Improving and Predicting Reproductive Performance

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Reproduction in a beef cow herd is a fragile thing, easy to disrupt and difficult to re-establish. The beef cow has priorities. Her first priority is survival, her second priority is the survival of her calf, and her third priority is reproduction. This means the first two priorities must be met before the third can be accomplished. It is difficult, with today's economy, to have good reproduction without excessive cost. The purpose of this paper is to briefly outline those ingredients necessary for good reproduction to occur in a beef cow herd, show methods that can be utilized to predict reproduction performance, and outline methods for determining the economic feasibility.

Most beef herds contain many non-producers such as dry cows, replacement heifers and bulls, and many cows which wean light calves. As an example of non-producers, look at a beef herd containing 100 cows. In addition to the 100 cows, there would be 15 replacement heifers and 5 bulls. If 90 cows weaned a calf there would be 30 non-producing animals in this herd.

TABLE 1. Non-Producers in a 100 Cow Herd

No. Calves Weaned	Dry Cows	Replacement Heifers	Bulls	Non-Producers No.	%	Cost Per Calf[a]
90	10	15	5	30	25	$333
80	20	15	5	40	33	375
70	30	15	5	50	42	428

[a] $250 per animal carrying cost

These non-producers must be reduced to make production of calves economically feasible. The cost of keeping non-producers is as great or greater than the cost of keeping producers.

Calves which are light at weaning will not pay the costs of keeping the cow. As an example, consider calves weaning at different weights.

TABLE 2. Weaning Weight and Net Return

Weaning Weight	Gross Return at 70¢	Cost of Keeping Cows	Net $ Return
500	350	250	100
450	315	250	65
400	280	250	30
350	245	250	— 5
300	210	250	—40

It does not take a mathematician to calculate the value of the heavy calf.

Calves wean light because they are born late or do not grow or both. As an example, look at the following table.

TABLE 3. Weaning Weight as Influenced by Time of Birth and Average Daily Gain

Day of Calving	Average Age At Weaning	Average Daily Gain Birth to Weaning 2.25	2.0	1.75
0-20	220	565	510	455
21-40	200	520	470	420
41-60	180	475	430	385
61-80	160	430	390	350
81-100	140	385	350	315
101-120	120	340	310	280
121-140	100	295	270	245

Look at the differences in weaning weights in this herd. Calves varied from 565 lbs to 245 lbs. The late calves were light even when they gained 2.25 lbs a day. You cannot just leave calves on the cow and wean later and expect calves to continue to gain. Calves stop growing when grass dries up and milk production stops in the cow. To wean heavy calves they must be born early and they must have the genetic ability to grow and the necessary nutrients to grow. A cow must wean at least 350 lbs of calf to pay her own costs. When you consider paying cost of non-producers, each cow must wean a considerably heavier calf.

TABLE 4. Influence of Non-Producers and Weaning Weight on Lbs. of Calf Weaned and Net Return in a 100-Cow Herd

Calves Weaned in 100-Cow Herd	Total Animals in Herd	Non-Producers	Lbs. of Calf Weaned Per Animal 500[a]	400	300	Net Return $ Per Animal[b] 500[a]	400	300
90	120	30	375	300	225	12	-40	-92
80	120	40	333	267	200	-17	-63	-100
70	120	50	292	233	175	-46	-87	-128

[a] Average weaning weight per calf
[b] Calves at 70¢ and $250 carrying cost

To make money, the number of non-producers must be kept low and the average weaning weight must be high. In cows weaning calves averaging 500 lbs, the pounds of calf weaned per animal in the herd varied from 375 lbs to 292 lbs. Pounds of calf weaned must be averaged out over a lot of

non-producers. Most of the figures on net return are negative. Only in those cows weaning 500 lbs of calf and having only 30 non-producers are the results positive. Now look back to the last table and see how many calves weighed 500 lbs or more. Only those calves born early and gaining 2 lbs or more a day weighed over 500 lbs.

A worthwhile goal in reproduction is to have 75% to 80% of the cows calving in the first 20 days of the calving season and 95% of the cows calving in a 60-day calving season. When 80% of the cows calve in the first 20 days, getting 95% to calve in 60 days is relatively easy. Consequently, our attention in this paper will be centered on achieving 80% pregnancy rate in 20 days. If 80% of the cows are going to calve in the first 20 days of the calving season, then 95% to 100% must show heat in the first 20 days of the breeding season and 80% to 85% must become pregnant on first service. To achieve this, we must have control of our management in a beef cow herd. We can't just hope. Everything must be done correctly with attention given to details.

The number of cows becoming pregnant early in the breeding season is determined by the following formula:

Cows in heat 1st 20 days of breeding x Cows pregnant from 1st service = Cows pregnant 1st 20 days of breeding season

Cows becoming pregnant from first service is a combination of cow fertility and bull fertility. Therefore, three things must be accomplished if 75% to 80% of the cows are to become pregnant the first 20 days of the breeding season.

1. Ninety-five to 100% of the cows must show heat the first 20 days of the breeding season.
2. Cow fertility must be high.
3. Cows must be bred by a fertile bull.

These three factors are not additive, but multiplicative. In other words, the formula is:

Cows in heat in 20 days x Cow Fertility x Bull Fertility = Cows pregnant in 20 days

$$\text{Cows in heat in 20 days} \Big/ \frac{\text{Cow Fertility} + \text{Bull Fertility}}{3} = \text{Cows Pregnant in 20 days}$$

Not

Poor performance in one area can't be averaged out. If one factor is low, then, ultimately, the cows pregnant early in the breeding season will be low. Three examples can illustrate the importance of this concept.

	Cows in Heat 20 days (%)	×	Cow Fertility (%)	×	Bull Fertility (%)	=	Cow Pregnant 20 days (%)
Ex. 1	95	×	95	×	95	=	86
Ex. 2	65	×	95	×	95	=	59
Ex. 3	65	×	95	×	60	=	37

In Example 1, only 86% of the cows are pregnant, even though all factors are 95%. In this equation you do not average the factors, but they are multiplied; consequently, 95% x 95% x 95% = 86%.

In Example 2, only one factor, in heat in 20 days, is low, but note that even though the other two factors are high, only 59% of the cows are pregnant. In Example 3, two of the factors are low; consequently, only 37% of the cows are pregnant early in the breeding season. The proportion pregnant can be no higher than the lowest factor.

These examples illustrate that to achieve good fertility all factors must be high. Consequently these three factors will be discussed in some detail.

Cows in heat in the first 20 days: The four factors determining how many cows will show estrus in the first 20 days are:

1. Calving time
2. Body condition of the cow
3. Suckling
4. Age of cow

Calving time and age of cow: More early calving cows will show heat the first 20 days of the breeding season than late calving cows and fewer young cows show heat than older cows. An example can help in understanding this concept.

TABLE 5. Calving Time and Heat, First 20 Days of Breeding Season

Time of Calving	Young Cows (%)	Mature Cows (%)
First Month	79	94
Second Month	44	69
Third Month	5	10

In a group of cows calving over a three month period, the number of mature cows showing heat in the first 20 days of breeding decreased from 94% in cows calving in the first month to 10% in those calving in the third month. This information would indicate that most older cows calving the first month of the calving season will show heat the first 20 days of breeding, but essentially none that calve the third month will show heat early. If a person is interested in 90 to 95% of the cows showing heat early in the breeding season, length of the calving season must be decreased to at least 60 days.

To help with understanding the concepts in this paper a hypothetical ranch will be utilized. The breeding season last spring started May 8th and ended July 27th. The cows were checked for pregnancy in September and the calving dates were estimated as follows:

Estimated Calving time	Total Cows	Body Condition			Ave. Calving Date	
		Thin	Moderate	Good	Calving	Julian
Feb. 14-Mar. 5	60	20	20	20	Feb. 24	55
Mar. 6-Mar. 25	60	20	20	20	March 16	75
Mar. 26-Apr. 14	60	20	20	20	April 5	95
Apr. 15-May 4	60	20	20	20	April 25	115
Total	240					

Body condition of the cows was estimated at the time of the pregnancy diagnosis. The first problem will be concerned with the effect of expected calving date on pregnancy rate. In this problem we will utilize the 80 cows in moderate body condition. They are expected to calve from February 14 to May 4. Twenty cows calved between February 14 and March 5th. Breeding will start May 15th and cows will be bred 60 days. A step by step solution to the problem is given.

First Problem in Post-Partum Cows—Steps to Solution

1. Use work sheet for post-partum cows.
2. The expected calving dates have been broken into 20-day intervals. Example: Feb. 14 to March 5, March 6 to March 25, etc.
3. The average calving date for each group was calculated. Example: Feb. 14 to March 5, then the average calving date was Feb. 24. The Julian date was then found; i.e. Feb. 24 = 55, March 16 = 75, etc.
4. Record number of cows in each calving group on work sheet for first, second, and third 20 days. Example: Feb. 14 to March 5 = 20 cows calved.
5. Look up Julian date for start of calving. Example: May 15 is day 135.
   Calculate and record Julian date at end of first 20 days of breeding.
   Example: 135 + 20 = 155. Also 135 + 40 = 175 or end of 2nd 20 days or 40 days of breeding. 135 + 60 = 195 or end of 3rd 20 days or 60 days of breeding.
6. Find difference between average calving date and date at end of 20 days of breeding.
   Example: 155 - 55 = 100. Do same for end of 40 and 60 days. 175 - 55 = 120; 195 - 55 = 40.
7. Look up expected percent cycling at the indicated days post-partum in Table 7 under moderate and record. Example: 100 days post-partum 100% are cycling.
8. Calculate expected number of cows cycling. Example: 20 cows x 100% = 20 cows cycling.
9. Assume a 60% conception rate.
10. Calculate expected number of cows pregnant. Example: 20 x 60% = 12.
11. Calculate for second 20 days of breeding June 5 through June 24.
12. Look up cycling 120 days - 100% x 20 = 20.
13. Subtract cows pregnant to previous breeding.
14. Assume conception rate of 60%.
15. Calculate pregnant - 8 x 60% = 5.
16. Calculate expected number of cows pregnant. Figure for 3rd 20 days. Remember previously pregnant involves 2 breedings. In this example 12 + 5 = 17.
17. Repeat procedure for each 20 days of expected calving period.

Body Condition is important in determining the proportion of cows showing heat and becoming pregnant. Many cows in thin body condition do not become pregnant. In one study the proportion open varied from 77% in very thin cows to 5% in cows in good body condition.

TABLE 6. Relationship Between Body Condition and Pregnancy Rate in Florida

	Very Thin	Thin	Slightly Thin	Moderate	Good
No. of Cows	115	545	564	344	234
Percent Open	77	49	27	14	5
Early Calvers (%)	5	15	19	40	56

Only 5% of the thin cows will calve early compared to 56% of the cows in good body condition. The main reason thin cows do not become pregnant or calve late is that the proportion of cows showing heat is delayed in cows in thin body condition. Note in the next table how the proportion of cows which have shown heat by 60 days after calving differs in cows that are in good body condition (91%) compared to those in moderate (61%) or thin (46%) body condition.

TABLE 7. Body Condition at Calving and Heat After Calving

Body condition at calving	No. Cows	Days After Calving									
		30 %	40 %	50 %	60 %	70 %	80 %	90 %	100 %	110 %	120 %
Thin	272	0	19	34	46	55	62	66	70	75	77
Moderate	364	10	21	45	61	79	88	92	100	100	100
Good	50	12	31	42	91	96	98	100	100	100	100

By 100 days after calving only 70% of the cows in thin body condition had shown heat.

A second problem involving the same ranch will be used to illustrate the relationship between body condition, calving date, heat and pregnancy.

2nd problem:
Use all cows in Problem #1
Use Table 7
Start breeding May 15th and breed 40 days
Assume a 60% conception rate
Use Cow Worksheet, Problem #2.

JULIAN CALENDAR

Mo.	1	2	3	4	5	6	7	8	9	10	11	12	Mo.	1	2	3	4	5	6	7	8	9	10	11	12
Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Day	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
1	1	32	60	91	121	152	182	213	244	274	305	335	1	366	397	425	456	486	517	547	578	609	639	670	700
2	2	33	61	92	122	153	183	214	245	275	306	336	2	367	398	426	457	487	518	548	579	610	640	671	701
3	3	34	62	93	123	154	184	215	246	276	307	337	3	368	399	427	458	488	519	549	580	611	641	672	702
4	4	35	63	94	124	155	185	216	247	277	308	338	4	369	400	428	459	489	520	550	581	612	642	673	703
5	5	36	64	95	125	156	186	217	248	278	309	339	5	370	401	429	460	490	521	551	582	613	643	674	704
6	6	37	65	96	126	157	187	218	249	279	310	340	6	371	402	430	461	491	522	552	583	614	644	675	705
7	7	38	66	97	127	158	188	219	250	280	311	341	7	372	403	431	462	492	523	553	584	615	645	676	706
8	8	39	67	98	128	159	189	220	251	281	312	342	8	373	404	432	463	493	524	554	585	616	646	677	707
9	9	40	68	99	129	160	190	221	252	282	313	343	9	374	405	433	464	494	525	555	586	617	647	678	708
10	10	41	69	100	130	161	191	222	253	283	314	344	10	375	406	434	465	495	526	556	587	618	648	679	709
11	11	42	70	101	131	162	192	223	254	284	315	345	11	376	407	435	466	496	527	557	588	619	649	680	710
12	12	43	71	102	132	163	193	224	255	285	316	346	12	377	408	436	467	497	528	558	589	620	650	681	711
13	13	44	72	103	133	164	194	225	256	286	317	347	13	378	409	437	468	498	529	559	590	621	651	682	712
14	14	45	73	104	134	165	195	226	257	287	318	348	14	379	410	438	469	499	530	560	591	622	652	683	713
15	15	46	74	105	135	166	196	227	258	288	319	349	15	380	411	439	470	500	531	561	592	623	653	684	714
16	16	47	75	106	136	167	197	228	259	289	320	350	16	381	412	440	471	501	532	562	593	624	654	685	715
17	17	48	76	107	137	168	198	229	260	290	321	351	17	382	413	441	472	502	533	563	594	625	655	686	716
18	18	49	77	108	138	169	199	230	261	291	322	352	18	383	414	442	473	503	534	564	595	626	656	687	717
19	19	50	78	109	139	170	200	231	262	292	323	353	19	384	415	443	474	504	534	565	596	627	657	688	718
20	20	51	79	110	140	171	201	232	263	293	324	354	20	385	416	444	475	505	536	566	597	628	658	689	719
21	21	52	80	111	141	172	202	233	264	294	325	355	21	386	417	445	476	506	537	567	598	629	659	690	720
22	22	53	81	112	142	173	203	234	265	295	326	356	22	387	418	446	477	507	538	568	599	630	660	691	721
23	23	54	82	113	143	174	204	235	266	296	327	357	23	388	419	447	478	508	539	569	600	631	661	692	722
24	24	55	83	114	144	175	205	236	267	297	328	358	24	389	420	448	479	509	540	570	601	632	662	693	723
25	25	56	84	115	145	176	206	237	268	298	329	359	25	390	421	449	480	510	541	571	602	633	663	694	724
26	26	57	85	116	146	177	207	238	269	299	330	360	26	391	422	450	481	511	542	572	603	634	664	695	725
27	27	58	86	117	147	178	208	239	270	300	331	361	27	392	423	451	482	512	543	573	604	635	665	696	726
28	28	59	87	118	148	179	209	240	271	301	332	362	28	393	424	452	483	513	544	574	605	636	666	697	727
29	29	—	88	119	149	180	210	241	272	302	333	363	29	394	—	453	484	514	545	575	606	637	667	698	728
30	30	—	89	120	150	181	211	242	273	303	334	364	30	395	—	454	485	515	546	576	607	638	668	699	729
31	31	—	90	—	151	—	212	243	—	304	—	365	31	396	—	455	—	516	—	577	608	—	669	—	730

Problem #1 COW WORKSHEET

	First 20 Days									Second 20 Days										Third 20 Days										
	Julian Date				Expected					Julian Date				Expected						Julian Date				Expected						
Calf Per.	Ave. Calving	End 20 Days	Days P P	No. Cows	In Heat %	In Heat No.	Conc Rate	Preg-nant		Ave. Calv Date	End 40 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Per.	Conc Rate	Preg-nant	Ave. Calv Date	End 60 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Period	Conc Rate	Preg-nant	Total Preg.
2–24	55	155	100	20	100	20	60	12		55	175	120	20	100	20	12	8	60	5	55	195	140	20	100	20	17	3	60	2	19
3–16	75						60											60										60		
4–5							60											60										60		
4–25							60											60										60		

Problem #2 COW WORKSHEET

	First 20 Days									Second 20 Days									Third 20 Days									
	Julian Date				Expected					Julian Date				Expected					Julian Date				Expected					
Calf Per.	Ave. Calving	End 20 Days	Days P P	No. Cows	In Heat %	In Heat No.	Conc Rate	Pregnant		Ave. Calv Date	End 40 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Per.	Conc Rate	Pregnant	Ave. Calv Date	End 60 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Period	Conc Rate	Pregnant	Total Preg.
2-24	55	155	100							55	175	120																
	T			20			60			T			20					60										
	M			20			60			M			20					60										
	G			20			60			G			20					60										
3-16	75	155	80							75	175	100																
	T			20			60			T			20					60										
	M			20			60			M			20					60										
	G			20			60			G			20					60										
4-5	95	155	60							95	175	80																
	T			20			60			T			20					60										
	M			20			60			M			20					60										
	G			20			60			G			20					60										
4-25	115	115	40							115	175	60																
	T			20			60			T			20					60										
	M			20			60			M			20					60										
	G			20			60			G			20					60										

There are two approaches to keeping cows in moderate body condition. First, cows should be carefully observed 1 or 2 months before calves are scheduled to be weaned. If cows are thin, calves should be weaned right away. This will give cows a few months of good feed before the quality of the forage declines. Calves are probably growing at a slow rate because of low quality feed available. Consequently weaning will help them.

The second approach which could be used is to sort cows by body condition at weaning time. Cows should be scored for body condition from 1 (thinnest) to 9 (fattest). A sheet describing a method of scoring follows this paper. Decisions on feeding should then be made. The amount of weight gain needed to change body condition must be kept in mind. To help with this, the following table is included.

TABLE 8. Weight Needed To Increase Body Condition

		Weight gain (lb.)				
Body Condition at Weaning	Body Condition at Calving	Calf Fluids and Membranes	Fat or Muscle	Total	Days Weaning to Calving	ADG
5 (moderate)	5	100	0	100	130	0.77
3	5	100	160	260	130	2.00
3	5	100	160	260	200	1.30
3	5	100	160	260	100	2.60
2	5	100	240	340	130	2.60
7	5	100	—160	— 60	130	—0.46

The body condition desired at calving is a 5. Note first that a cow that scores a 5 at weaning must gain 100 lbs in order to calve with a body condition of 5. This 100 lbs represents the weight of the calf, fluid, and membranes. Thus, even a cow with ideal body condition at weaning must gain nearly .8 lbs a day to calve in ideal condition. A cow that scores only a 3 at weaning time must gain 2.0 lbs a day when there are 130 days from weaning to calving. If calves are weaned earlier so there are 200 days between weaning and calving, she only has to gain 1.3 lbs. However, when calves are weaned late and there are only 100 days from weaning to calving, a cow scoring a 3 at weaning must gain 2.6 lbs. a day to score a 5 at calving time. To change a cow from one body condition to the next requires the cow to gain or lose approximately 80 lbs of fat and/or muscle.

Each year is different. Cows are different. You must assess the body condition of your cows and the forage available, and then put together a plan so cows will score a 5 or 6 at calving time. Don't ignore the problem and think it will go away. Thin cows will come back to haunt you next year. They will either be open or calve late.

Suckling. The interval from calving to first heat was 20 to 42 days longer in cows suckling calves than in milked cows. Methods that might be used to shorten the interval from calving to first heat are to wean the calf early or decrease the frequency of suckling.

TABLE 9. Effect of Suckling on the Interval from Calving to 1st Heat.

	Suckled	Non-Suckled	Difference
Type of Cow	(Days)	(Days)	(Days)
Holstein	58	38	20
Milking Shorthorn	94	64	30
Beef	73	31	42

Flushing and 48-hour calf removal can be helpful in improving reproductive performance. Neither practice alone is as beneficial as a combination of the two. A study conducted at Howell's in South Texas with first-calf cows that were slightly thin (scored at 4) at calving time demonstrates this principle.

TABLE 10. Pregnancy Rates Following Calf Removal and Flushing.

	Control	Fl[a]	CR[b]	Fl + CR
No. Cows	18	21	21	21
Pregnant (%)				
21 days	28	14	38	57
24 days	56	52	62	72
63 days	72	76	62	86

[a] Flushed with 10 lbs. corn for two weeks before breeding and first three weeks of breeding.
[b] Calf removal for 48 hours at start of breeding.

Pregnancy rate was only increased in the group where flushing and calf removal were both used. Flushing cows for 3 weeks before breeding did not increase pregnancy rate.

Feeding thin cows (3 or less) for short periods after calving to get them to show heat does not work. This principle is illustrated in the following table:

TABLE 11. Changing Body Condition Post-Calving.

Body Condition		Weight	Days	
At Calving	Needed at Start of Breeding	Gain Needed	Calving to Breeding	ADG
3	5	160 lbs.	80	2.0
3	5	160 lbs.	60	2.7

A minimum of 2 lbs a day must be gained by the cow scoring a 3 at calving if we want her to have enough body condition to show heat early in the breeding season. If, in addition to scoring 3, she has only 60 days from calving to breeding, she must gain 2.7 lbs per day. This is an almost impossible task. As soon as you increase her feed, she will increase her milk production. Therefore, only a small amount of the nutrients fed go to weight gain. It is difficult, if not impossible, to get her to gain 2 lbs a day while nursing a calf. This means that we need to put the condition on the cow before calving.

Cows which score a 4 or greater will respond beautifully to a little extra feed for 3 weeks or so prior to breeding *if* the calves are removed for 48 hours when the bulls are placed in the breeding pasture. Note what happened again at Howell's

Problem #3 COW WORKSHEET

	First 20 Days									Second 20 Days										Third 20 Days										
	Julian Date				Expected					Julian Date				Expected						Julian Date				Expected						
Calf Per.	Ave. Calving	End 20 Days	Days P P	No. Cows	In Heat %	In Heat No.	Conc Rate	Preg-nant		Ave. Calv Date	End 40 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Per.	Conc Rate	Preg-nant	Ave. Calv Date	End 60 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Period	Conc Rate	Preg-nant	Total Preg.
2-24	55	155	100																											
	T			20			60																							
	M			20			60																							
	G			20			60																							
3-11	75	155	80																											
	T			20			60																							
	M			20			60																							
	G			20			60																							
4-5	95	155	60																											
	T			20			60																							
	M			20			60																							
	G			20			60																							
4-25	115	155	40																											
	T			20			60																							
	M			20			60																							
	G			20			60																							

with flushing alone compared with flushing and calf removal.

How do you get cows to gain a little weight just prior to breeding? Grain is one way. A good pasture which has some dry matter is another. However, you **cannot** expect a cow to gain weight on little short green grass. That kind of grass is 90% water. Get good hay, grain or a pasture that has some good growth or you will be disappointed.

Removing calves for 48 hours can be a problem in some situations. The best way to accomplish it without extra labor being involved is to remove calves for 24 hours, work the calves (brand, castrate, etc.) and then turn them back to their mothers at the end of the 48-hour period. Calves must *not* nurse for a 48-hour period to get maximum results.

Table 12 indicates what can be expected from calf removal and flushing. Note little or no change in thin cows showing heat.

TABLE 12. Body Condition at Calving, Flushing, Calf Removal for 48 Hours & Heat.

	30	40	50	60	70	80	90	100	110	120
Thin	0	19	40	55	65	72	76	80	85	85
Moderate	45	61	79	88	92	100	100	100	100	100
Good	42	91	96	98	100	100	100	100	100	100

To understand what 48-hour calf removal and flushing can accomplish, problem number 3 is provided.

Use cows in Problem #2 but remove the calves for 48 hours and flush the cows. Use Table 12 to estimate cows showing heat. Calculate cows pregnant after 20 days of breeding. Use 60% conception rate. Compare results to Problem #2.

Fertile Bulls must (1) produce adequate sperm, (2) a large proportion of the sperm produced must be normal, and (3) the bulls must have the desire and ability to deposit the sperm in the cows. Scrotal circumference is a good measure of semen production. In can be measured quickly and easily with a tape. Available data indicate that bulls with a scrotal circumference of less than 30 cm have reduced fertility. Ten to 15% of the bulls in most breeds have little or no desire to breed. Simple reliable tests for determining these bulls in all herds are yet to be developed. However, reliable tests for bulls who have been handled regularly have been developed.

The effect of selecting bulls for semen quality was recently demonstrated at the King Ranch. Semen from 79 bulls was collected and evaluated. Twenty-seven of these bulls were selected and placed with 675 cows. These 27 bulls had 80% or more normal sperm. Another 26 bulls were placed with 655 cows. These bulls were selected as a representative sample of the original group of bulls. As an example, 52% of the original group had 80% or more normal sperm. In the control group of bulls, 14 (54%) had 80% or more normal sperm. In the original group, 16% had less than 40% normal sperm. Pregnancy rates after 120 days of breeding were 93% in the selected group and 87% in the controls. A study the second year compared bulls with 80% or more normal sperm, bulls with 70% or more normal sperm and control bulls. Five percent fewer cows bred to the control bulls became pregnant than those bred to the bulls selected for semen quality.

Bulls should be evaluated each year. Semen quality will improve in certain bulls from the first semen collection to the second. If a bull has poor semen, collect a second time immediately. If semen is still poor, collect the bull 3-4 weeks later. Then make a decision. Do **NOT** compromise. **Do Not** use a bull with poor semen.

TABLE 13. Bulls Selected for Semen Quality at King Ranch.

	Multiple Sire - 1980[a]		Multiple Sire - 1981		
	Control	80% or Over	Control	80% +	70% +
Number Exposed	572	656	1,179	522	769
Pregnant	87%	93%	85%	90%	91%

[a] Four bulls per 100 cows

Cow Fertility is affected by two factors: time from calving to breeding and weight change near breeding. Conception rate at first service increases markedly as interval from calving to breeding increases up to 40 days post-calving. By 50 days after calving, cows have generally neared maximum conception rates. This means higher conception rates at first service in early calving cows.

Cows losing weight after calving have a lower conception rate than cows gaining weight. Forty-three percent of the cows losing weight conceived on first service compared to 60% of the cows gaining weight.

The effect of days post-calving, weight change following calving and selecting bulls for fertility is shown in Table 14.

TABLE 14. Conception Rate As Influenced By Weight Change After Calving, Fertile Bulls and Time After Calving.

	Untested Bulls			Bulls tested for potential fertility[a]		
	Days after calving			Days after calving		
	30	30-60	Over 60	30	30-60	Over 60
Losing Wt.	21	33	43	21	43	43
Gaining Wt.	41	53	63	41	63	80

[a] 70% or more normal sperm, physically sound, scrotal circumference over 32 cm, and libido.

Problem #4 is designed to show the effect of this on pregnancy rate. Selected cows from the hypothetical ranch have been used. Calves were removed for 48 hours.

Problem #4

Calving Date	Bred By Tested Bulls				Bred By Tested Bulls			
	Thin Cows		Moderate Cows		Thin Cows		Moderate Cows	
	Loss	Gain	Loss	Gain	Loss	Gain	Loss	Gain
Feb. 14								
Mar. 6	20	20	20	20	20	20	20	20
Apr. 18								
May 8	20	20	20	20	20	20	20	20

L = Losing weight
G = Gaining weight
U = Untested
T = Tested for fertility

Problem #4 COW WORKSHEET

	First 20 Days									Second 20 Days										Third 20 Days									
	Julian Date				Expected					Julian Date				Expected						Julian Date				Expected					
Calf Per.	Ave. Calving	End 20 Days	Days P P	No. Cows	In Heat %	In Heat No.	Conc Rate	Preg-nant		Ave. Calv Date	End 40 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Per.	Conc Rate	Preg-nant	Ave. Calv Date	End 60 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Period	Conc Rate	Preg-nant	Total Preg.
2-24	55	155	100																										
	T	L	U	20	70	14																							
	T	G	U	20	80	16																							
	T	L	T	20	70	14																							
	T	G	T	20	80	16																							
	M	L	U	20	100	20																							
	M	G	U	20	100	20																							
	M	L	T	20	100	20																							
	M	G	T	20	100	20																							
4-25	115	155	40																										
	T	L	U	20	19	4																							
	T	G	U	20	19	4																							
	T	L	T	20	19	4																							
	T	G	T	20	19	4																							
	M	L	U	20	61	12																							
	M	G	U	20	61	12																							
	M	L	T	20	61	12																							
	M	G	T	20	61	12																							

Use Table 14 for conception rates, tables 7 and 12 for heat rates. Breed 20 days.

The O'Connor method was devised to cause most cows to calve early in the calving season and decrease the number of non-producers, thus optimizing pounds of calf weaned per animal in a cow herd and increasing the net return. All factors discussed previously were combined to cause this to happen.

The O'Conner management system was first put into practice at Mr. Tom O'Conner's near Victoria, Texas. Reproductive performance in a small group of cows was noted to be exceptionally high.

Reproductive Performance In A Herd At O'Connors

% Pregnant After Breeding			
21 days	42 days	63 days	84 days
80	87	87	93

A large proportion of the cows became pregnant in a short period because Mr. O'Conner:

1. Calved all cows in this group at least 30 days prior to the start of the breeding season.
2. Cows were in moderate or good body condition at calving times.
3. Cows were gaining weight for three weeks prior to the start of the breeding season and for the first three weeks of the breeding season.
4. Calves were removed from cows for 48 hours at the start of the breeding season.
5. Cows were bred to fertile bulls.

The number of cows involved was small; therefore, an experiment was designed at Brigham Young University to further test the concepts of this management system and compare pounds of calf weaned with a control group. The work was done cooperatively on a ranch at Elberta, Utah. Mr. Dale Jolley was the manager. Two hundred and thirty cows were checked for pregnancy in October. An attempt was made to divide the cows into groups by stage of pregnancy. The cows had been exposed to bulls for 5 months and some cows were only 35-40 days pregnant at the time of pregnancy examination. Cows selected to be in the O'Conner management group were all early calvers (calving 30 days before the start of the breeding season) while cows in the control group were expected to calve for the 150-day period. The control group contained the same percentage of early calving cows as was found in the original group. Cows were scored for body condition and were allotted so each group was similar. Most cows in both groups were in moderate or good body condition at calving time. Cows in the O'Conner group were full fed corn silage starting two weeks before breeding and were continued on this ration for the first three weeks of breeding. Calving started in the last of January and bulls were turned with cows on April 22nd. All bulls were evaluated for fertility four weeks before the start of the breeding season. All bulls turned with the O'Connor group had testicles larger than 32 cm in circumference and had more than 70% normal sperm. Calves were removed from cows for 48 hours and the bulls were placed with the cows at the time of calf removal.

Thirty-three of the 85 cows in the O'Conner management group showed heat within 48 hours after calf removal. Twenty-five days after the start of the breeding season 95% had been bred. This increased to 98% after 46 days of breeding.

Reproductive Performance At Elberta, Utah, Using O'Connor System

	Cows Managed Under		
	O'Connor System	Control System	Difference
No. Cows	89	86	
Showing heat after breeding (%)			
25 days	95	59	36
46 days	98	72	26
Pregnant after 1 breeding (%)	80	50	30
Calved (%)			
After 20 days	80	28	52
After 40 days	91	52	39
After 60 days	99	72	27
After 120 days	99	93	8

Conception rate at first service was high in the O'Conner group (80%). Seventy-five percent of the cows in the O'Connor group appeared to be pregnant after 21 days of breeding. At the time of pregnancy exam, only cows bred the first 11 days of the breeding season could be checked for pregnancy. Fifty-four (64%) of the 85 cows were pregnant. It was estimated from heat dates and conception rate that 10 more cows would be pregnant in the first 20 days of breeding. Thus, a 75% pregnancy rate was estimated after 21 days of breeding.

Eighty percent of the cows managed under the O'Connor system calved the first 20 days of the breeding season. This was in contrast to 28% in the control group. Most of the O'Connor cows (91%) had calved in 40 days while only half (52%) of the controls had calved. It was 120 days before 91% of the control cows had calved. Application of five principles resulted in large numbers of cows pregnant in a short period time.

This can be used as a model to improve fertility in cow herds. The following programs must be developed to cause this to happen.

1. A sixty-day breeding season.
2. A nutrition program to insure all cows in at least moderate body condition at calving.
3. A nutrition program to make certain cows are gaining weight for 3-week period prior to breeding and first 3 weeks of breeding.

4. A method of removing calves for a 48-hour period at the start of the breeding season.
5. A program for evaluating bulls for potential fertility each year.

The next question—Does it pay? Estimates of calf weaning weight have been made and additional costs are known. The additional costs were $1,095 in 89 cows in the O'Connor System.

It is estimated 5,123 additional pounds of calf will be weaned, or approximately 51 lbs of calf per cow bred. It is estimated that this will increase the income $1,900 in a 100-cow herd if calves bring 60¢, or a 181% return on the investment of $1,095.

Estimated Economic Value of the O'Connor Management System

	Cows Managed Under O'Connor System	Control System	Difference
Additional Costs:			
Feed	$ 910	0	$ 910
Labor	60	0	60
Semen Evaluation	125	0	125
Total	$1,095		$1,095
Production:			
No. Calves Weaned	85	82	3
Ave. Weaning Weight (lbs.)	529	486	43
Total Lbs. Weaned	44,974	39,851	5,123
Estimated Gross Income:			
$60/cwt	26,985	23,910	3,075
$65/cwt	29,233	25,903	3,330
$70/cwt	31,482	27,896	3,586
Increase in Estimated Income:			
$60/cwt	25,890	23,910	1,980
$65/cwt	28,138	25,903	2,235
$70/cwt	30,387	27,896	2,491

Return on 18-month Investment:

	Increased Income	Costs
$60/cwt	1,980 +	1,095 × 100 = 181%
$65/cwt	2,325 +	1,095 × 100 = 204%
$70/cwt	2,491 +	1,095 × 100 = 227%

Reproduction can be improved. Each thing must be done correctly . . .

1. Cows should calve in a 60-day period;
2. Be in moderate body condition at calving time;
3. Be gaining weight at the start of the breeding season;
4. Calves should be removed from cows for 48 hours at the start of the breeding season;
5. Cows should be bred to fertile bulls.

To help calculate the economic importance in other cow herds Problem #5 was set up.

Problem #5

Calculate the pounds of calf weaned using the following example: calf weighed 80 lbs at birth and gained 2.25 lbs per day; wean October 9; breed for 60 days.

Problem #5

Calving Time	Body Condition	Wt. change near breeding	Cows bred by: Untested bulls	Cows bred by: Bulls tested for potential fertility
2-14 to 3-16	Thin	Losing	—	20
	Moderate	Losing	—	20
	Moderate	Gaining	20	20
4-18 to 5-8	Thin	Losing	20	—
	Moderate	Gaining	—	20

To Calculate Average Weaning Weight

Cows Pregnant in	Ave. Date bred (Julian)	Ave. Birth date (Julian)	Weaning date (Julian)	Weaning age (days)	Gain to wean	Weaning weight (lbs.)
1st 20 days of breeding	155					
2nd 20 days of breeding	175					
3rd 20 days of breeding	195					
282-day gestation period						

There is one other important ingredient to get from where you are to where you want to be. You have to calve early in the calving season.

The *length of the breeding season* is an important factor in determining pregnancy rate. Late calving cows have smaller calf crops than early calving cows. As an example, pregnancy was 88% in early calving cows compared to 60% in late calving cows, in cows calving from Nov. 15 to May 21.

Calving Time and Pregnancy

Time of Calving	Breeding Time: Feb. 10 to April 11 — 60 days	Feb. 10 to June 11 — 120 days	Feb. 10 to August 9 — 180 days
Nov. 15 to Feb. 10 (%)	70	85	8ℰ
Feb. 11 to May 21 (%)	36	57	60

Similar results have been noted in an 80-day breeding season. Pregnancy rate was decreased from 88% in early calving cows to 60% in late calving cows. Cows calving early have more time to show heat before start of breeding. Consequently, more will become pregnant.

The only reliable method for making sure cows calve early in the calving season is to have a short breeding season. Results shown here indicate the breeding season should not last more than 60 days.

Shortening the breeding season from 150 days or even from 90 days to a 60-day season may present a cash flow problem. The first year the breeding season is shortened there could be fewer calves for sale. Therefore, some suggestions of how this can be accomplished would appear

Problem #5

Pounds Calf Weaned

Group No.	1st 20 days	2nd 20 days	3rd 20 days	Total lbs.	$ @ 65¢	$ Per cow
1A						
No. Calves						
Ave. Weight						
Total Weight						
1B						
No. Calves						
Ave. Weight						
Total Weight						
1C						
No. Calves						
Ave. Weight						
Total Weight						
1D						
No. Calves						
Ave. Weight						
Total Weight						
2A						
No. Calves						
Ave. Weight						
Total Weight						
2B						
No. Calves						
Ave. Weight						
Total Weight						

Problem #5 COW WORKSHEET

	First 20 Days									Second 20 Days										Third 20 Days										
	Julian Date					Expected				Julian Date								Expected		Julian Date					Expected					
Calf Per.	Ave. Calving	End 20 Days	Days P P	No. Cows	In Heat %	In Heat No.	Conc Rate	Preg-nant		Ave. Calv Date	End 40 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Per.	Conc Rate	Preg-nant	Ave. Calv Date	End 60 Days	Days P P	No. Cows	In Heat %	In Heat No.	Prev. Preg.	Heat This Period	Conc Rate	Preg-nant	Total Preg.
2-24	55	155	100							55	175	120								55	195	140								
	T	L	T	20	70	14	43	6					20					43					20					43		
	M	L	T	20	100	20	43	9					20					43					20					43		
	M	G	U	20	100	20	63	13					20					63					20					63		
	M	G	T	20	100	20	80	16					20					80					20					80		
4-24	115									115	175	60								115	195	80								
	T	L	U	20	19	4	33	1					20					33					20					33		
	M	G	T	20	61	12	63	8					20					63					20					63		

important. The first step is to get an estimate of how many calves were dropped in the different weeks of the calving season. This should then be related to the breeding season to ascertain when cows are being bred. Next, an estimate of the amount and quality of forage availabe in different months of the year should be made. A chart which shows the nutrient requirements of cows should be obtained. A breeding season should be selected so that nutrient requirements of cows match as nearly as possible the available forage supply. The present calving pattern should be compared with the desired calving pattern. Changes that need to be made can then be made intelligently. Sometimes the breeding season can be shortened with only small losses in calf numbers the first year. Other times rather drastic changes must be made. There are two possible methods.

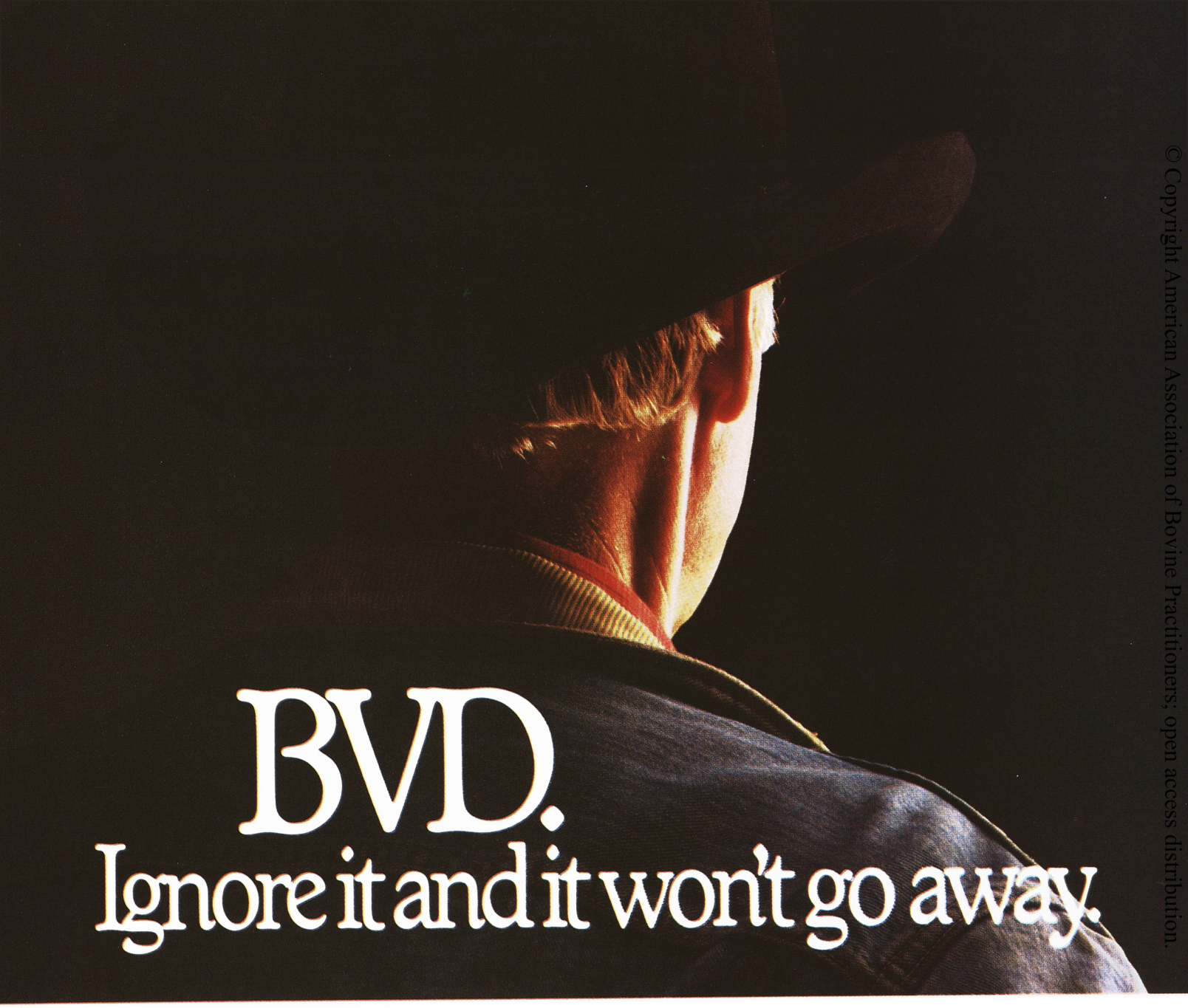
First, a plan is developed in which the breeding season is shortened two to four weeks per year. A heifer development program where heifers are bred only 45 days is an important part of this program and must be implemented or the plan will not work. This will be discussed in another paper. Second, a plan can be developed in which cows are bred in a fall and spring program. Forage supply must be carefully evaluated in this type of program. Calf numbers may actually be increased in this program.

An example of how the breeding season might be shortened from 150 days to 60 days follows. Thirty replacements per 100 cows are added each year for 3 years. To get these 30 replacement heifers calving in a 45-day period, 35 heifers are bred and open heifers culled. The cost per animal in the herd is increased from $250 to $270. The net return is changed from -$39 to +$45. This is assuming a 90% calf drop each year. Generally, when you have a long calving season, the calf crop is lower.

Changing Length of Calving Season

Expected Day of Calving	1st year	2nd year	3rd year	4th year	5th year
1-20	10	30	50	70	75
21-40	10	20	20	25	20
41-60	10	10	20	5	5
61-80	20	20	10		
81-100	20				
101-120	10				
121-140	5				
141-150	5				
Total No. Pregnant	100	100	100	100	100
No. Replacements Saved	35	35	35	12	12
Pregnant Replacements in herd	10	30	30	30	10
Cost per Animal	250	270	270	270	250
Calf Crop Weaned	90	90	90	90	90
Animals per 100 Calves	127	135	135	135	127
Lbs. Calf Weaned Per Animal	281	308	336	352	393
Net Return	—39	—39	—18	—6	+45

This particular method resulted in an increase in revenue but a place must be found to carry an extra 25 heifers each year for 3 years. Consequently, this may not be feasible to implement. This could be implemented by checking cows for pregnancy and culling open and late-calving cows. Using this system, the number of cows replaced would be determined by the number of pregnant replacement heifers available to be placed in the herd.



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