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Management of reproduction in Scottish suckler herds.

Alistair W. Stott[ac], George J. Gunn[b] and Antonio Varo Barbudo[a]

[a]Land Economy and Environment Research Group, Scottish Agricultural College, King's Buildings, West Mains Road, Edinburgh, Scotland EH9 3JG.

[b]Epidemiology Unit, Scottish Agricultural College, Drummond Hill, Stratherrick Road, Inverness, IV2 4JZ

[c]Corresponding author, email: alistair.stott@sac.ac.uk

Abstract

A survey of the management of reproduction on 66 Scottish suckler herds calving in spring 2003 was analysed using multiple regression. The predicted mean value of suckled calves produced was £237/cow (SE 1.8). The regression coefficients of the predictors was 0.74 (0.05), 15 (3.9) and 248 (16.5) for date of first calving, average number of 21-day calving periods (calving spread) and proportion of cows barren respectively. Improving each predictor by 1 SD had the combined potential to improve predicted calf value by £64/cow, over 80% of the current typical gross margin for this type of enterprise. Bull care had a significant influence on calving spread and number of biosecurity measures taken had a positive influence on the proportion of cows barren. However, length of breeding season had no significant impact on the above predictors. Reproductive performance was highly variable and indicators were considerably poorer than published targets. It was concluded that farmers in this sample were not managing their herds for high reproductive performance and output as often advocated. This result suggests considerable scope for improved private and public benefits from the management of reproduction in this type of beef production system.

Keywords and JEL codes (if available)

Beef cow, fertility, economics, management

Introduction

Finished cattle and calves represented over 21% of agricultural output in Scotland in 2006 (Scottish Executive, 2007), the largest sector. Much of this output depends on suckler (cow-calf) herds rearing beef breeds in traditional extensive systems. Such herds contribute to the attributes associated with the high quality 'Scotch meat' brands on which Scottish agriculture increasingly depends (Quality Meat Scotland, 2007). They are also instrumental in the drive for sustainable rural development, protection and enhancement of the environment and improved animal health and welfare, all components of the Scottish Government's vision for Scotland's farming industry (Scottish Executive, 2006). However, these farms are often situated in disadvantaged areas where costs of production are relatively high. Their viability is therefore particularly threatened by reform of the Common Agricultural Policy introduced in 2005, which removed many of the production-linked subsidies that insulated these enterprises from competitive markets (Oglethorpe, 2005).

Despite the importance and vulnerability of Scottish suckler herds, few studies have been made of the management practices that under pins their technical performance. A postal survey was therefore conducted in 2004 of a stratified random sample of 720 Scottish cattle farms (Varo Barbudo, 2005). The survey focused on the management of reproduction as this process offers great scope for improvement in profitability (Riddell and Caldow, 2007). It also governs the timing and pattern of calving over multiple cycles thus affecting the enterprise's impact on the environment and on animal health and welfare.

Most of the herds responding to the survey of Varo Barbudo (2005) operated spring calving systems. This paper explores the relationship between the management of reproduction in these 66 herds, their reproductive performance and the output of suckled calves per cow, which is the most important parameter for measuring production efficiency in beef cow herds (Caldow et al., 2005). The aim was to establish the nature of and scope for improvements in efficiency and hence estimate the potential viability of these herds in future. Such information will help to predict and guide the development of quality beef farming in Scotland and its roles in food production and environmental management.

Methods

Data about reproductive performance and important aspects of the management of fertility during the calving year 2003 were collected via a postal survey in early spring 2004. A stratified random sample of 720 cattle farms was obtained from the census branch of the then Scottish Executive Environmental and Rural Affairs Department (SEERAD). The stratification involved the 4 agricultural regions (North East, Highlands and Islands, South West and East of Scotland) defined by SEERAD. There was further stratification by farm size. Farms with fewer than 40 cattle were excluded since small herds were unlikely to yield the data required. The six remaining classes for herd size were based on the SEERAD categories for cow number: 40-59, 60-79, 80-99, 100-149, 150-199, and 200-over (Scottish Executive, 2003). Farmers were given a period of 3 weeks to complete and return the questionnaire. Non-respondents were sent a further copy of the questionnaire.

A summary of the questionnaire and the full survey instrument may be found in Varo Barbudo (2005) and is available from the corresponding author on request. It contained eight sections, A to G: on the farm business, breeding, calving distribution, culling policy, feeding, biosecurity, and bull management respectively. Respondents were asked to record the date(s) when bulls were put to the cows and the number of cows subsequently calving in each of 4 consecutive 21-day intervals, starting from the date when the first calf was born. Calvings were classified as either spring (bulls out in summer 2002) or autumn (bulls out in winter 2002).

Based on the date of first calving and from this the mid-point date of each calving period, the average weight of suckled calves available for sale on a set date (16th October 2003) was predicted for each farm using the growth model of Naazie et al. (1997). Parameters used in this model were as derived by Varo Barbudo (2005). These weights were multiplied by a typical price of £1.20/kg liveweight (SAC, 2007) to give a calf value per cow put to the bull (CVAL). The relative importance of reproductive performance parameters (RPP); date of first calving (DOB1), average calving period number (calving spread, AVCP) and proportion of barren cows put to the bull (PBARREN) was assessed by multiple linear regression on CVAL. The four regions of Scotland were also declared as a factor in the regression model and various parameters of farm size (see Table 1) fitted. The effect of +1 standard deviation change in these reproductive performance parameters on CVAL was then predicted using the regression equation. All statistical analyses were conducted using 'Genstat' (Lawes Agricultural Trust, 2005).

To link the RPPs to management actions, a further set of regression analyses were carried out. This time the dependent variable was an RPP and the independent variables were drawn from a set of management actions and farm parameters derived from responses to the survey of Varo Barbudo (2005). Farm region was again also included as a factor. These independent variables were fitted sequentially to the model using a stepwise regression methodology to arrive at a final model that provided a high adjusted R^2 statistic without addition of excessive non-significant terms at the margin that provided little further improvement in adjusted R^2. The full set of independent variables used is listed in table 1.

Table 1 Independent variables used in the second regression analysis

Variable description	Units	Label
1. Farm area	Ha	AREA
2. Grazing area	Ha	GAREA
3. Number of cows and heifers put to bull		COWS
4. Number of other enterprises on the farm	0 to 10	ENTERPRISES
5. Do you hire casual labour?	Y/N	CLAB
6. Number of full and part time employees	FTE	LAB
7. Number of culled females		CULL
8. Females culled for infertility	Y/N	CULLFERT
9. Replacements home bred?	Y/N	REPLH
10. Number of herd condition monitor/feed assessments*	0 to 4	MONITOR
11. Number of biosecurity measures taken*	0 to 7	BIOSEC
12. Number of bull checking measures*	0 to 5	BULLCARE
13. Date bull introduced to cows	Day	BULLIN
14. Breeding season length (time bull with cows)	Days	BSL
15. Region factor:		REGION
Highlands and Islands	1	
North East Scotland	2	
South West Scotland	3	
East Scotland	4	

*See Varo Barbudo (2005) for details.

Results

There was a 36% response rate to the 720 questionnaires delivered, of which 106 were usable. The distribution of usable responses by region was: 21% North East, 36% Highlands and Islands, 17% South West, and 26%, East of Scotland. Of the usable responses, only 6 had exclusively autumn calving herds, a further 2 appeared to be operating year round calving policies and 32 had both spring and autumn calving herds. As these small subgroups were likely to have particular reproductive management strategies they were excluded from this analysis. This left 66 herds that were exclusively spring calving. Summary statistics for these herds are given in Table 2. The geographical distribution of survey herds is shown in Figure 1.

Figure 1: *Distribution of the 106 survey herds returning useable results. Spring calving herds used in this analysis are labelled with: •*

Table 2 Summary statistics for 66 spring calving suckler herds calving in 2003.

Variable description	Mean*	SD	Median
1. Farm area (Ha)	330	985	124
2. Grazing area (Ha)	121	171	73
3. Number of cows and heifers put to bull	63	72	39
4. Number of other enterprises on the farm	1.8	1.0	2
5. Do you hire casual labour? (Prop.)	0.3		
6. Number of full and part time employees	0.8	1.4	2.4
7. Number of culled females	6.9	10.3	3
8. Are any females culled for infertility?	0.41		
9. Are replacements home bred?	0.38		
10. Number of herd condition monitor/feed assessments	2.1	1.4	2
11. Number of biosecurity measures taken	2.9	1.7	3
12. Number of bull checking measures	2.7	1.0	3
13. Date bull introduced to cows	99	43	87
14. Breeding season length (time bull with cows, days)	124	46	123
15. Region factor:	Counts:		
Highlands and Islands	31		
North East Scotland	16		
South West Scotland	12		
East Scotland	7		

*Mean or in the case of binomial variables, the proportion of affirmative answers
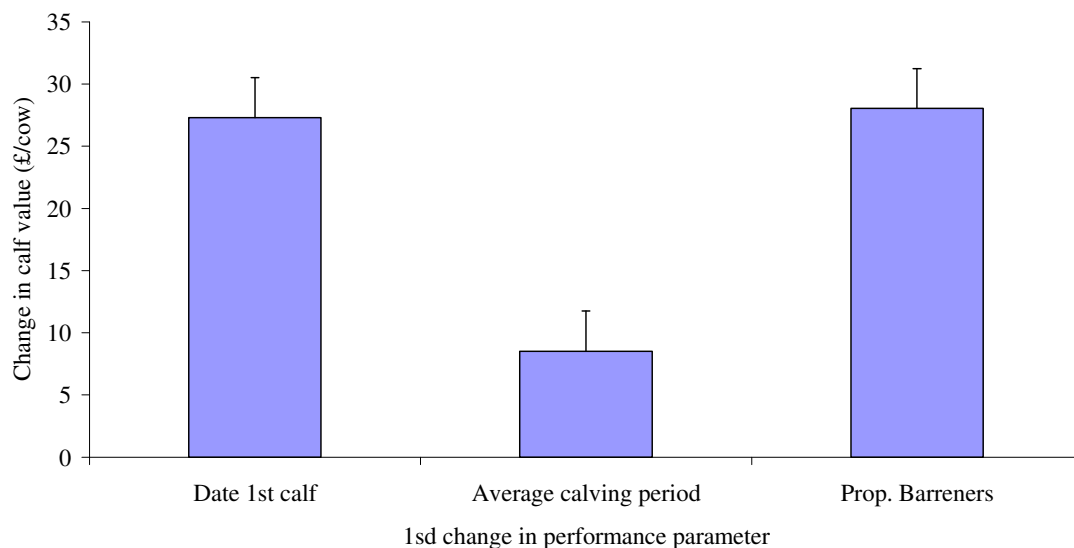
The regression equations for the RPPs on CVAL were as follows (standard errors in brackets):

$$CVAL = 341 - 0.74*DOB1 - 15*AVCP - 248*PBARREN$$
$$\quad\quad (1.0) \quad (0.05) \quad\quad (3.9) \quad\quad\quad (16.5)$$

The adjusted R^2 was 87% and the standard error of observations 15.2. Fitting REGION or any scale parameter gave no improvement in the model fit. The fitted mean value of CVAL was £237/cow with a standard error of 1.8. Means and standard deviations of the independent variables were 71 (37.1), 1.9 (0.50) and 0.10 (0.12) for DOB1, AVCP and PBARREN respectively. The fitted values of CVAL for a 1 SD change in each RPP are shown in figure 1. This shows that PBARREN had the greatest impact on CVAL with an increase in barreners of 0.12 leading to a decrease in CVAL of £28/cow. The 37 days delay in first calving reduced CVAL by £27/cow and 0.5 increase in AVCP (10.5 days) cost £9/cow.

Figure 1: Predicted effect of changed reproductive performance on suckled calf sale value

The regression equations for the three RRPs were as follows:

$$DOB1 = 2.02 + 0.66BULLIN - 1.4REGION2 + 15.7REGION3 + 11.0REGION4$$
$$\quad\quad (7.94) \quad (0.07) \quad\quad (7.05) \quad\quad\quad (7.72) \quad\quad\quad (9.6)$$

$$AVCP = 1.64 + 0.16ENTERP + 0.0016COWS - 0.11LAB + 0.12MONITOR -$$
$$\quad\quad (0.24) \quad (0.06) \quad\quad (0.0009) \quad\quad (0.05) \quad\quad (0.04)$$

$$0.14BULLCARE - 0.002BSL - 0.30REGION2 - 0.15REGION3 - 0.44REGION4$$
$$(0.06) \quad\quad\quad (0.001) \quad\quad (0.14) \quad\quad\quad (0.16) \quad\quad\quad (0.18)$$

$$PBARREN = 0.14 - 0.017BIOSEC$$
$$\quad\quad\quad\quad (0.03) \quad (0.008)$$

Not surprisingly, the start of the calving season (DOB1) was strongly related to the date the bull was introduced to the cows, with every 6.6 days delay in the breeding season adding 10 days to the date of first calving. Region3 also showed a significantly later start of the calving period ($p<0.05$) by nearly 16 days. The R^2 for this model was 63%.

Figure 2: Predictions of average calving period (AVCP)*

Mean, Region and independent variables +1SD
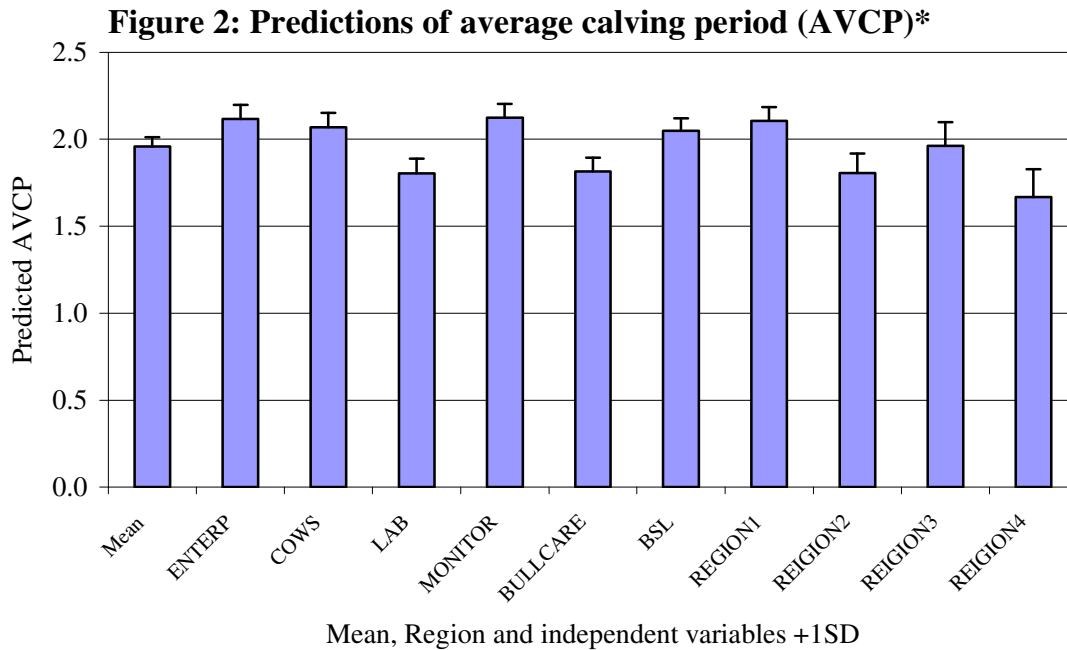
* AVCP is measured in 21-day periods.

Figure 2 shows the predicted AVCP for all independent variables in the model that had a significant ($p<0.05$) effect plus COWS, BSL and REGION3 where the regression coefficients did not differ significantly from zero ($p>0.05$). More enterprises on the farm and more monitoring were associated with higher AVCP, while more employed labour (LAB) and BULLCARE were associated with lower AVCP. Regions 2 and 4 had a lower AVCP than region 1. The R^2 for this model was 32%.

The only significant predictor of PBARREN was the number of biosecurity measures adopted (BIOSEC). The fitted mean of PBARREN was 0.096 (0.014), with +1sd BIOSEC this fell to 0.094 (0.014). The R^2 for this model was 5%.

Discussion

Improving all RRPs by 1SD together added about £64/cow to CVAL. This represents about a 27% improvement on the fitted mean of CVAL through earlier, tighter calving patterns and fewer barren cows. Achieving such improvements might add some extra costs (e.g. greater purchased feed costs) but these are likely to be outweighed by cost savings, such as more efficient resource use and improved capacity to maintain the desired calving timing and pattern in subsequent years. This latter advantage will be explored in subsequent work using dynamic programming models (Stott et al., 2005), incorporating the interaction between reproduction and replacement decisions in

suckler herds. Other advantages of compact calving include reduced disease risk, better fertility, more efficient marketing and a greater pool of replacement heifers (Riddell and Caldow, 2007).

Adding an extra £64/cow would improve current gross margins of upland spring calving suckler herds by over 80% (SAC, 2007). However to achieve this in our sample of herds would require performance in all RRPs to be in the top 16% (+1SD). The corollary of this is that herds performing in the bottom end of the distribution must have RRPs that deliver close to negative gross margins. Without the £148 suckler cow premium available when this survey was undertaken (SAC, 2002) such herds must now be unviable.

A trade-off between AVCP and PBARREN might be expected, leading to an unacceptably high correlation between independent variables in the regression against CVAL. This would arise if farmers were applying a short breeding season length in order to achieve a tight calving pattern, accepting that fewer cows would have time to re-breed. No such correlation was present in our data. Furthermore, no significant relationship was found in the regression between AVCP and BSL. This suggests that farmers were not using BSL as a means to control AVCP and hence reap the benefits of compact calving mentioned above. Neither did they seem to be obtaining any compensation from longer BSL via reduced PBARREN. Caldow et al. (2005) recommend a BSL target of 77days with an inter quartile range of 70-84days. Our data with a mean of 124 days (Table 2) and an inter quartile range of 88-153 days was well outside these targets. There was a negative correlation between DOB1 and AVCP (-0.25) suggesting a slight tendency for later calving herds to have a more compact calving pattern. This could mean that farms with poor fertility were compensating by starting calving earlier in the year.

As BSL was not limiting AVCP, the effect of other independent variables became more important. The positive association between LAB and AVCP was not unexpected given the relative cost/availability of employed labour and the benefits of compact calving for efficiency of labour use. BULLCARE shortened AVCP by 0.14 with each increment predicted by the earlier equation to be worth £2.10/cow in improved calf value. Five specified and 3 further free response bull care options were given in the questionnaire (Varo Barbudo, 2005). Most were simple inexpensive checks for mating behaviour and foot condition etc. Responses were counted for this analysis and not scored or ranked. Our result suggests that further study is warranted to discover which aspects of bull care have greatest impact on AVCP and hence suckler herd profitability.

Our analysis explained little of the variation in PBARREN. This was disappointing as it had the greatest impact on CVAL. However, the link to BIOSEC suggests important associations between PBARREN and animal health. As with BULLCARE, BIOSEC was a simple count of the number of bio-security options ticked by respondents. Further study of this association therefore seems justified.

Although we confined our analysis to spring calving herds, there was a large variation in all parameters measured. For example, CVAL ranged from £104 to £309/cow, DOB1 ranged from 1st January to 19th July, AVCP from 1.14 (24 days) to 3.3 (69 days) and PBARREN from 0 to 0.69. These figures suggest a very wide range of systems

and performances matched presumably by a diversity of impacts on the environment and the rural economy. There is clearly scope for developments that would bring both public and private benefits to regions where beef suckler systems are a dominant form of agriculture and sometimes an important sector of the local economy. These regions are often fragile in social, economic, ecological and environmental senses. Further analysis of the contribution of beef suckler systems to economic sustainability via a study of fertility is therefore likely to benefit advisers and policy makers. Santarossa et al. (2004) have demonstrated a suitable methodology in the dairy sector. The work reported here provides some of the basic information necessary for such an analysis.

Acknowledgements

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