Brood Cow Performance In Western North Dakota: Drylot Phase

By

D.G. Landblom and J.L. Nelson

Introduction: Calf weaning weight, nutrient requirements of the cow and the overall cost of production are parameters affected by a cow's level of milk production, body condition, and mature body weight. Several investigations have been conducted to measure the interrelationship of cow size, maintenance requirements and calf weaning weight. They clearly show that energy requirements for maintenance are dependent on cow weight, and that as mature cow weight increases calf weaning weight also increases (Klosterman et al., 1968; Urick et al., 1971; Jeffrey and Berg, 1972; Miguel et al., 1972; Benyshek and Marlowe, 1973; Turner et al., 1974, NRC, 1984; Rode and Bowden, 1987).

Weaning weight can be raised by increasing mature body weight, increasing milking ability, or through a combination of both factors. Although selection for increased milk production among beef breeds results in heavier calves at weaning, infusing dairy blood into the beef herd is a more rapid method for increasing milk production (Cundiff, 1970). However, it is also associated with poorer reproductive performance when post partum energy levels are inadequate (McGinty and Frerichs, 1971; Halloway et al., 1975, and Wyatt et al., 1977). Rahnfeld and co-workers, in an evaluation of breed crosses maintained under two environments, reported that cows having the greatest milk yield were also identified as having below average weight of calf weaned per year. The reduction reported was due to reduced conception rates, high calf mortality and high cow losses during wintering. In their study, cows reared with insufficient energy intake sacrificed themselves to feed their calves. Loss of body condition put conception rates and winter survival in jeopardy.

Lactation status not only affects maintenance energy requirements, which are higher for cows of high milk production potential per unit of body weight than cows with low milk production potential (Ferrell and Jenkins, 1982), but it also increases forage intake of free ranging beef cows. Kronberg et al., (1986) found that the forage intake of lactating Hereford and Simmental x Hereford cross cows was 23% and 39% more, respectively, than their non-lactating counterparts.

Environmental differences under which beef cattle are raised in North Dakota vary widely from year to year, and within each year. In addition to dealing with environmental differences, cattlemen have a number of genetic options to choose from when deciding which genetic combination is best suited to their particular situation. The challenge for cattlemen therefore, is matching the genetic options available to them to the feed resources on their farms and ranches. This project is designed to help cattlemen in the decision making process, when evaluating cattle with varying production characteristics, by documenting the feed energy inputs necessary for cows with varying body weight and milking ability to reproduce and over winter successfully. Within the investigation there are three major relationships of importance: 1) the relationship between nutrition and reproduction, 2) the relationship between nutrition and total beef production, and 3) the relationship between grazing intensity and its affect on species composition, plant density change and overall carrying capacity.

The project is divided into two phases. Phase I is the drylot period when cows are confined and fed harvested feeds. Phase II is the grazing period . For the purpose of this progress report, only the drylot data will be reported and related to weaning weight.

Cow breed combinations being used to document energy inputs for western North Dakota were selected according to their expected mature body weight and milking ability, and are characterized as being light, medium and heavy for body weight, and low, medium and high for milking ability. The Hereford breed serves as the foundation and control breed and is characterized as being of medium body weight and low for milking production. Developed from the Hereford breed, the other breed combinations and categories are shown below:

Mature Body Weight	
Light:	Milking Shorthorn X Angus X Hereford (MSxAxH)
Moderate:	Hereford (H)
	Angus x Hereford (AxH)
Heavy:	Simental x Hereford (SxH)
Milking Ability	

Low:	Hereford (H)
Medium:	Angus x Hereford (AxH)
	Simental x Hereford (SxH)
High:	Milking Shorthorn x Angus x Hereford (MSxAxH)
*All combinations are terminally crossed to Charolais sires.	

Procedure: In 1986, the initial breed groups were fed long crested wheatgrass hay ad libitum and one pound of dry rolled barley per head daily during the gestation phase. As each cow calved she and her calf were weighed and transferred to postcalving lots where they were allowed free choice access to the complete mixed lactation ration shown in table 1. On May 21st the groups were moved to crested wheatgrass pasture, and then exposed to fertile Charolais bulls on June 1st. The breeding season was completed on July 31st.

In 1987, the cows grazed crop aftermath until December 14, 1986 when they were moved into drylot and started on the silage based gestation rations shown in table 2. The groups were maintained on the rations for a one week adjustment period before being weighed on two consecutive days. Weights from the two consecutive weighings were averaged and the gestation phase was started on December 22, 1986. As each cow calved, she and her calf were weighed and transferred to separate cow lots reserved for each breed after calving, and started on the complete mixed lactation ration shown in table 2. The groups were maintained on these rations until they were turned out on crested wheatgrass spring pasture April 30, 1987. The previous year, 30 percent of the MS x A x H cows were open at the end of the breeding season. Therefore, in 1987 eight pounds of dry rolled barley was fed per head during the first heat cycle of breeding to the higher lactating Milking Shorthorn and Simmental cross cow groups. Fertility tested Charolais bulls were with the cow groups from June 1st to August 1st.

In 1988, the groups were handled in much the same way as in 1987, but didn't graze crop aftermath as long. They were adjusted to the silage based gestation rations shown in table 3, and weighed on trial December 15, 1987. A longer drylot lactation period was needed in 1988 because of drought. Below normal spring precipitation and above normal temperatures combined to reduce crested wheatgrass growth substantially. The cow groups were turned out on crested wheatgrass on May 27, 1988 when suitable growth was attained. Feeding of eight groups (MS x A x H and S x H) began on May 27th also. Fertility tested Charolais bulls were with all groups from June 1st until August 15th. The breeding season was extended two additional weeks because of the prolonged high temperatures experienced during June and July.

In 1989, drought conditions also shortened crop aftermath grazing. The cow groups were adjusted to the drylot rations shown in table 4, and weighed on trial November 10, 1988, after two consecutive weighings. Spring turnout on crested wheatgrass and the feeding of barley flushing supplement to the two highest lactating groups (SxH and MSxAxH) both occurred on May 25, 1989. As in previous years, fertility tested Charolais bulls were put with the cows on June 1st and removed on August 15, 1989.

The experiment began in 1986 with an unequal number of cows in each breed group that were bred to Charolais. In all subsequent years the herds have been maintained at ten cows. Replacements for cows that have had to be removed from the study have been limited. Replacements are being made at two specific times during the production year. Cows that lose calves anytime before the start of the breeding season on June 1st are replaced with a comparable pair from a reserve gene pool. Those cows that are examined for pregnancy and identified as open at weaning are replaced with a comparable bred cow from the reserve pool when the winter feeding period is started.

Dry matter intake during gestation has been regulated based on body weight measurements taken biweekly. The breed groups are fed to gain approximately two pounds daily during the last trimester of pregnancy so that they will have a net gain after calving ranging from .2 and .4 tenths of a pound per day. The (H) and (A x H) groups are fed 22 pounds of dry matter as a basal ration, and the (MS x A x H) and (S x H) groups are fed 24 pounds of dry matter as a basal ration. Adjustments to the basal dry matter intake levels are made upward or downward based upon body weight changes at biweekly weighing, and are further adjusted for cold weather according to the following schedule: 15^{o}F (no adjustment), 0^{o}F (+9%), -15^{o}F (+18%), and -30^{o}F (+27%).

In this study, energy input is being measured in megacalories per pound of calf weaned per exposed cow and is obtained by charting the total calculated digestible energy consumed during gestation and lactation in drylot against the pounds of calf weaned from all exposed cows. Additional measurements include: 1) gestation and lactation body weight changes, 2) gestation and lactation dry matter feed consumption, 3) wintering economics, and 4) milking ability estimates at selected dates during the grazing season.

Milk production is estimated using the weigh-suckle-weigh method (Neville, 1962). The estimates are being made approximately mid June, late August, and late October of each year.

Statistical analysis was conducted with MSUSTAT (version 4.10).

Results and Discussion: Four of seven drylot wintering cycles scheduled for this long term investigation have been completed. Drylot wintering begins in mid December after the cow groups have completed grazing crop aftermath, and continues until approximately mid May when the breed groups are turned out on crested wheatgrass pasture. Starting and completion dates have varied each spring and fall in response to seasonal precipitation ands its affect on grazable forage. The summer grazing period on native range begins the third week of June each year, and is completed when pastures are sufficiently grazed based on clipping appraisals.

The Nutrient Requirements of Beef Cattle (1984) handbook currently recommends that dry pregnant mature beef cows weighing approximately 1100 pounds should consume 21.0 pounds of dry matter that contains 53.2% TDN, and it further recommends that 1200 pounds cows in the same stage of pregnancy consume 22.3 pounds of dry matter containing 52.9% TDN. Our past winter feeding experience indicates that NRC recommendations need to be adjusted upward approximately 10% to account for the more harsh environment of southwestern North Dakota. Rahnfeld and co-workers found in their work with ten breed crosses that NRC feeding standards needed to be adjusted upward an average 17% to account for the environmental differences encountered in Canada. In our study, we have found that each cow group has required feeding of a different level of dry matter in order to maintain body weight at or near the projected levels. The wintering and lactation rations fed are shown in tables 1, 2, 3 and 4, and a comparison of the levels of dry matter fed versus NRC recommendations is shown in table 5. The heaviest body weight (SxH) and the lightest body weight (MSxAxH) groups have been fed 8.2% and 13.9% above NRC standards, respectively, and experienced a slight weight improvement up to calving, as shown in table 6. The moderate body weight groups (H and AxH), were fed 9.1% and 5.7% above NRC standards, respectively, but had a slight weight loss up to calving. The values used appear to be sufficient for wintering provided that feed levels after calving contain adequate energy for lactation and body weight gain. Rations used during the short lactation period after calving, but before turnout on crested wheatgrass, have provided adequate energy for lactation and body weight gain. Gains for each body weight group are as follows: light weight (MSxAxH) .94, moderate weight (H) 1.13, moderate weight (AxH) .89, and heavy weight (SxH) .70. Feed intake to produce these gains during the short period between calving and turnout on spring pasture appears to be one of the keys to reproductive success.

Drylot costs for wintering and lactation are also shown in table 6. When combined, the total average wintering costs were as follows: light weight (MSxAxH) $171.11, moderate weight (H) $154.32, moderate weight (AxH) $165.00 and heavy weight (SxH) $175.78.

Table 7 contains a four year production summary. The highest milking ability groups (MSxAxH and SxH) had longer postpartum intervals, but the difference between them and the other two lower milking groups (H and AxH) were not significant.

Milking ability had a positive (P<.01) effect on weaning weight. The highest milking group (MSxAxH) produced calves that weighed 642.8 pounds, which was significantly heavier than the lowest milking ability group (H) that weaned calves averaging 578.2 pounds. Pounds of calf weaned per cow exposed is a measurement in part of reproductive failure. Therefore, the significant advantage measured for weaning weight is lost when reproduction is taken into account. Pounds of calf weaned per cow exposed to date are as follows: light weight (MSxAxH) 587.1 pounds, moderate weight (H) 547.8 pounds, moderate weight (AxH) 578.1 and heavy weight 588.7 pounds.

Feed costs per pound of calf weaned per cow exposed, which are also shown in table 7, were relatively close. Costs incurred to date per pound of calf weaned per cow exposed are $.2813 (H), $.2914 (MSxAxH), $.2829 (AxH) and $.2985 (SxH). Expressing these costs in term of net return over feed and processing makes the differences easier to understand. Table 8 shows a partial economic analysis in which feed and processing charges have been deducted from the gross returns per cow exposed. The moderate weight/moderate milking ability (AxH) group returned most the net dollars of $13,938.72. This was $402.22 more than the heavy weight/moderate milking ability (SxH) group that netted a total of $13,536.50. The light weight/high milking ability (MSxAxH) group returned $29.08

less, and the moderate weight/low milking ability (H) group returned $310.98 less than the highest returning (AxH) group.

Summary: There are three more production years and grazing data to be incorporated into this project before it is finalized. It is apparent, however, that while the cows used in this study represent only a small number of breeds and combinations available to select from in the beef industry, their diversity in terms of body weight and milking ability are manageable within the environment of southwestern North Dakota.

Literature Cited

Benyshek, L. L. and T. J. Marlowe. 1973. Relationship between Hereford cow weight and progeny performance. J. Anim. Sci. 37: 406.

Cundiff, L. 1970. Experimental results on crossbreeding cattle for beef production. J. Anim. Sci. 30:964.

Ferrell. C. L. and T. G. Jenkins. 1982 Efficiency of cows of different size and milk production. Germ Plasm Evaluation Program Progress Report No. 10. US-MARC, ARM-NC-24, pp 12.

Halloway, J. W., D. F. Stephens, J. V. Whiteman and R. Totusek. 1975. Performance of 3-year old Hereford x Holstein and Holstein cows on range and in drylot. J. Anim. Sci. 40:114.

Jeffrey, H. B. and R. T. Berg. 1972. An evaluation of several measurements of beef cow size as related to progeny performance. Can. J. Anim. Sci. 52:23.

Klosterman, E. W., L. G. Sanford and C. F. Parker. 1968. Effects of cow size and condition and ration protein content upon maintenance requirements of mature beef cows. J. Anim Sci. 27:242.

Kronberg, S. L., K. M. Havsted, E. L. Ayers and D. E. Doornbos. 1986. Influence of breed on forage intake of range beef cows. J. of Range Mgmt., Vol. 39 (5), pp 421.

Lund, R. E. 1988. MSUSTAT Statistical Analysis Package, Microcomputer version 4.10. Research and

Development Institute, Inc., Montana State University, Bozeman, Montana 59717-0002.

McGinty, D. D. and W. G. Frerichs. 1971. Milk yields and calf performance from crossbred and Hereford cows. J. Anim. Sci. 33: 210 (Abstr.)

Miguel, M. C., H. A. Fitzugh, Jr. and R. C. Thomas. 1972. Relationships between dam weight and progeny weight. J. Anim. Sci. 35:180 (Abstr.)

Neville, W. E. 1962. Influence on dam's milk production and other factors on 120- and 240-day weight of Hereford calves. J. Anim Sci. 21:315.

NRC. 1984. Nutrient Requirements of Domestic Animals. Nutrient Requirements of Beef Cattle Sixth Revised Ed. National Academy of Science - National Research Council, Washington, D. C.

Rahnefeld, G. W., Fredeen, H. T., G. M. Weiss, J. E. Lawson and J. E. Newman. Beef cow productivity under two environments in relation to winter feed inputs. Canada-Manitoba Economic and Regional Development Agreement, Technical Bulletin. Obtain from Information Officer at one of the following Agriculture Canada Research Stations: Brandon, Manitoba, R7A 5Z7, Lacombe, Alberta, T0C 1S0, or Lethbridge, Alberta, T1J 4B1.

Rahnefeld, G. W. Fredeen, H. T., G. M. Weiss, J. E. Lawson and J. E. Newman. Summer feed inputs, milk production and calf growth for ten beef breed crosses under two environments. Canada-Manitoba Economic and Regional Development Agreement, Technical Bulletin No. 12101.2. Obtain from Information Officer at one of the following Agriculture Canada Research Stations: Brandon, Manitoba, R7A 5Z7, Lacombe, Alberta, T0C 1S0, or Lethbridge, Alberta, T1J 4B1.

Rahnefeld, G. W. Fredeen, H. T., G. M. Weiss, J. E. Lawson and J. E. Newman. Beef cow reproduction in relation to cow weight and condition. Canada-Manitoba Economic and Regional Development Agreement, Technical Bulletin No. 12101.3. Obtain from Information Officer at one of the following Agriculture Canada Research Stations: Brandon, Manitoba, R7A 5Z7, Lacombe, Alberta, T0C 1S0, or Lethbridge, Alberta, T1J 4B1.

Rode, L. M. and D. M. Bowdon. 1987. Beef cow size and productive efficiency. Rangelands, Vol. 9 (1), pp 11.

Turner, H. A., G. B. Thompson and J.L. Clark. 1974. Cow size as related to energetic efficiency. J. Anim. Sci. 39:256 (Abstr.).

Urick, J. J., B. W. Knapp, J. S. Brinks, O. F. Pahnish and T. M. Riley. 1971. Relationship between cow weights in Angus, Charolais and Hereford breeds. J. Anim. Sci. 33:343.

Wyatt, R. D., K. S. Lusby, J. V. Whiteman, M. B. Gould and R. Totusek. 1977. Performance of 4- and 5-year old Hereford, Hereford x Holstein and Holstein cows on range and in drylot. J. Anim. Sci. 45:1120.

Table 1. Ration dry matter composition and ingredient cost per pound of dry matter. 1986

	Int'l. Feed Numb.	Dry Matter Ration %	Dry Matter Cost/Pound
Gestation:			
Crested Wheatgrass Hay	2-05-424	96.3	.025
Dry Rolled Barley	4-00-535	3.7	.037
Feeding Charge			.0025
		100.00	
Crude Protein:9.6%;Calcium: .38%; Phosphorous: .27%			
*Mineral Fed Free choice			
Lactation:			
Alfalfa	1-00-071	19.1	.0222
Crested Wheatgrass			

Hay	2-05-424	21.4	.025
Corn Silage	3-02-822	39.8	.01944
Dry Rolled Barley	4-00-535	13.1	.037
Sunflower Meal		5.9	.0584
Trace Mineral Salt	6-04-152	.35	.064
Dicalcium Phosphate	6-01-080	.35	.191
Processing			.0125
		100.00	
Crude Protein:11.0%; Calcium: .54%; Phosphorous: .38%			

Table 2. Ration of dry matter composition and ingredient cost per pound of dry matter. 1987.

	Int'l. Feed Numb.	Dry Matter Ration %	Dry Matter Cost/Pound
Gestation:			
Corn Silage	3-02-822	59.5	.01944
Oat Hay	1-03-276	39.7	.02108
Trace Mineral Salt	6-04-152	.51	.064
Dicalcium Phosphate	6-01-080	.29	.191
Processing			.0125

		100.00	
Crude Protein: 8.1%; Calcium: .45%; Phosphorous: .24%			
Lactation:			
Alfalfa	1-00-071	25.6	.0222
Corn Silage	3-02-822	46.4	.01944
Oat Hay	1-03-276	20.3	.02108
Barley Dist. Dry Grain	5-02-144	2.1	.050
Soybean Oilmeal	5-20-637	3.4	.1139
Trace Mineral Salt	6-04-152	1.1	.064
Dicalcium Phosphate	6-01-080	1.1	.191
Processing			.0125
		100.00	
Crude Protein: 10.7%; Calcium: .87%; Phosphorous: .43%			

Table 3. Ration dry matter composition and ingredient cost per pound of dry matter. 1988.

	Int'l. Feed Numb.	Dry Matter Ration %	Dry Matter Cost/Pound
Gestation:			
Corn Silage	3-02-822	57.9	.01944

Oat Hay	1-03-276	41.3	.02108
Trace Mineral Salt	6-04-152	.4	.064
Dicalcium Phosphate	6-01-080	.4	.191
Processing			.0125
		100.00	
Crude Protein: 8.1%; Calcium: .48%; Phosphorous: .26%			
Lactation:			
Alfalfa	1-00-071	24.3	.0222
Corn Silage	3-02-822	48.2	.01944
Oat Hay	1-03-276	20.5	.02108
Soybean Oilmeal	5-20-637	4.8	.1139
Trace Mineral Salt	6-04-152	1.1	.064
Dicalcium Phosphate	6-01-080	1.1	.191
Processing			.0125
		100.00	
Crude protein:10.7%; Calcium: .85%; Phosphorous: .44%			

Table 4. Ration dry matter composition and ingredient cost per pound of dry matter. 1989.			
	Int'l. Feed	Dry Matter	Dry Matter

	Numb.	Ration %	Cost/Pound
Gestation:			
Corn Silage	3-02-822	47.4	.04
Alfalfa Hay	1-00-071	17.6	.05
Alfalfa Cubes	1-00-063	9.1	.05
Oat Straw	1-03-283	18.2	.025
D. R. Barley	4-00-549	6.9	.04792
Sod. Phosphate (XP-4)	6-04-287	.36	.4306
Trace Mineral Salt	6-04-152	.43	.065
Vitamin A, D & E		.027	.4534
Processing			.0125
		100.00	
Crude Protein: 8.4%; Calcium: .51%; Phosphorous: .26%			
Lactation:			
Corn Silage	3-02-822	55.7	.04
Alfalfa Hay	1-00-071	21.6	.05
Alfalfa Cubes	1-00-063	9.8	.05
D.R.Barley	4-00-549	12.1	.04792
Sod. Phosphate (XP-4)	6-04-287	.38	.4306
Trace Mineral Salt	6-04-152	.40	.065
Vitamin A, D & E		.027	.4543

Processing			.0125
		100.00	
Crude protein: 9.6%; Calcium: .54%; Phosphorous: .29%			

Table 5. Daily feed allowance per cow in relation to NRC standards. 1986-1989.				
Body Wt.	Light	Moderate		Heavy
Breed	(MSxAxH)	(H)	(AxH)	(SxH)
Gestation:				
Actual, Lbs.	24.6	23.9	24.0	25.1
NRC	21.6	21.9	22.7	23.2
% above NRC	13.9%	9.1%	5.7%	8.2%
Lactation:				
Actual, Lbs.	32.4	28.0	31.3	33.5
NRC	23.2	23.1	24.0	24.7
% above NRC	39.7%	21.2%	30.4%	35.6%
Total Combined Digestible Energy, Mcal.	5063.0	4792.0	4976.3	5245.9

Digestible Energy/Pound of Calf Weaned, Mcal	8.62	8.75	8.61	8.91

Table 6. Four year mean gestation and lactation gain, dry matter feed consumption and partial economics. 1986-1989.

Body Weight	Light	Mod	Mod	Heavy	
Breed	(MSxAxH)	(H)	(AxH)	(SxH)	SE
Gestation:					
No. Head	40	38	40	37	
Days Fed	107.2	100.2	96.7	103.9	
Initial Wt., Lbs.	1154	1176	1229	1267	
Calving Wt., Lbs.	1163	1157	1210	1271	
Wt. Change, Lbs.[4]	9[a]	-19[a]	-19[a]	4[a]	10.78
ADGain or Loss, Lbs.	.08	-.15	-.20	+.04	
Gestation Economics:					
DM Feed, Lbs.	2640	2391	2320	2610	
DM Feed/Hd/Day., Lbs.	24.6	23.9	24.0	25.1	
Feed Cost/Lb. of DM, $	.0367	.0366	.0366	.0368	
Feed Cost/Hd., $	96.89	87.51	84.91	96.05	
Feed Cost/Hd/Day, $	.90	.87	.88	.92	
Lactation:					
No. Head	39[2]	37[1]	40	36[3]	

Days Fed	49.1	54.2	58.1	51.2	
Calving Wt., Lbs.	1163	1154	1216	1259	
Spr. Turnout Wt., Lbs.	1209	1215	1267	1295	
Gain, Lbs.[4]	46[a]	61[a]	51[a]	36[a]	14.59
ADG After Calving, Lbs.	.94	1.13	.89	.70	
Lactation Economics:					
DM Feed/Hd., Lbs.	1590	1515	1816	1715	
DM Feed/Hd/Day., Lbs.	32.4	28.0	31.3	33.5	
Feed Cost/Lb. of DM, $	.0441	.0441	.0441	.0441	
Feed Cost/Hd., $	70.12	66.81	80.09	75.63	
Feed Cost/Hd/Day, $	1.42	1.23	1.38	1.48	
Combined Wtr. Costs:					
Gestation Cost, $	96.89	87.51	84.91	96.05	
Lactation Cost, $	70.12	66.81	80.09	75.63	
Flushing Feed, $	4.10	---	---	4.10	
Total Average Wintering Cost, $	171.11	154.32	165.00	175.78	

1One cow removed
[2]One cow removed
[3]One cow removed
[4]Values unlike superscripts differ significantly (P<.01).

Table 7. Four year mean production summary. 1986-89.					
Breed	(MSxAxH)	(H)	(AxH)	(SxH)	SE
Body Wt. Category[1]	Light 1258 Lb.[a]	Mod 1294 Lb.[ab]	Mod 1320 Lb.[c]	Heavy 1352 Lb.[c]	15.05
Milking Ability Category[1]	High 16.0 Lb.[c]	Low 10.5 Lb.[a]	Med 12.7 Lb.[ab]	Med 14.6 Lb.[bc]	.6177
No. Exposed	38	37	38	37	
No. Exposed That Weaned A Calf	35	35	36	35	
Weaning Percent	92.1%	94.6%	94.7%	94.6%	
Postpartum Interval, Da.[1]	85.5[a]	80.9[a]	84.7[a]	90.9[a]	3.138
Total Lbs. of Calf Weaned From Exposed Cows[1]	24,426 (642.8)[b]	21,394 (578.2)[a]	23,333 (614.0)[ab]	23,026 (622.3)[ab]	13.35
Lbs. of Calf Weaned/Cow Exposed[1]	22,308 (587.1)[a]	20,270 (547.8)[a]	21,966 (578.1)[a]	21,783 (588.7)[a]	27.62
Wintering Cost/Lb. of Calf Weaned/Cow Exposed	$.2914	$.2813	$.2829	$.2985	
1Values with unlike superscripts differ significantly (P<.01).					

Table 8. Partial economic model estimating net returns for each of the body weight groups.[1]

Body Weight Class	Light	Moderate	Moderate	Heavy
Breed	(MSxAxH)	(H)	(AxH)	(SxH)
Total Lbs. of Calf Weaned From Exposed Cows	22,308	20,270	21,966	21,783
Gross Return/Cow Exposed, $ (Mkt. Value/cwt.)[2]	$20,411.82 ($91.50)	$19,337.58 ($95.40)	$20,208.72 ($92.00)	$20,040.36 ($92.00)
Less Total Wintering Cost, $	-$6,502.18	-$5,709.84	-$6,270.00	-$6,503.86
Net Return, $	$13,909.64	$13,627.74	$13,938.72	$13,536.50

1This partial economic model includes direct costs for feed and processing only. No other variable or fixed costs are included.

2Market value is the three year average for years 1988-89 & 90 during September and October at Dickinson, North Dakota.