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Low Cost Cow/Calf Program: The School – Part VI

In this issue of Dr. Dick Diven's (Agri-Concepts, Inc.) information we will go through some production year scenarios looking at the Net Energy maintenance needs of the cow compared to that available from the rangeland forage and see what affect it has on her body condition. We'll then provide a protein supplement that will meet the rumen microbes' needs, though maybe not the cow's, and see what affect that has on her condition. Though maintaining a cow's body condition at a constant level is not realistic or even necessary we do want her in good condition at either calving or breeding and we'll look at which may be more realistic for this region.

THE COW HERD

The cows in our herd have an average shrunk body weight (4% shrink after standing overnight without feed and water) of 1200 pounds when in body condition score (BCS) 5.5 (1 = emaciated; 9 = obese). Thus their empty body weight (EBW) will be about 1021 pounds (1200 lb * 0.851). The calving season is 60 days; average calf birth weight 100 pounds; peak milk production at week 9 is 17.5 lb/day; calves weaned at eight months; and the herd on native range year round.

It has been mentioned in previous installments of this series that it is ideal for the cows to be in BCS 5 – 6 at calving so that they bred back to calve again within a years time. However, depending on when the calving season is the cows could be in a lower condition, though probably not below a 4, and still bred back to calve the same time next year. They would, however, need to be on an increasing plane of nutrition and gaining weight so that they are in BCS 5 – 6 at the start of the breeding period. Remember the purpose of Dr. Diven's program is to lower cost of production, primarily feed costs, while ensuring your cow herd's nutritional needs are being met.

Production Year
We'll look at the monthly Net Energy maintenance (NEm) needs of cows calving either the first of Feb, Mar, Apr, May, or Jun without any supplementation and the affect it has on their weight and BCS at the beginning of the breeding period and a year later at calving. Then we'll see what affect providing a protein supplement to ensure the rumen microbes' needs are being met and see how that affects the cows' weight and BCS at breeding and a year later.

We first need to determine is how much Net Energy for maintenance (NEm) our cows will consume from native rangeland forage. An aside: If you are uncomfortable with the NEm system but are familiar with total digestible nutrients (TDN) understand that for the most part the relationship between %TDN and Mcal NEm is 100:1, i.e. if forage contains 50% TDN its NEm value is ≈ 0.50 Mcal/lb or 50 Mcal/cwt. Thus if 24 pounds of this forage on a dry matter basis is consumed the cow will obtain 12 lb of TDN or 12 Mcal of NEm.

There are different methods to determine how much NEm the mature cow will consume from the forage. If you recall in Part II the following equation from Galyean & Hubbert (1993) that Dr. Diven uses was provided: *Mcal NEm consumed = (0.65 * Empty Mature Body Weight)$^{0.75}$ * (0.144598 * NEm + 0.206865 * NEm^{2} – 0.036915)*

As noted in Part II (Feb 2010) this equation is a bit daunting so use of a computer spreadsheet program is highly recommended. However, a goal of this series was to simplify the information so we are going to use a different method to determine Mcal of NEm consumed. Another reason to use a different method is that the above formula possibly overestimates NEm consumption, especially as forage NEm content increases. It also does not account for changes in how much the cow will eat based on her stage of production. There are a couple of equations in "Nutrient Requirements of Beef Cattle, 7th revised edition, 1996" to estimate dry matter intake (DMI) and as a result appear to do a better job of estimating NEm consumption but again a computer spreadsheet program is needed to use them. Thus, we are going to use a method Dr. Danny D. Simms in his publication "Feeding the Beef Cowherd *for Maximum Profit*" (2009) suggests to determine DMI and resultant NEm consumption. Calculations are still necessary but use of a calculator is all that is needed, in fact they can be done with pencil and paper.

A rule of thumb for how much forage a cow and ruminants in general will consume is 2% of their body weight. However, stage of production and forage quality influences this. Table 1 *(Table 14-2, D.D. Simms, 2009)* provides intake guidelines for beef cows. For February the cows in lactation will consume 2% of their body weight in low quality range forage unless they are supplemented with protein but as indicated above we'll look at that later. Multiplying the cows' SBW of 1200 pounds by 2% indicates they would consume 24 lb/day (1200 * 0.02) of the range forage on a dry matter basis. The amount of NEm they consume is determined by multiply pounds DMI by Mcal NEm/lb of forage. Thus if NEm content of Feb range forage is 0.48 Mcal/lb then the cows would consume 11.5 Mcal NEm/day (24 lb * 0.48 Mcal/lb). Table 2 shows percent of body weight used to estimate DMI, lb/day of DMI, Mcal NEm/lb in range forage, and resultant Mcal NEm consumed for each month of the year.

Now we need to determine the Mcal of NEm needed by the cows for maintenance (M) and lactation (L) for the month of Feb. For NEm (M) we multiply the cows' metabolic body weight by 0.04256. Metabolic body weight is EBW to the 0.75 power. As noted above it is best to have cows in BCS 5 to 6 at calving to ensure timely bred back so we will begin each calving month scenario with the cows in a BCS 5.5. As indicated above these cows EBW in BCS 5.0 would be 1021 lb so when in BCS 5.5 it would be 1250 lb (See Note for Appendix Table 4) * 0.851 = 1064 lb. Thus, their NEm (M) needs would be: $1064^{0.75}$ * 0.04256 = 186.3 * 0.04256 = 7.9 Mcal/day.

Table 1: Percent of body weight to estimate forage dry matter intake of beef cows in different physiological stages and subjected to different supplementation programs.

Forage Type[1]/Conditions	Dry, Gestating	Lactating
Low quality/unsupplemented	1.5	2.0
Low quality/protein supplemented	1.8	2.2
Low quality/energy supplemented	1.5	2.0
Average quality/unsupplemented	2.0	2.3
Average quality/protein supplemented	2.2	2.5
Average quality/energy supplemented	2.0	2.3
High quality	2.5	2.7

[1]Forage Type: Low quality – winter range, crop residues in winter, very low quality hay (e.g. mature bromegrass); Average quality – late summer/early fall range, good grass hay (e.g. late bloom brome), crop residues shortly after harvest; High quality – spring/early summer range, alfalfa hay and corn silage.

Table 2: Dry matter intake (DMI) of range forage and net energy maintenance (NEm) consumed by a 1200 lb shrunk body weight (SBW) cow calving 1 Feb, calf weaned 1 Oct.

Month	# Days	% of Body Weight	DMI[1] (lb/day)	NEm (Mcal/lb)	NEm Consumed[2] (Mcal/day)	NEm Consumed[3] (Mcal/month)
Feb	28	2.0	24.0	0.48	11.5	323
Mar	31	2.0	24.0	0.46	11.0	342
Apr	30	2.0	24.0	0.50	12.0	360
May	31	2.7	32.4	0.73	23.7	733
Jun	30	2.5	32.4	0.65	21.1	632
Jul	31	2.5	32.4	0.65	21.1	653
Aug	31	2.3	27.6	0.64	17.7	548
Sep	30	2.3	27.6	0.63	17.4	522
Oct	31	2.0	24.0	0.58	13.9	432
Nov	30	1.5	18.0	0.54	9.7	292
Dec	31	1.5	18.0	0.52	9.4	290
Jan	31	1.5	18.0	0.50	9.0	279

[1]DMI (lb/day) = 1200 lb * % of Body Weight
[2]NEm Consumed (Mcal/day) = DMI (lb/day) * NEm (Mcal/lb)
[3]NEm Consumed (Mcal/month) = NEm (Mcal/day) * # Days

If we were to try and maintain these cows in a BCS 5.5 throughout the year their NEm (M) requirement would be 7.9 Mcal/day every month. However, since this is not realistic the amount required will vary with their weight. Before we can determine their NEm (M) needs for the remaining months we need to determine NEm amounts needed for lactation, gestation, cold stress, and grazing activity. Mcal of NEm (L) needed each day in the first month (Feb) is 3.1 (Appendix Table 6 from Part V, Sep 2010). We enter that value into Table 3 and can enter the remaining values for months 2 – 8 (Mar – Sep).

Obviously the Feb calving cows are no longer in gestation (G) so there is no requirement for Mcal NEm (G) between Feb and Aug. Granted the cows should become pregnant by May if they are to calve again in Feb but the amount of NEm (G) needed during the first four months of pregnancy is considered to be negligible and covered by the amount allocated for NEm (M). The 5th month of gestation for the Feb calving cows will be Sep and they will require 0.7 Mcal NEm (G) (Appendix Table 3 from Part V, Sep 2010). We enter this amount in Table 3 and can enter the amounts for months 6 – 9 (Oct – Jan).

Because we do not live in a thermal-neutral environment we want to estimate how much additional NEm the cows' will need for cold stress. Appendix Table 1 shows average monthly temperatures for Buffalo, Wyoming, wind chill temperatures based on an average wind speed of 10 mph (Appendix Table 2), and the lower critical temperature of beef cattle at different hair coat conditions (Appendix Table 3). A cow's weight and hair coat condition influences the amount of additional NEm she needs due to the cold.

Going to Appendix Table 1 we find that the average temperature in Feb for Buffalo, WY is 25.5° F. Average wind speeds for Buffalo are not listed in climatic data so I decided that an average daily wind speed of 10 mph should be sufficient to estimate additional NEm needs. As a result the wind chill temperature (WCT) for Buffalo in Feb is estimated to be 13° F. The cows' lower critical temperature (LCT) is 18° F (dry, heavy winter coat) so the difference between WCT and LCT is 5° F. We find in Appendix Table 3 that a 1200 lb cow with a heavy winter coat requires 0.7% more NEm for every degree below their LCT. So we multiply 5° by 0.7%, multiply the product by Mcal of NEm (M) the cow requires in Feb and divide that product by 100.

$(5 * 0.7 * 7.9) \div 100 = 27.7 \div 100 \approx 0.3$ Mcal NEm the cow needs for cold stress and is entered into Cold Stress column of Table 3.

On most sunny days in Feb the temperature will be above the cows' LCT so the additional Mcal of NEm would not be needed, especially those days the overnight low is above their LCT. However, we are balancing for the month as a whole so the additional daily amount of NEm for cold stress can be accumulated for those days that extra energy is needed. For example, if the temperature drops to -10° F with a 25 mph wind, WCT would be -38° F. The difference between WCT and LCT would be 56° F (18 – -38). Mcal NEm needed for these conditions: $(56 * 0.7 * 7.9) \div 100 = 3.1$ Mcal/day

If we multiply the 0.3 Mcal NEm from above by 28 days we come up with an extra 8.4 Mcal for severe cold weather. Dividing this 8.4 Mcal by 3.1 Mcal needed for the above cold weather results in enough additional NEm for 2 to 3 days of these conditions. The reality is that the rancher might not need to provide an energy supplement throughout the month for cold stress but just for those days when conditions such of the above occur. Including Mcal NEm for cold stress provides us a reservoir for possible needs.

One more item we need to account for with regard to NEm needs by the cows and that is for grazing activity. If they were in a dry lot this would not be a concern but because they are on range it is. Pastures with abundant forage and fairly level terrain (e.g. irrigated hay fields) the extra amount of NEm for grazing is 10% to 20% (Simms, D.D. 2009, NRC 1996) but for cows grazing range with significant terrain it can be 50% more. Thus the additional amount of NEm needed for terrain negotiation in Feb is 4.0 Mcal (7.9 Mcal NEm (M) * 0.5). This value is entered into the Grazing Activity column of Table 3. Total Mcal NEm that our Feb calving cows need for that month is 428: (NEm (M) + (L) + Cold + Grazing = 15.3 Mcal/day * 28 days).

We now need to determine the amounts the cows will need for each remaining month of the production year. Because they will gain or lose weight due to amount of NEm consumed compared to needed, their NEm (M), cold, and grazing activity requirements will vary.

In Part III (Apr 2010 issue) we learned that net energy for weight change (NE_{Δ}) is the amount of Mcal gained or lost at a particular BCS when the cow changes weight. Dr. Diven used information from Buskirk, et al. (1992) to determine change in weight and BCS a cow would experience if she consumed more or less Mcal NEm than she needed. However, I've decided to use a method Dr. Simms promotes in his book that is from the 7th Edition of Nutrient Requirements of Beef Cattle (1996). Hopefully it will be simpler to use. Appendix Table 4 lists the Mcal NEm required or provided for each change in BCS for cows of different sizes at BCS 2 – 9.

Table 3: Daily Mcal NEm required for maintenance (M), gestation (G), lactation (L), cold stress, and grazing activity by a 1200 pound shrunk body weight cow in BCS 5.5 at calving (1 Feb), calf birth weight 100 pounds, peak milk 17.5 lb/day, calf weaned 1 Oct.

Month	(M)[1]	(G)[2]	(L)[3]	Sub-total	Cold Stress[4]	Grazing Activity[5]	Total (Daily)	Total (Month)	Monthly Balance[6]	Daily Balance[7]
Feb	7.9	0.0	3.1	11.0	0.3	4.0	15.3	428	-105	-3.8
Mar	7.6	0.0	5.7	13.3	0.0	3.8	17.2	532	-190	-6.1
Apr	7.0	0.0	5.8	12.8	0.0	3.5	16.3	488	-128	-4.3
May	6.5	0.0	4.9	11.4	0.0	3.3	14.6	454	279	9.0
Jun	7.5	0.0	3.8	11.2	0.0	3.7	15.0	450	182	6.1
Jul	8.0	0.0	2.8	10.7	0.0	4.0	14.7	456	197	6.4
Aug	8.4	0.0	2.0	10.3	0.0	4.2	14.5	451	97	3.1
Sep	8.6	0.7	1.4	10.7	0.0	4.3	15.0	449	73	2.4
Oct	8.7	1.3	0.0	10.0	0.7	4.3	15.0	466	-35	-1.1
Nov	8.6	2.2	0.0	10.8	0.8	4.3	15.9	478	-186	-6.2
Dec	8.3	3.5	0.0	11.7	0.6	4.1	16.4	509	-219	-7.1
Jan	7.7	5.3	0.0	13.0	0.5	3.9	17.4	540	-261	-8.4

[1]EBW from Table 4 to the 0.75 power multiplied by 0.04256
[2]From Appendix Table 3, Part V September 2010
[3]From Appendix Table 5, Part V September 2010
[4]See Appendix Tables 1 and 2 below [(WCT – LCT) * % increase due to hair coat * Mcal NEm (M)
[5]NEm (M) * 0.50
[6]Monthly totals consumed from Table 2 minus Monthly totals required
[7]Daily Balance: Monthly balance divided by # days in the month

Because our Feb calving cows began the month in BCS 5.5, Mcal NEm required or available for a change in one CS is 226 (Appendix Table 4: 1200 lb weight column. The cows consumed 105 Mcal less NEm than they required for the month (Table 3) so they will have lost weight. How much weight they possibly lost is determined by multiplying 226 Mcal by 0.8 (It's assumed that it takes 1 Mcal of mobilized body fat to replace 0.8 Mcal of diet NEm but if they were gaining weight it is a 1:1 relationship) then dividing the product (181) by the daily Mcal balance of -3.8 (-105 divided by 28 days) and we come up with a -48. This is how many days it would take for these cows to lose one CS or approximately 90 lb. For Feb it would be approximately 53 lb [(28/48)*90] or (0.58 * 90). As a result change in BCS of the cows for the month would be 5.5 minus 0.6 (53 lb ÷ 90 lb) = 4.9.

Because the cows lost weight during Feb it would appear that an energy supplement should have been provided. However, with the cows having been in a BCS 5.5 at the beginning of the month this weight loss might not be an issue, especially with it being only half a score. We now need to go through the entire year to see the potential affect on the cows' BC for critical times such as beginning of breeding and at calving the following year without any supplements.

As noted above the Feb calving cows lost 53 lb of body weight during the month so their Mar EBW would be 1012 lb (1065 – 53). The Mcal NEm (M) they now need would be 7.6 ($1012^{0.75}$ * 0.04256; 179.4 * 0.04256). We enter 7.6 into the NEm (M) column of Table 3 for Mar and then total the amounts for (M), (G) and (L). There is no cold stress on average for the month of Mar although we know there are times when there will be and the rancher has to be prepared for those days. Once we add in the amount of NEm for grazing activity we find that the cows' are short 190 Mcal for the month (6.1 Mcal/day), thus they will have lost more weight. Going to Appendix Table 4; 1200 lb SBW column and BCS 4 row we find 196 Mcal for NE_{Δ}. To estimate the amount of potential loss in weight we multiply 196 Mcal by 0.8 = 157; divide this by 6.1 = 26 days to lose one CS. The cows would have lost 107 lb during March ((31 ÷ 26)*90) so their new EBW would be 904 lb (1012 – 108) and the amount of NEm (M) would be 7.0 Mcal ($904^{0.75}$ * 0.04256).

Table 4 shows the EBW and BCS changes for these Feb calving cows for the year. Without providing any energy or protein supplement it appears we have a problem as these cows' BCS at the beginning of Feb of the next year will be 3.6, not a good situation going into calving. In addition, their BCS the 1st of May, beginning of the breeding period, is 2.8. This BCS and the fact they have been losing condition through the winter and early spring greatly reduces their chance of being bred not only within the first 21 days but for the entire 60 day period. Is this academic exercise realistic? I don't know, I'll let the experienced ranchers of this region decide but I would venture to guess it is in the ball park.

If we do the same exercise for cows calving the beginning of Mar, Apr, May, or Jun we'll find that their BCS at the beginning of the breeding season (Jun, Jul, Aug, or Sep) will be 5.2, 6.3, 7.2, and 6.5, respectively (Tables 5, 6, 7, and 8. Except for possibly the Mar calving cows, the others are in a desired body condition for breeding. In addition, BCS at the beginning of the next calving season will be 2.9, 2.0, 2.0, and 3.8, respectively for Mar, Apr, May, and Jun calving cows.

It would appear that we need to provide the cows an energy supplement in those months when rangeland forage is deficient regardless of the month they calve. However, that may or may not be necessary. Before we do, let's provide a protein supplement in the months that NEm is deficient. By doing this the rumen microbes' protein needs most likely will be met, will ensure that is the case later. Recall that in order for the rumen bugs to fully utilize all available energy in the consumed forage their protein needs have to be satisfied otherwise some of the energy will go unutilized. An additional benefit to the cow is that she will be able to consume more of the low quality rangeland forage possibly meeting her energy needs or at least close enough that an energy supplement will not be necessary. The reason she will be able to consume a greater amount of the low quality range forage and thus obtain more energy is that the rumen bugs with an adequate supply of protein will be able to digest the forage more completely resulting in it moving out of the cow's rumen faster making more room.

I'll bring it up now for those that might be wondering if weaning the calves earlier than at 8 months would help reduce NEm demand. It can and weaning as early as 5 months may result in the cow being in as much as a 0.5 BCS greater at time of calving the next year. Something to consider as it might be cheaper to feed the calves than the cows, especially for later calving herds. Many scenarios that can be looked at!

Table 4: Change in empty body weight (EBW) for a 1200 pound shrunk body weight cow and resultant body condition scores (BCS).

Month	EBW (lb)[1]	BCS[2]	Daily Balance[3]	Mcal NE_{Δ}[4]	Gain/Lost (lb)[5]	Change in BCS
Feb	1065	5.5	-3.8	226 * 0.8 = 181	-53	-0.6
Mar	1012	4.9	-6.1	196 * 0.8 = 157	-108	-1.2
Apr	904	3.7	-4.3	172 * 0.8 = 138	-84	-0.9
May[7]	820	***2.8***	9.0	151 * 1.0 = 151	166	1.8
Jun	986	4.6	6.1	196 * 1.0 = 196	84	1.0
Jul	1070	5.6	6.4	226 * 1.0 = 226	78	0.8
Aug	1148	6.4	3.1	264 * 1.0 = 264	33	0.4
Sep	1181	6.8	2.4	264 * 1.0 = 264	25	0.3
Oct	1202	7.1	-1.1	311 * 0.8 = 249	-13	-0.2
Nov	1190	6.9	-6.2	264 * 0.8 = 211	-79	-0.9
Dec	1123	6.0	-7.1	264 * 0.8 = 211	-93	-1.0
Jan	1029	5.0	-8.4	226 * 0.8 = 181	-129	-1.4
Feb	899	**3.6**				

[1]EBW for months Mar – Feb = Previous months EBW +/- change in weight for month.
[2]BCS for months Mar – Feb = Previous months BCS +/- change in BCS for month.
[3]Daily Balance of Mcal NEm: From Table 3.
[4]From Appendix Table 4: When daily balance is negative it takes 1 Mcal of body fat to replace 0.8 Mcal of diet NEm; when positive a 1:1 relationship.
[5]Number of days in month / (Mcal NE_{Δ}/Daily Balance) * 90 lb (Note: Rounded to nearest 5 lb)
[6]Gain/Lost lb / 90
[7]Beginning of breeding period (approximately 83 days after calving)

Table 5: Monthly net energy maintenance (NEm) consumed and required by a 1200 lb shrunk body weight cow calving 1 Mar, calf weaned 1 Nov and resultant changes in empty body weight (EBW) and body condition score (BCS).

Month	Mcal NEm Consumed	Mcal NEm Required	Balance	EBW (lb)	BCS	Gain/Loss (lb)	+/- BCS
Mar	342	465	-123	1065	5.5	-61	-0.7
Apr	360	513	-154	1004	4.8	-92	-1.0
May	733	508	225	916	3.8	118	1.4
Jun[1]	632	495	137	1034	***5.2***	54	0.6
Jul	653	491	162	1088	5.8	65	0.7
Aug	548	477	70	1153	6.5	24	0.2
Sep	522	443	78	1177	6.7	27	0.3
Oct	496	492	4	1204	7.0	1	0.1
Nov	292	455	-164	1205	7.1	-69	-0.7
Dec	290	475	-184	1146	6.4	-77	-0.9
Jan	279	494	-215	1067	5.5	-93	-1.2
Feb	242	464	-222	960	4.3	-127	-1.4
Mar				833	**2.9**		

[1]*Beginning of breeding period (approximately 83 days after calving)*

Table 6: Monthly net energy maintenance (NEm) consumed and required by a 1200 lb shrunk body weight cow calving 1 Apr, calf weaned 1 Dec and resultant changes in empty body weight (EBW) and body condition score (BCS).

Month	Mcal NEm Consumed	Mcal NEm Required	Balance	EBW (lb)	BCS	Gain/Loss (lb)	+/- BCS
Apr	360	450	-90	1065	5.5	-45	-0.5
May	733	534	199	1020	5.0	79	0.9
Jun	632	538	93	1099	5.9	38	0.4
Jul[1]	653	538	115	1137	***6.3***	39	0.4
Aug	548	514	34	1176	6.7	11	0.2
Sep	522	470	51	1187	6.9	18	0.2
Oct	496	488	8	1205	7.1	2	0.0
Nov	389	481	-92	1207	7.1	-33	-0.4
Dec	290	455	-165	1174	6.7	-70	-0.8
Jan	279	463	-184	1104	5.9	-92	-1.0
Feb	242	425	-183	1012	4.9	-105	-1.2
Mar	257	491	-234	907	3.7	-153	-1.7
Apr				754	**2.0**		

[1]*Beginning of breeding period (approximately 83 days after calving)*

Table 7: Monthly net energy maintenance (NEm) consumed and required by a 1200 lb shrunk body weight cow calving 1 May, calf weaned 1 Jan and resultant changes in empty body weight (EBW) and body condition score (BCS).

Month	Mcal NEm Consumed	Mcal NEm Required	Balance	EBW (lb)	BCS	Gain/Loss (lb)	+/- BCS
May	733	465	268	1065	5.5	113	120
Jun	632	555	77	1172	6.7	26	0.3
Jul	653	582	71	1198	7.0	21	0.2
Aug[1]	548	559	-11	1219	***7.2***	-4	0.0
Sep	522	507	15	1215	7.2	4	0.0
Oct	496	517	-20	1219	7.2	-7	-0.1
Nov	389	477	-89	1212	7.1	-33	-0.3
Dec	387	482	-95	1179	6.8	-40	-0.5
Jan	279	446	-167	1139	6.3	-71	-0.8
Feb	242	402	-160	1068	5.5	-80	-0.8
Mar	257	456	-199	988	4.7	-114	-1.3
Apr	270	467	-197	874	3.4	-129	-1.4
May				745	**2.0**		

[1]*Beginning of breeding period (approximately 83 days after calving)*

Table 8: Monthly net energy maintenance (NEm) consumed and required by a 1200 lb shrunk body weight cow calving 1 Jun, calf weaned 1 Feb and resultant changes in empty body weight (EBW) and body condition score (BCS).

Month	Mcal NEm Consumed	Mcal NEm Required	Balance	EBW (lb)	BCS	Gain/Loss (lb)	+/- BCS
Jun	632	450	182	1065	5.5	72	0.8
Jul	653	564	89	1137	6.3	30	0.3
Aug	548	574	-26	1167	6.6	-9	-0.1
Sep[1]	522	526	-4	1156	***6.5***	-1	0.0
Oct	496	530	-34	1155	6.5	-15	-0.2
Nov	389	483	-94	1140	6.3	-40	-0.4
Dec	387	456	-69	1100	5.9	-35	-0.4
Jan	372	451	-79	1065	5.5	-39	-0.4
Feb	242	367	-125	1026	5.1	-62	-0.7
Mar	257	409	-152	964	4.4	-90	-1.0
Apr	270	412	-142	876	3.4	-93	-1.0
May	679	457	222	783	2.4	133	1.4
Jun				916	**3.8**		

[1]*Beginning of breeding period (approximately 83 days after calving)*

There are numerous protein supplements that could be used but because we want to determine if the provision of an energy supplement will also be needed we'll use a high protein (30%) range cube product. Provision of a high protein (25% to 35%) supplement ensures that the cows are able to consume the maximum amount of low quality range forage as possible (From J. Patterson, MSU Extension Beef Specialist's "Prime Cuts", Vol. 1 #8). For now we will not concern ourselves with how much of these cubes are needed to meet the rumen bugs' needs we'll just assume that they are and adjust DMI accordingly.

From Table 1 we find that lactating cows on low quality forage will increase their DMI from 2% of SBW to 2.2% if provided a protein supplement and if in late gestation from 1.5% to 1.8%. Thus, the cows will increase their DMI of winter range forage from 24 lb to 26.4 lb if in lactation and from 18 lb to 21.6 lb when dry.

For cows calving between Feb and Jun the potential increase in their DMI (Nov – Apr) as a result of the protein supplement resulted in them obtaining enough additional energy that their BCS a year later was 4.5, 4.1, 3.8, 3.4, and 4.5, respectively (Tables 9 – 13). In addition, except for the Feb calving cows whose BCS at the beginning of the breeding season was 3.5, scores for the Mar – Jun cows was 5.4, 6.4, 7.2, and 6.5, respectively, well within the desired condition for breeding. This would indicate that providing an energy supplement would not be necessary, except for possibly the Feb calving cows following calving up to breeding. However, because the Mar, Apr, and May calving cows BCS at time of calving the following year was less than 5.0 it might be necessary to supply them with an energy supplement from the last month of gestation until green grass. By not doing so it is possible that their BCS at the beginning of the breeding season will be lower and lower over the years resulting in later and later calves.

Table 9: Daily dry matter intake (DMI), monthly net energy maintenance (NEm) consumed and required by a 1200 lb shrunk body weight cow calving 1 Feb, calf weaned 1 Oct and resultant changes in empty body weight (EBW) and body condition score (BCS).

Month	DMI[2] (lb/day)	Mcal NEm Consumed	Mcal NEm Required	Balance	EBW (lb)	BCS	Gain/Loss (lb)	+/- BCS
Feb	26.4	355	428	-73	1065	5.5	-36	-0.4
Mar	26.4	376	536	-160	1029	5.1	-79	-0.9
Apr	26.4	396	500	-104	949	4.2	-60	-0.7
May[1]	32.4	733	473	260	889	***3.5***	136	1.5
Jun	32.4	632	460	172	1025	5.1	69	0.8
Jul	32.4	653	462	191	1094	5.8	76	0.8
Aug	27.6	548	456	91	1170	6.7	31	0.3
Sep	27.6	522	453	68	1201	7.0	20	0.2
Oct	24.0	432	471	-39	1221	7.2	-14	-0.2
Nov	21.6	350	482	-132	1207	7.1	-48	-0.5
Dec	21.6	348	519	-170	1159	6.5	-73	-0.8
Jan	21.6	335	556	-221	1086	5.7	-110	-1.2
Feb					976	**4.5**		

[1]*Beginning of breeding period (approximately 83 days after calving)*
[2]DMI between Nov and Apr increased due to protein supplementation

Table 10: Daily dry matter intake (DMI), monthly net energy maintenance (NEm) consumed and required by a 1200 lb shrunk body weight cow calving 1 Mar, calf weaned 1 Nov and resultant changes in empty body weight (EBW) and body condition score (BCS).

Month	DMI[2] (lb/day)	Mcal NEm Consumed	Mcal NEm Required	Balance	EBW (lb)	BCS	Gain/Loss (lb)	+/- BCS
Mar	26.4	376	474	-97	1065	5.5	-48	-0.5
Apr	26.4	396	516	-120	1016	5.0	-60	-0.7
May	32.4	733	519	214	957	4.3	98	1.1
Jun[1]	32.4	632	500	131	1055	***5.4***	52	0.6
Jul	32.4	653	496	157	1108	6.0	53	0.6
Aug	27.6	548	479	68	1161	6.6	23	0.3
Sep	27.6	522	445	77	1184	6.8	22	0.2
Oct	27.6	496	470	26	1206	7.1	8	0.1
Nov	21.6	350	454	-104	1214	7.2	-38	-0.4
Dec	21.6	348	490	-142	1176	6.7	-60	-0.7
Jan	21.6	335	507	-172	1116	6.1	-73	-0.8
Feb	21.6	290	491	-201	1042	5.3	-100	-1.1
Mar					942	**4.1**		

[1]*Beginning of breeding period (approximately 83 days after calving)*
[2]DMI between Nov and Apr increased due to protein supplementation

Table 11: Daily dry matter intake (DMI), monthly net energy maintenance (NEm) consumed and required by a 1200 lb shrunk body weight cow calving 1 Apr, calf weaned 1 Dec and resultant changes in empty body weight (EBW) and body condition score (BCS).

Month	DMI[2] (lb/day)	Mcal NEm Consumed	Mcal NEm Required	Balance	EBW (lb)	BCS	Gain/Loss (lb)	+/- BCS
Apr	26.4	396	458	-62	1065	5.5	-31	-0.3
May	32.4	733	538	196	1034	5.2	78	0.9
Jun	32.4	632	542	90	1112	6.0	31	0.3
Jul[1]	32.4	653	540	113	1143	***6.4***	39	0.4
Aug	27.6	548	515	33	1181	6.8	9	0.1
Sep	27.6	522	471	51	1191	6.9	15	0.2
Oct	27.6	496	465	31	1205	7.1	9	0.1
Nov	26.4	428	457	-29	1214	7.2	-10	-0.1
Dec	21.6	348	466	-118	1204	7.0	-43	-0.5
Jan	21.6	335	486	-151	1161	6.6	-64	-0.7
Feb	21.6	290	453	-163	1097	5.9	-69	-0.8
Mar	21.6	308	540	-232	1027	5.1	-115	-1.3
Apr					912	**3.8**		

[1]*Beginning of breeding period (approximately 83 days after calving)*
[2]DMI between Nov and Apr increased due to protein supplementation

Table 12: Daily dry matter intake (DMI), monthly net energy maintenance (NEm) consumed and required by a 1200 lb shrunk body weight cow calving 1 May, calf weaned 1 Jan and resultant changes in empty body weight (EBW) and body condition score (BCS).

Month	DMI[2] (lb/day)	Mcal NEm Consumed	Mcal NEm Required	Balance	EBW (lb)	BCS	Gain/Loss (lb)	+/- BCS
May	32.4	733	474	260	1065	5.5	103	1.1
Jun	32.4	632	554	78	1168	6.6	27	0.3
Jul	32.4	653	581	72	1195	6.9	25	0.3
Aug[1]	27.6	548	559	-11	1219	***7.2***	-4	0.0
Sep	27.6	522	507	15	1215	7.2	4	0.0
Oct	27.6	496	494	2	1220	7.2	1	0.0
Nov	26.4	428	454	-26	1220	7.2	-9	-0.1
Dec	26.4	426	471	-45	1211	7.1	-16	-0.2
Jan	21.6	335	464	-129	1194	6.9	-55	-0.6
Feb	21.6	290	434	-143	1139	6.3	-61	-0.7
Mar	21.6	308	497	-189	1078	5.6	-94	-1.0
Apr	21.6	324	511	-187	984	4.6	-107	-1.2
May					877	**3.4**		

[1]*Beginning of breeding period (approximately 83 days after calving)*
[2]DMI between Nov and Apr increased due to protein supplementation

Table 13: Daily dry matter intake (DMI), monthly net energy maintenance (NEm) consumed and required by a 1200 lb shrunk body weight cow calving 1 Jun, calf weaned 1 Feb and resultant changes in empty body weight (EBW) and body condition score (BCS).

Month	DMI[2] (lb/day)	Mcal NEm Consumed	Mcal NEm Required	Balance	EBW (lb)	BCS	Gain/Loss (lb)	+/- BCS
Jun	32.4	632	458	173	1065	5.5	69	0.8
Jul	32.4	653	563	89	1134	6.3	30	0.3
Aug	27.6	548	573	-25	1164	6.6	-11	-0.1
Sep[1]	27.6	522	525	-3	1154	***6.5***	-1	0.0
Oct	27.6	496	508	-11	1152	6.5	-5	-0.1
Nov	24.0	389	460	-72	1147	6.4	-30	-0.3
Dec	24.0	387	443	-56	1117	6.1	-24	-0.3
Jan	26.4	409	441	-32	1093	5.8	-16	-0.2
Feb	21.6	290	390	-100	1077	5.6	-50	-0.6
Mar	21.6	308	449	-141	1027	5.1	-70	-0.8
Apr	21.6	324	449	-125	957	4.3	-72	-0.8
May	30.0	679	500	179	885	3.5	93	1.0
Jun					979	**4.5**		

[1]*Beginning of breeding period (approximately 83 days after calving)*
[2]DMI between Nov and Apr increased due to protein supplementation

Running the same type of scenarios but starting at the beginning of breeding with the cows in BCS 5.5 at that time; meaning an energy supplement had to be provided the Feb calving cows prior to then, cow BCS by time of calving was 5.4, 4.2, 3.2, 2.4, and 4.2 for the Feb – Jun calving cows, respectively (Data not shown). Their respective BCS at the beginning of the next breeding season was 3.5, 4.6, 5.2, 5.8, and 5.8. This indicates that the Feb calving cows probably do need an energy supplement from at least calving to green grass and the Mar ones may also.

In the next installment we'll determine how much of the 30% crude protein range cubes is actually needed to satisfy the rumen microbe needs as well as if any additional is needed to ensure that the cow's needs are being met as well. We'll also determine how much energy, in the form of alfalfa and/or grass hay, needs to be supplied for those situations that call for it. Because hay, especially good quality alfalfa, contains crude protein, we'll need to adjust our range cube amounts accordingly.

As most know, Ranchers who have their cows calve in late winter and early spring generally do not have them out on open range but closer to home on smaller pastures. Because of this they need to feed them hay as there is not enough range forage to support them. So we will also determine how much hay is needed along with any protein supplementation for these situations.

I hope you have found this exercise interesting and are learning from it, I know that I am but find I have to discipline myself as to not worry about being too exact. We're dealing with living creatures and all are different and don't necessarily respond the same, so averages based on the best science available is all we can work with. My encouragement to Ranchers is to pay attention to your cows' body condition, especially during the last trimester of pregnancy and the post-partum period so you can provide them the nutrition they need to ensure successful breed back.

Appendix Table 1: Monthly maximum, minimum, and average temperatures at Buffalo, Wyoming (1971-2000), wind chill temperatures (WCT) based on average air temperatures and average wind speed of 10 mph, lower critical temperature (LCT) for beef cattle at different hair coat conditions[1], and differences between LCT and WCT.

	Average Monthly Temperatures (°F)					
Month	**Max**	**Min**	**Avg.**	**WCT (°F)**	**LCT (°F)**	**Difference**
Jan	33.0	7.3	20.2	8	18	10
Feb	38.0	13.0	25.5	13	18	5
Mar	46.7	22.4	34.6	23	18	
Apr	55.5	32.0	43.8	33	32	
May	64.9	41.0	53.0		45	
Jun	76.4	50.3	63.4			
Jul	84.0	56.2	70.1			
Aug	83.3	54.6	69.0			
Sep	71.6	43.4	57.5		45	
Oct	59.7	32.3	46.0	33	45	12
Nov	43.2	18.9	31.1	18	32	14
Dec	34.8	9.6	22.2	8	18	10

[1]Coat conditions (LCT): Wet or summer (59); Dry, fall (45); Dry, winter (32); and Dry, heavy winter (18).

Appendix Table 2: Wind chill temperatures based on air temperature and wind speed (Table 4-2, D.D. Simms, 2009).

Wind Speed (mph)	Air Temperature, Degrees F											
	-10	**-5**	**0**	**5**	**10**	**15**	**20**	**25**	**30**	**40**	**45**	**50**
Calm	-10	-5	0	5	10	15	20	25	30	40	45	50
5	-16	-11	-6	-1	3	8	13	18	23	33	38	43
10	-21	-16	-11	-6	-1	3	8	13	18	28	33	38
15	-25	-20	-15	-10	-5	0	4	9	14	24	29	34
20	-30	-25	-20	-15	-10	-5	0	4	9	19	24	29
25	-38	-32	-27	-22	-17	-12	-7	-2	2	12	17	22
30	-46	-41	-36	-31	-27	-21	-16	-11	-6	3	8	13
35	-60	-55	-50	-45	-40	-35	-30	-25	-20	-10	-5	0
40	-78	-73	-68	-63	-58	-53	-48	-43	-38	-28	-23	-18

Appendix Table 3: Increased net energy maintenance requirements for cattle per degree of coldness 1 (Table 4-4, D.D. Simms, 2009).

Coat condition	Cow Shrunk Weight (lb)			
	1000	**1100**	**1200**	**1300**
	Percentage increase per degree of coldness			
Summer or wet	2.0	2.0	1.9	1.9
Fall	1.4	1.3	1.3	1.3
Winter	1.1	1.0	1.0	1.0
Heavy winter	0.7	0.7	0.7	0.7

Appendix Table 4: Energy reserves (NE_{Δ}) for cows with different body sizes and condition scores.

Body Condition Score	Mature Shrunk Body Weight (lb) at Body Condition Score 5						
	900	**1000**	**1100**	**1200**	**1300**	**1400**	**1500**
	Mcal of NE_{Δ} required or provided for each condition score[1]						
2	114	126	139	151	164	177	189
3	129	143	157	172	186	200	214
4	147	163	180	196	212	229	245
5	170	188	207	226	245	264	283
6	198	220	242	264	286	308	330
7	234	260	285	311	337	363	389
8	280	311	342	373	405	436	467
9	342	380	418	456	494	532	570

Nutrient Requirements of Beef Cattle, NRC, 1996 (Appendix Table 13)

[1]Represents the energy mobilized to the next lower score, or required to move from the next lower score to this one. Each lb of SBW change contains 2.65 Mcal, and shrunk body weights (SBW) at CS 1 through 9 are 76.5, 81.3, 86.7, 92.9, 100, 108.3, 118.1, 129.9, and 144.3% of CS 5 weight, respectively. Thus, a 1200 lb BCS 5 cow would have a SBW of 918, 976, 1040, 1115, 1200, 1300, 1417, 1559, and 1732 lb for BCS 1 – 9, respectively. The difference in weight for this cow between BCS 5 and 6 is 100 lb. Dividing 264 Mcal (BCS 6) by 100 lb = 2.65 Mcal.

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