

New Zealand Society of Animal Production online archive

This paper is from the New Zealand Society for Animal Production online archive. NZSAP holds a regular annual conference in June or July each year for the presentation of technical and applied topics in animal production. NZSAP plays an important role as a forum fostering research in all areas of animal production including production systems, nutrition, meat science, animal welfare, wool science, animal breeding and genetics.

An invitation is extended to all those involved in the field of animal production to apply for membership of the New Zealand Society of Animal Production at our website www.nzsap.org.nz

[View All Proceedings](#)

[Next Conference](#)

[Join NZSAP](#)

The New Zealand Society of Animal Production in publishing the conference proceedings is engaged in disseminating information, not rendering professional advice or services. The views expressed herein do not necessarily represent the views of the New Zealand Society of Animal Production and the New Zealand Society of Animal Production expressly disclaims any form of liability with respect to anything done or omitted to be done in reliance upon the contents of these proceedings.

This work is licensed under a [Creative Commons Attribution-NonCommercial-NoDerivatives 4.0 International License](http://creativecommons.org/licenses/by-nc-nd/4.0/).



You are free to:

Share— copy and redistribute the material in any medium or format

Under the following terms:

Attribution — You must give [appropriate credit](#), provide a link to the license, and [indicate if changes were made](#). You may do so in any reasonable manner, but not in any way that suggests the licensor endorses you or your use.

NonCommercial — You may not use the material for [commercial purposes](#).

NoDerivatives — If you [remix, transform, or build upon](#) the material, you may not distribute the modified material.

<http://creativecommons.org.nz/licences/licences-explained/>

Nutritional buffering: Do we make the best use of this phenomena in the breeding cow

A.B. PLEASANTS, R.A. BARTON¹ AND D.G. McCALL

Whatawhata Research Centre, Private Bag 3089, Hamilton, New Zealand.

ABSTRACT

The nutritional buffering capacity of the beef cow, defined as the ability to absorb low levels of feeding without compromising productivity, is reviewed in regard to winter management. It is shown that resistance to liveweight loss is repeatable for cows within the same herd between years (correlations 0.4 to 0.8, $P < 0.01$). However this capacity is associated with lower calf weaning weight (correlations 0.3 to 0.5, $P < 0.05$). There was no association between the amount of winter liveweight loss and cow liveweight, calf birth weight or time to first oestrus in the cow. It is shown that these results are consistent with evidence for the variation of maintenance requirements between cows.

It is suggested that the buffering capacity of the beef cow could be exploited through animal breeding or by management of early nutrition. There may be no one cow type which is optimal for all farming situations, and instead a range of cow types which are more or less able to buffer feed shortages may be preferred.

Keywords: beef cow; winter nutrition; maintenance variability.

INTRODUCTION

Nutritional buffering is defined as the ability of an animal such as the breeding cow to cope with a range of nutrition levels while maintaining productivity. This is a valuable attribute in an animal farmed on New Zealand hill country where variability of pasture supply can be a problem particularly in the winter and spring. The spring calving breeding cow can be used to absorb the effects of low fluctuations in winter pasture growth by underfeeding when this happens. This attribute of the cow can be used to buffer other enterprises on a farm, such as finishing cattle (Pleasant *et al.*, 1991).

Cows calving in the spring can lose liveweight over the winter without significantly affecting productivity (Hight, 1968; Nicoll, 1979). This depends on cows gaining sufficient liveweight in the summer and autumn if the strategy is to be used every year. The ability of the cow to consume large amounts of pasture in the late spring is an asset in controlling surplus pasture and maintaining quality in hill pastures where conservation is not possible (Sheath *et al.*, 1984).

Profitability on most sheep and beef farms in New Zealand is set by winter carrying capacity. In this context a cow which can withstand undernutrition is valuable since the winter carrying capacity of the farm can be increased.

This paper examines variation in the ability of a beef cow to withstand a period of winter undernutrition. We present some results which show that cows differ in their degree of winter liveweight loss when offered the same amount of pasture. Furthermore these differences are repeatable between years. However, the ability of a cow to resist liveweight loss is associated with low calf weaning weight. In the discussion

we show that these results are consistent with work on variation in maintenance requirements.

MATERIALS AND METHODS AND RESULTS

To examine the capacity of cows to buffer winter liveweight loss, data were used from a series of trials that investigated the effect of winter feeding levels on the productivity of spring calving cows (Morris *et al.*, 1978; Pleasants and Barton, 1979; 1985; 1992; Anderson *et al.*, 1981; 1985). Three groups of mixed age cows which had experienced similar winter liveweight loss in adjacent years were identified. Group 1 (1976/1977) 18 cows, group 2 (1978/1979) 63 cows, and group 3 (1980/1981) 45 cows.

Table 1 shows the average winter liveweight loss of these cows and the correlations between winter liveweight loss in successive years, as well as the relationship between cow winter liveweight loss and calf weaning weight.

There are significant ($P < 0.01$) positive correlations between winter liveweight loss in successive years (Table 1). Cows which lose more than the average winter liveweight in one year tend to lose more than the average liveweight in the succeeding year.

There were also significant ($P < 0.05$) relationships between cow winter liveweight loss and calf weaning weight (corrected for sex and birthdate). Cows which weaned heavy calves tended to lose more liveweight over winter. However, there was no relationship between cow winter liveweight loss and calf birthweight.

There was no relationship between the autumn liveweight of the cow (before winter liveweight loss) and the amount of winter liveweight loss. Neither was there any relationship between the

¹Department of Animal Science, Massey University, Palmerston North, New Zealand.

TABLE 1: Correlations between the amount of cow liveweight loss in subsequent winter periods (1 May to 30 June), and correlations between cow winter liveweight loss and calf weaning weight.

	Herd 1 1976	Herd 2 1978	Herd 3 1980
Number of cows	18	63	45
Winter liveweight loss kg \pm standard deviation	80 \pm 14.5	72 \pm 18.7	41 \pm 19.0
Correlation between liveweight loss in adjacent years	0.57**	0.76**	0.39**
Correlation between cow live- weight loss and calf weaning weight	.50**	0.25*	0.29*
Regression of calf weaning weight on cow liveweight loss ¹ kg/kg	0.28	0.20	0.32

**P < 0.01

*P < 0.05

¹Regression estimates in this case where the independent variable (cow liveweight loss) has high error variance are inconsistent. These estimates are to serve as a guide to the relative magnitudes of the relationships only.

winter liveweight loss of the cow and her calving date, or the length of her post partum anoestrus period after calving.

DISCUSSION

Winter Nutritional Buffering Capacity

Within herd, variation in liveweight loss during the winter may be due to a number of factors. Some cows may be more efficient foragers than others, or some cows may select diets which enable them to maintain liveweight for longer. However, the circumstances in which the above cows were grazed during the winter would give them little scope to express such variation. Cows were grazed at 25 animals/ha on pastures previously grazed by 300 ewes/ha. A third option is that cows vary in their maintenance requirements.

Early theories on the energy required for maintenance related maintenance to liveweight raised to some power (0.70 to 0.75). This was based on empirical adjustments to a theory which suggested maintenance should be related to heat loss through the surface of a cylindrical body representing an animal (Blaxter, 1962; Brody, 1945). Recent work has shown this model to be too crude. Ferrill and Jenkins (1985) argue that the maintenance requirement of a cow depends on the amount of metabolically active tissue (heart, liver, digestive tract, kidneys etc.). Cow liveweight could be a poor approximation to this measure.

At a constant liveweight, maintenance requirements may change with body condition, growth rate, sex, climate and lactation potential (Ferrill and Jenkins, 1985; Jenkins *et al.*, 1991; Frisch and Vercoe, 1977). Cows which grow faster, or which have a higher potential to produce milk (eg. dairy type cows) have higher maintenance requirements when compared at the same liveweight (Taylor *et al.*, 1986). Our results show that cows which lose more liveweight over the winter wean heavier calves while the birth weight of these calves is unaffected. This is consistent with the evidence of Taylor *et al.*, (1986) if differences in cow liveweight loss are due to differences in maintenance requirements which in turn

are related to cow milk production and calf weaning weight. A further factor to consider is that cows appear to adapt to low winter nutrition. Thus Hughes *et al.*, (1978) reported that in a lifetime trial Hereford cows on a low plane of winter nutrition (liveweight loss 14% of autumn liveweight) outperformed cows on a higher plane of winter nutrition (liveweight loss 9% of autumn liveweight) after the 4th year. Specifically, the weaning weight of the calves from the low plane cows were higher and cow losses were lower, while reproductive performance was the same in both groups. Similar results were reported by Pope (1967), McCormick (1967), Hight (1968), Lamm and Meacham (1967) and Anderson *et al.*, (1985). These trials imply that the ability of the beef cow to buffer low winter nutrition increases with experience of low winter nutrition. Investigations which show that maintenance requirements are reduced by a history of low nutrition (Ferrill and Jenkins, 1985; Taylor *et al.*, 1986; Jenkins and Ferrill, 1983) would be consistent with this effect.

There is an interesting dichotomy in the between year/herd and the within year/herd response to cow winter liveweight loss. Within herd and year (meaning cows with the same nutritional history), cows in the herd which resist liveweight loss are less productive. That is they wean calves with lower liveweights. But between herd and year (meaning cows with different nutritional history), cows which experience liveweight loss adapt resistance to this liveweight loss and become more productive. This suggests that difficulties may arise in interpreting aspects of cow efficiency without information on nutritional history.

Spring and Summer Nutritional Buffering Capacity

The ability of cows to gain liveweight rapidly once pasture supply increases in the spring has long been known (Hight, 1968; Bircham, 1977). Herds which lose most liveweight during the previous winter and early spring appear to have greater intakes (Smeaton *et al.*, 1983). This represents a means of controlling surplus pasture mass, therefore maintaining quality in hill country pastures where conservation is not possible (Sheath *et al.*, 1984; McCall *et al.*, 1988). Since cows usually recover the liveweight lost during winter, it is possible that cows within a herd which lose more winter liveweight and wean heavier calves are more desirable from an efficiency perspective. Alternatively, a farm subject to uncertain winter feed supplies may favour cows which are resistant to winter liveweight loss; since a higher stocking rate could be managed with less risk. The concept that no one type of cow is optimal in all environments, and that a range of options should be available in animal breeding plans has been put forward by Frisch and Vercoe (1978).

CONCLUSION

The beef cow has a large contribution to make to assist the stability, sustainability and flexibility of many farming systems. However, it is not clear which is the best cow type. Different farms may have different preferred cow types. The source of resistance to winter liveweight loss for cows within a herd has not been established. While we have suggested that variation in maintenance requirements is a factor this evi-

dence is circumstantial. The potential which could be exploited if variation existed in maintenance requirements between cows of the same liveweight was recognised by Dickerson (1978) and Fitzhugh (1978). If maintenance requirements are associated with buffering capacity, animal breeding plans which aim to reduce the maintenance requirements of the cow may lead to reduced calf production. Further investigations are needed to determine the optimum balance between winter buffering ability and cow productivity for New Zealand conditions.

ACKNOWLEDGEMENTS

Mr. D.R. Patterson was responsible for the collection and management of the data used in the analysis.

REFERENCES

- Anderson, W.J., Pleasants, A.B., Barton, R.A. 1981. Effect of plane of nutrition on calf birth weight, calf growth rate, and subsequent performance of Angus heifers calving in the spring. *New Zealand Journal of Agricultural Research* **24**: 269 - 275.
- Anderson, W.J., Barton, R.A., Pleasants, A.B. 1985. Influence of autumn liveweight during pregnancy on post-partum liveweight of Angus heifers and their spring born calves. *New Zealand Journal of Experimental Agriculture* **13**: 225-229.
- Blaxter, K.L. 1962. The energy metabolism of ruminants. Published Hutchinson. London. 329pp.
- Bircham, J.S. 1977. Grazing management for the improvement of browntop pastures in hill country: A programme. *Proceedings of the New Zealand Grassland Association* **38**: 87-93.
- Brody, S. 1945. Bioenergetics and growth. Published Reinhold. New York 1023pp.
- Dickerson, G.E. 1978. Animal size and efficiency. *Animal Production* **27**: 367-379.
- Ferrill, C.L. and Jenkins, T.G. 1985. Cow type and the nutritional environment: Nutritional aspects. *Journal of Animal Science* **61**: 725-741.
- Fitzhugh, H.A. 1978. Animal size and efficiency with special reference to the breeding female. *Animal Production* **27**: 393.
- Frisch, J.E. and Vercoe, J.E. 1977. Food intake, eating rate, weight gains, metabolic rate and efficiency of feed utilisation in *Bos taurus* and *Bos indicus* crossbred cattle. *Animal Production* **25**: 343-358.
- Jenkins, T.G. and Ferrill, C.L. 1983. Nutrient requirements to maintain weight of mature nonlactating nonpregnant cows of four diverse breed types. *Journal of Animal Science* **56**: 761-770.
- Jenkins, T.G. Cundiff, L.V., Ferrill, C.L. 1991. Differences among breed crosses of cattle in the conversion of food energy to calf weight during the preweaning interval. *Journal of Animal Science* **69**: 2762-2769.
- Hight, G.K. 1968. A comparison of the effects of three nutritional levels in late pregnancy on beef cows and their calves. *New Zealand Journal of Agricultural Research* **11**: 477-486.
- Hughes, J.H., Stephens, D.F., Lusby, K.S., Pope, L.S., Whiteman, J.V., Smithson, L.J., Totusek, R. 1978. Long-term effects of winter supplement on growth and development of Hereford range females. *Journal of Animal Science* **47**: 816-827.
- Lamm, W.D. and Meacham, T.N. 1979. Performance of Angus and Angus x Holstein cows wintered at two energy levels. *Journal of Animal Science* **49**: 385. Abstract.
- McCall, D.G., Scott, M.L., Dow, B.W. 1988. Calf weaning and summer grazing strategies for efficient beef cow use on hill country. *Proceedings of the New Zealand Society of Animal Production* **48**: 237-242.
- McCormick, W.C. 1967. Breeding of cow and plane of nutrition. In Factors affecting calf crop. Edited Cunda, T., Warnick, A., Kroger, M. Published University of Florida. 376pp.
- Morris, S.T., Pleasants, A.B., Barton, R.A. 1978. Post-partum oestrus interval of single-suckled Angus beef cows. *New Zealand Journal of Agricultural Research* **21**: 577-582.
- Nicoll, G.B. 1979. The influence of pre and post calving pasture allowance on hill country beef cow and calf performance. *New Zealand Journal of Agricultural Research* **22**: 417-424.
- Pleasants, A.B. and Barton, R.A. 1979. Post-calving nutrition of single-suckled Angus beef cows. *New Zealand Journal of Agricultural Research* **22**: 1-7.
- Pleasants, A.B., Barton, R.A., Batley, P.J. 1991. The role of beef breeding cows in strategic management of feed supply under pasture variability. *Proceedings of the New Zealand Grassland Association* **53**: 145-149.
- Pleasants, A.B. and Barton, R.A. 1985. Pre-calving nutrition of Angus beef breeding cows. *New Zealand Journal of Experimental Agriculture* **13**: 231-234.
- Pleasants, A.B. and Barton, R.A. 1992. Effects of different rates of liveweight change from 60 days before calving on the productivity of mature Angus breeding cows. *New Zealand Journal of Agricultural Research* **35**: 199-204.
- Pope, L.S. 1967. Winter feeding and reproduction. In Factors affecting calf crop. Edited Cunda, T., Warnick, A., Kroger, M. Published University of Florida. 376pp.
- Sheath, G.W., Webby, R.W., Pengelly, W.J. 1984. Management of late spring, early summer pasture surpluses in hill country. *Proceedings of the New Zealand Grassland Association* **45**: 199-206.
- Smeaton, D.C., McCall, D.G., Wadams, T.K. 1983. Effects of pasture allowance level after calving on performance of beef cows on hill country. *New Zealand Journal of Experimental Agriculture* **11**: 303-308.
- Taylor, St. C.S., Thiessen, R.B., Murray, J. 1986. Interbreed relationship of maintenance energy to milk yield in cattle. *Animal Production* **43**: 37-61.