 5. Relative risk of culling for low and high producing cows, as compared to average cows.¹

Item	Category	Low cows ²	High cows ²
Years	1981 – 1989	4.20 ^a	0.50 ^a
	1996 – 2000	2.55 ^b	0.68 ^b
Herd size after expansion	Under 150	2.63	0.62 ^a
	150 – 350	2.55	0.71 ^b
	>350	2.50	0.70 ^b
Rolling herd average, lb	20,000 – 25,000	2.64	0.67 ^a
	>25,000	2.37	0.75 ^b
Cows per full time employee	<30	2.59	0.62 ^a
	30 – 50	2.56	0.70 ^b
	>50	2.47	0.76 ^b
Family labor, percent of total	<50	2.24 ^a	0.74 ^a
	50 – 80	2.64 ^b	0.72 ^a
	>80	2.56 ^b	0.63 ^b
Primary calving location	Maternity pen	2.50 ^a	0.61 ^a
	Bedding pack	2.56 ^a	0.74 ^b
	Pasture/dry lot	3.16 ^b	0.83 ^b
Freestall bedding	Mattress	2.32 ^a	0.68
	Sand	2.60 ^b	0.69
Fans	No	2.52	0.76 ^a
	Yes	2.60	0.67 ^b
Sprinklers	No	2.52	0.72 ^a
	Yes	2.67	0.63 ^b
Headlocks	No	2.48	0.71 ^a
	Yes	2.63	0.65 ^b
Milking frequency	2X	2.63	0.64 ^a
	3X	2.46	0.75 ^b
Heifer raising	Raised on farm	2.52	0.66 ^a
	Custom raised	2.64	0.75 ^b
Artificial insemination	Natural Service	2.18 ^a	0.71
	AI + Clean up bull	2.46	0.73 ^a
	All AI	2.63 ^b	0.66 ^b

¹ Weigel et al, 2003 (17).

² Relative risk of culling compared to average cows. A value of 1.0 means that the risk of being culled is similar to average cows. A value of 0.5 would mean that cows have half the chance of being culled as average cows. A value of 2.0 would mean that cows have twice the chance of being culled as average cows.

^{a,b} Differences between rows with differing superscripts were statistically significant ($P < 0.05$).

Using Culling Data in Herd Management

Even though cull rate has a huge impact on profitability, it is an over used number in herd management. Annual cull rates should be thought of in the same light as rolling herd average or days in milk. It is only valuable in benchmarking against yourself or other dairy producers on a periodic basis. Annual cull rate is often used as a proxy by lenders and other professionals to evaluate herd health and reproduction. Using cull rate to identify and monitor health problems is a futile effort. To be successful dairy producers must more proactive and identify problems when they occur, not after the cow is culled. There are better monitors of herd management than cull rate. However, cull rate can identify management areas with the potential for improvement. For example, culling too many cows for mastitis in order to keep your SCC down.

Developing a Comprehensive Culling/Replacement Strategy

All cows are depreciable assets that must eventually be replaced. Ultimately the goal should be to develop a culling/replacement strategy that maximizes herd profit. This is done by keeping cows healthy and productive. All herds have the opportunity to increase profitability by decreasing the involuntary cull rate (Table 6).

Table 6. Optimum levels of voluntary culling and yearly returns per cow for several levels of involuntary culling¹

Involuntary culls ----- % -----	Voluntary cull	Difference in annualized return \$ per cow
20	8	0
16	9	+23
14	10	+45
2	15	\$136

¹ Roger et al, 1988, (16).

Each month develop a list of cows culled, reasons and date at culling. Include early lactation cull rates. Summarize these reasons and compare them to one month ago and one year ago. Review this list with employees and your team of dairy professionals on a regular basis.

The Appendix contains some example forms for your use. These lists can also be easily generated in Dairy Comp 305. I like to track 30 and 100 day lactational cull rates (percent of animal that calve in a specific time frame that are culled within 30 and 100 days of calving).

Following is the DC305 command that I like to use:

List **bn lact dim frsh milk scc psc ardat car rem for frsh=mm/dd/yy-mm/dd/yy by ardatlb**. You must include the switch "b" at the end of the command to include both dead and live cows.

BARN NAME	Lact	DIM	FRESH	MILK	SCC	PSCC	ARDAT	CAR	REM
=====	=====	=====	=====	=====	=====	=====	=====	=====	=====
				top of report missing					
319	1	55	11/01/03	112	52	18	--	--	--
162	2	45	11/11/03	62	125	118	--	--	--
100	1	1	11/01/03	--	--	--	11/01/03	dcar6	dyst
82	5	10	10/23/03	--	--	--	11/02/03	dcar1	ketosis
55	6	40	11/01/03	--	--	--	11/10/03	dcar7	mast
Total 32									

All cows with archive dates (ardat) are gone from the herd. The dim for cows that are gone is the number of days in milk when they left (i.e., #100 died the day of calving). The 30 day lactational cull rate for this herd for this period of time is 6.25% (2/32). Do not include cow #55 because she is 40 dim when she was sold. If coded correctly you can also determine reasons cows left the herd. The car (condition affecting record) code is standardized across all herds. The remark column is an excellent place for your specific herd culling reasons.

Examine time periods as close to the present time as possible.

Example: If you want to know the 30- and 100-day lactational cull rate incidence on January 1, develop the command and examine cows calving from November 1 to December 1 for the 30-day cull rate. For the 100-day cull rate, look at cows calving from August 20 to September 20.

Planning a Culling/Replacement Strategy to Maximize Herd Profit

1. Develop a comprehensive cow flow.
This is especially important for herds with limited replacements available. See appendix for example. This will allow you to plan your culling and purchasing needs. Develop reasonable culling goals as you develop your cow flow.
2. Decrease involuntary cull rate as low as possible.
The method is done by keeping the barn full of healthy cows. If your herd cull rate is too high you must determine the reason(s) cows are breaking and fix those management deficiencies. Selling cows without fixing the management deficiencies will only decrease profitability. Work with your consultants and employee's to develop compressive protocols and monitors to prevent good genetic, high producing cows from being prematurely culled. With record keeping systems today it is easy to develop systems that help identify management breakdowns that ultimately lead cow breakdowns. Most involuntary culls are sold for the following reasons:

Most involuntary culls are sold for the following reasons:

- a. Transition cow problems - This is a very broad category that is difficult to categorize. It could include retained fetal membranes, metritis, displaced abomasums, milk fevers, calving injuries, and early lactation low producers. Most cows culled less

than 100 DIM belong in this category. A guideline is that less than 6-7% of cows die or end up culled because of transition cow problems.

- b. Lameness/feet and legs - An increasing number of cows are being culled due to lameness or feet and leg problems. Set a guideline of having less than 6-7% of cows that freshen leave due to lameness/feet and legs.
 - c. Mastitis - These are cows that are being culled primarily because they have an acute case of mastitis or chronically elevated SCC. If cows are culled during the first 60 days of lactation for mastitis there is 50-70% chance that infection started during the dry period. Set a guideline that less than 6-7% of cows that freshen leave due to mastitis. This includes cows that die because of complications from mastitis.
 - d. Reproduction - These are cows that do not conceive or do not conceive in a timely manner. It should also include cows that abort. Set a guideline that less than 6-7% of cows that freshen leave due to reproduction.
 - e. Diseases - This category should have a very limited number of animals. This would include animals culled for Johne's, pneumonia, hardware or other unknown reasons. Less than 2% of cows should be in this category.
3. Cull correct cows to maximize future herd profitability.
Many dairy producers with small herds are able to do this intuitively. However, as herds get larger, it becomes more difficult to assess which cows might be the best candidate for culling. Dairy Comp 305 has a built in module called "Cow Value" that can help make that decision.

The following information is adapted from the Help section of the Dairy Comp 305 program (6). Please refer to this section for more detailed information.

Information about the Cow Value (cowval) Command

The "Cow Value" module in Dairy Comp 305 estimates the value of each cow in a dairy herd relative to an average fresh heifer. A positive Cow Value means the animal is worth more than an average heifer in that herd. A negative Cow Value suggests the animal is worth less than an average heifer. The value of an animal's future production is based on:

The amount of milk she is likely to produce in the future.

The price of milk in the future.

The value of the money you must invest in the animal.

The amount of milk an animal is likely to produce in the future is based on.

Age – The younger the animal, the longer she is likely to stay in the herd and produce milk.

Stage of lactation - an animal that is 30 days in milk is likely to produce more milk in the future than an animal that is 200 days in milk.

Reproductive status - an animal that is pregnant is likely to produce more future milk, than an animal that is open.

Production level - a high producing animal is likely to produce more milk than a low producing animal.

CWVAL and PGVAL Relative to Reproductive Status

If an animal is not pregnant, the value of getting her pregnant would be her current PGVAL. (If she became pregnant today her new CWVAL would be her current CWVAL plus her current PGVAL).

If the animal is pregnant her CWVAL already includes her PGVAL. If she were to abort then her CWVAL would decrease by the PGVAL.

If the animal is open and becomes bred her CWVAL goes up because she is more likely to be pregnant than before she was bred so she is more likely to produce more milk into the future.

Example Cow Value List

SHOW ID LACT DIM MILK RV RPRO DSLH DCC CWVAL PGVAL BY CWVAL FOR DIM > 75

ID	LACT	DIM	MILK	RV	RPRO	DCC	CWVAL	PGVAL
4224	3	84	26	59	BRED	0	-757	-248
1430	3	85	45	70	BRED	0	-646	157
6848	1	125	48	72	BRED	0	-410	587
32	3	457	47	114	NO BRED	0	-330	449
993	3	209	14	85	BRED	0	-330	-325

Animal 4224 is the least valuable animal in this herd. Her CWVAL is -\$757 relative to an average springing heifer in this dairy. Further, If she were to get pregnant her value to this herd would decrease another \$248 because she may be kept another lactation rather than be replaced with a more profitable animal. This suggests that the dairy will make more money, beginning today, if this animal is replaced with an average, fresh, first lactation animal.

Animal 6848 has a negative CWVAL but her PGVAL tells us that if she turns out to be pregnant to this current breeding (27 days ago) her value will become +\$587 + (-\$410) = +\$147. She will become \$147 more valuable than an average fresh heifer in this herd.

Animal 32 has been coded not to breed. The CWVAL shows that she should be replaced and the PGVAL tells us that she would have been \$449 more valuable had she gotten pregnant earlier in this lactation.

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The end of the Cow Value report

ID	LACT	DIM	MILK	RV	RPRO	DCC	CWVAL	PGVAL
5413	1	484	0	120	DRY	274	1782	2789
2579	1	465	79	130	PREG	131	1791	1359
2699	1	332	0	136	DRY	246	1814	2821
5324	1	343	82	135	PREG	91	1912	1426

This report lists the most valuable animals at the end. Animal 5324 wins. Notice that if she aborts her value will drop from \$1912 to \$486 (\$1912-\$1426).

Evaluating and Decreasing Your Cull Rate

Below is a system that can help you understand your culling rate and take action to decrease it.

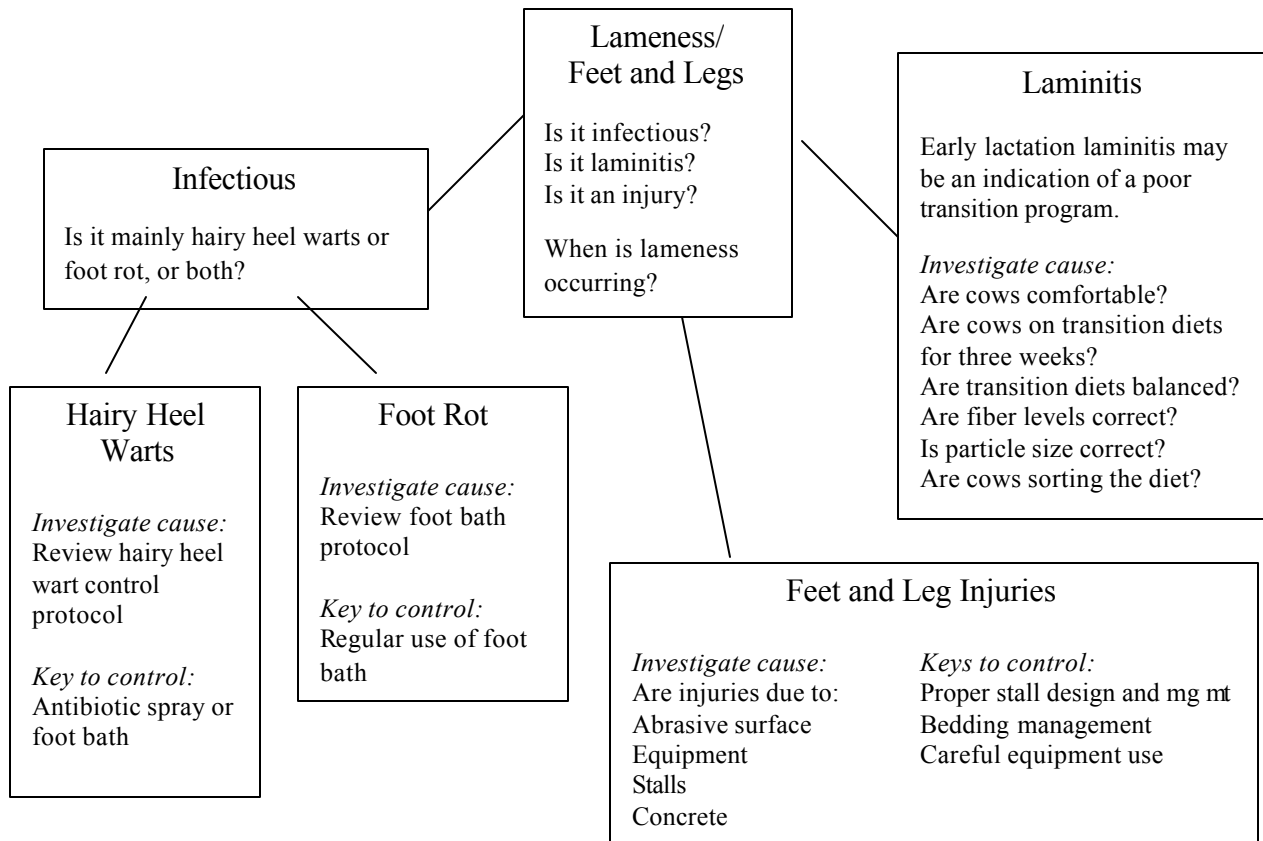
1. Define the problem.

- a. Determine cull rate.
 - Total involuntary cull rate - If the total involuntary culling rate is greater than 35% there is certainly opportunities to improve it. A guideline of 25-28% should be achievable. However, the goal should be to minimize the involuntary cull rate.
 - Cows leaving in early lactation
- b. Determine why cows are culled.

It is very important to develop a short clearly defined list of reasons cows are culled. This can be a challenge. Often cows are culled because of a combination of factors. For example, a 150-day pregnant cow 700 days in milk with a 500,000 SCC and milking 35 lbs. is culled. Management needs to ask - Would this cow have been culled if she had got pregnant in a timely manner? Did she not come in heat because she had sore feet and couldn't walk? Would I keep her if her SCC were low? Did she not conceive because she had retained fetal membranes and severe metritis?

2. Identify the major reason(s) cows are getting culled and generate possible solutions.

- a. Analyze records to determine early lactation culls and the broad category that is causing cows to leave. This will help determine the specific solution that must be implemented. If all categories are higher than desired, either focus on one category or as many as desired.
- b. Further investigate the details to better understand the reasons and generate possible solutions. Following is an example of a flow chart that might be used if culling for lameness/feet and legs is too high.



3. Develop an action plan.

Work with the appropriate team of advisors and employees to develop an action plan based on your investigative work.

4. Set up a monitoring plan.

Develop a list of key monitors to determine if your action plan is working? In the above example if your investigation reveals that cows have laminitis from cows sorting feed, develop the appropriate monitors to track changes.

- Measure particle size of delivered TMR three times a week.
- Measure particle size of the refusals.
- Make visual observations of sorting behavior of cows.
- Monitor milk components.
- Monitor manure consistency.
- Monitor cud chewing on a regular basis.
- Monitor hoof trimmer evaluation of hoof health.

5. Implement the plan.

Work with your employees, family and dairy advisors to implement the plan.

6. Make modifications to the plan as needed.

A similar process could be developed for any of the major broad categories.

Conclusion

High cull rates are very costly to dairy producers. The goal should not be just to minimize the cull rate. Culling should be considered as part of a strategic culling/replacement strategy to maximize herd profit. The goal should be to minimize the number of cows that leave due to health reasons. To reach this goal management should develop protocols and monitoring systems to keep cows healthy and productive. This will not only optimize the cull rate but also maximize profit for the dairy.

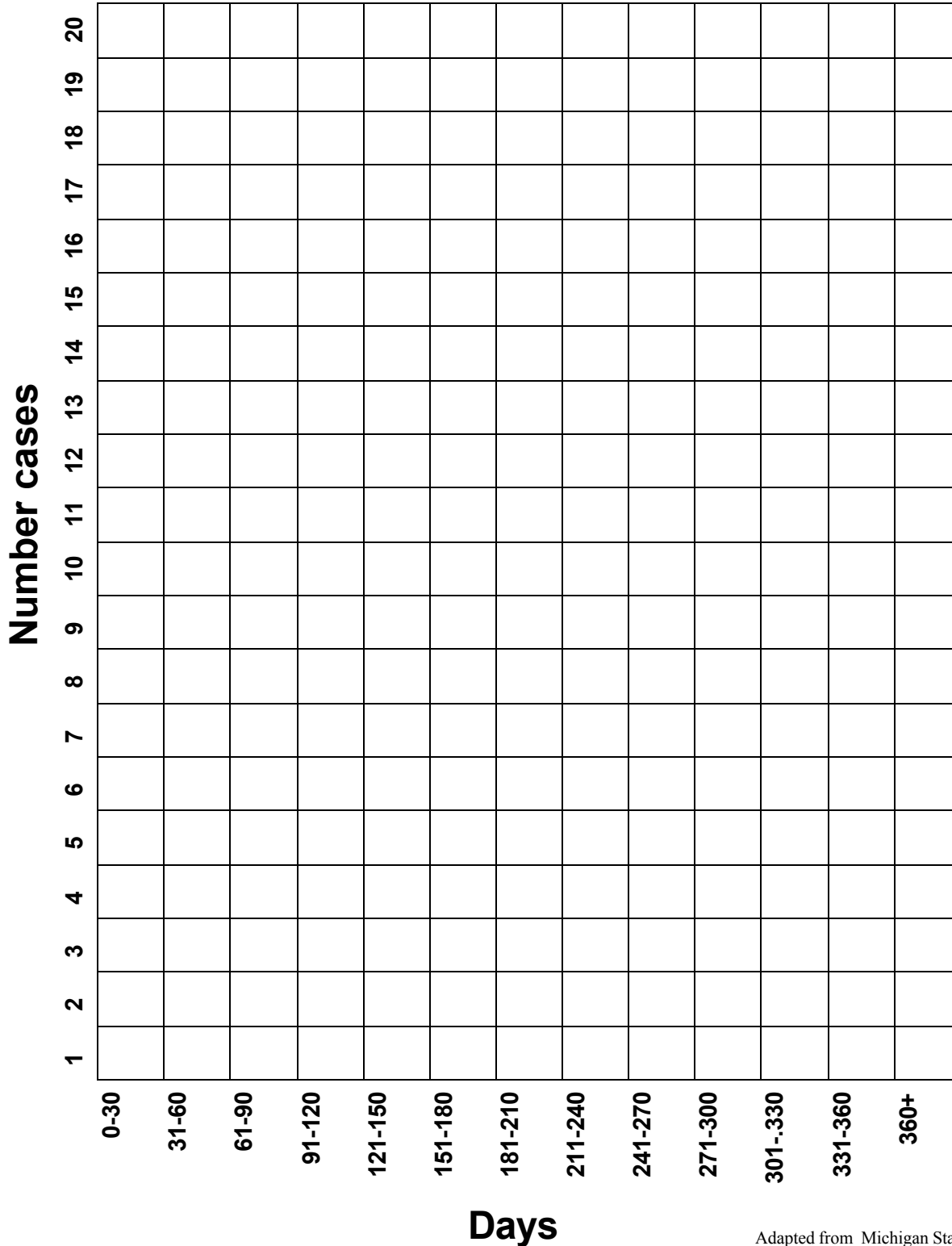
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Time Period _____

Monitor - Herd Turnover
 Number cows removed _____



Adapted from Michigan State University

Time Period _____

Monitor - Herd Turnover
 Number cows removed _____

Number cases	20																			
	19																			
	18																			
	17																			
	16																			
	15																			
	14																			
	13																			
	12																			
	11																			
	10																			
	9																			
	8																			
	7																			
	6																			
	5																			
	4																			
	3																			
	2																			
	1																			
	Dairy	Died	Low Production	Reproduction	Mastitis	Udder	Milk Fever/down	Displaced abomasum	Other Diseases	Injury	Lameness - feet & legs	Johne's Disease	Unknown							

Adapted from Michigan State University

Time Period _____

Projected Cow Flow

Cows	Month					
Beginning Inventory						
Cows to Calve (+)						
Cows to Dry off (-)						
Heifers Due (+)						
Total Calvings (+)						
Cows to Cull (-)						
Animals to Purchase (+)						
Ending Inventory						

Cows	Month					
Beginning Inventory						
Cows to Calve (+)						
Cows to Dry off (-)						
Heifers Due (+)						
Total Calvings (+)						
Cows to Cull (-)						
Animals to Purchase (+)						
Ending Inventory						