MILK DEVELOPMENT COUNCIL

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FINAL REPORT

SEPTEMBER 1999

CONTENTS

IMPROVING THE LONGEVITY OF COWS IN THE UK DAIRY HERD
SEPTEMBER 1999

Report for the Milk Development Council on the Results of the Longevity Project, which has been funded by the MDC, with further sponsorship from NMR and Kingshay Farming Trust.

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INTRODUCTION

SUMMARY

High wastage levels in UK dairy herds result in the average life span being just over three lactations. Whilst overall culling rate has a direct influence on herd lifespan, control of culling for forced reasons is the vital factor.

For a herd to achieve its objectives, a high proportion of the overall culling rate must be in the control of the herd manager.

This study shows that management practices play a key role in achieving this.

FOREWORD

The average lifespan of cows in NMR recorded Holstein Friesian herds is 3.04 lactations (NMR/ADC), which means that herd depreciation represents a major cost for UK dairy herds often equal to the purchased feed cost.

The table below illustrates the annual cost of replacing a mature cow in the herd with a new heifer.

TABLE 1 - THE CASH COST OF REPLACING A COW WITH A HEIFER

Animal	
Replacement heifer	£800
less value of cull	£325
	£475
Yield Effect	
Mature cow yield lost	7315 litres
Replacement heifer yield gained	6000 litres
Assuming same feed input	
Loss of 1315 litres @ 19 p / litre	**£250**
Calf Effect	
A calf from a cow	£80
A calf from a heifer	£30
Loss of	**£50**
Total cost per replacement	**£775**
Cost per litre (7000 litre herd average)	**2.66 ppl**

See Appendix 1 for sources of data and full explanations of the figures used

The figures in Table 1 reflect the average herd in the study, which had a 24% cull rate of which 57% were for "forced" or involuntary reasons.
By reducing the number of "forced" replacements resulting from avoidable culling, herd profitability can be improved through reduced replacement costs. This provides increased selection opportunities which lead to faster genetic improvement. These points are modelled in the Discussion.

AIMS AND OBJECTIVES OF THE RESEARCH

- To establish the factors leading to above average longevity and lower levels of culling in dairy herds in the UK and to assess the relative importance and inter-relationships of these factors.
- To make this information available to all producers to assist them in adjusting their herd management to enhance both herd profitability and animal welfare.

MATERIALS AND METHODS

The NMR membership of 13,000 milk producers were invited to take part in the study in September 1997, of which some 1,300 volunteered to participate.
The study comprised of three main parts:

1) Individual cull information
2) NMR production Data
3) Farm Questionnaire

Firstly, participating farmers noted the **reasons for culling** every animal that left the herd over a twelve month period, starting in November 1997. The NMR contractor recorded this information onto special recording sheets at each monthly milk recording. These cull recording sheets offered the opportunity to provide primary, secondary and subsequent cull reasons, for each cow leaving the herd, from a list of some 34 reasons.

Secondly, NMR supplied Kingshay with each participating herd's milk **production data**. This data consists of the full NMR records for each individual animal in each participating herd.

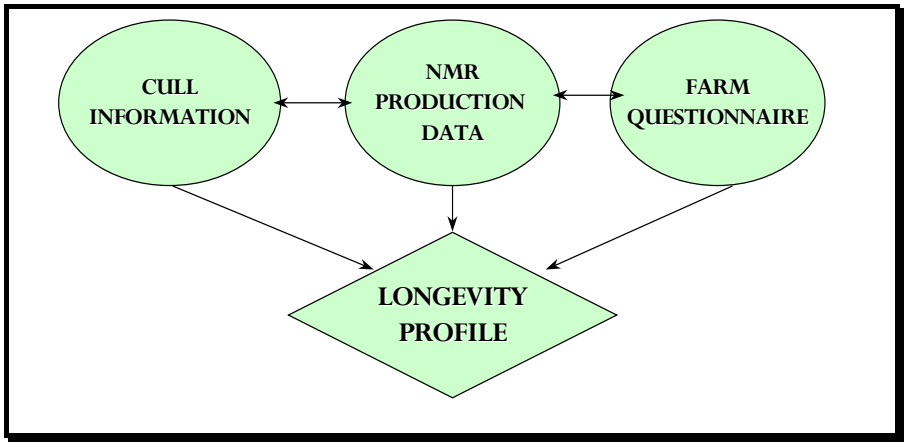
Thirdly, each participating herd was sent a questionnaire asking for specific and detailed information on the **management system** for their herd. It was mailed to all participants in April 1998 and some 1,066 were returned, reflecting the tremendous support for this project and importance farmers place on improving longevity in their herds. The questionnaire asked for details of the herd management system including pedigree status, fertility management, herd replacements, housing, space available per cow, cow tracks, grazing, milking, labour, veterinary practice and nutritional aspects.

DATA ANALYSIS

The data from the cull records, NMR herd records and questionnaire has been incorporated in a database and relationships established. An individual "Longevity Profile" for each herd was produced enabling participating herds to benchmark their performance against other similar herds and to identify changes to their system to improve the longevity of their own herd.

Figure 1 summarises the data sources

FIGURE 1 - THE PROJECT DESIGN



RESULTS AND DISCUSSION

ANALYSIS GROUP

This report examines the results from a subset of herds selected from all the participating herds. This selection eliminated herds where cull reasons were given for less than 70% of cows that left during the study period as determined from NMR records. Herds affected by the BSE cohort scheme have also been excluded because the culling pattern in these herds was distorted by the compulsory removal of animals during the study period. The start of the study period was delayed from an original commencement date of April 1997 to November 1997 in order to lessen the impact of the scheme.

Of the 1098 herds that completed the cull recording period, 345 were affected by the cohort scheme. In this report the results quoted are for the subset of 317 herds with comprehensive cull data that were unaffected by the cohort scheme. This group of herds is referred to in the report as the Analysis Group.

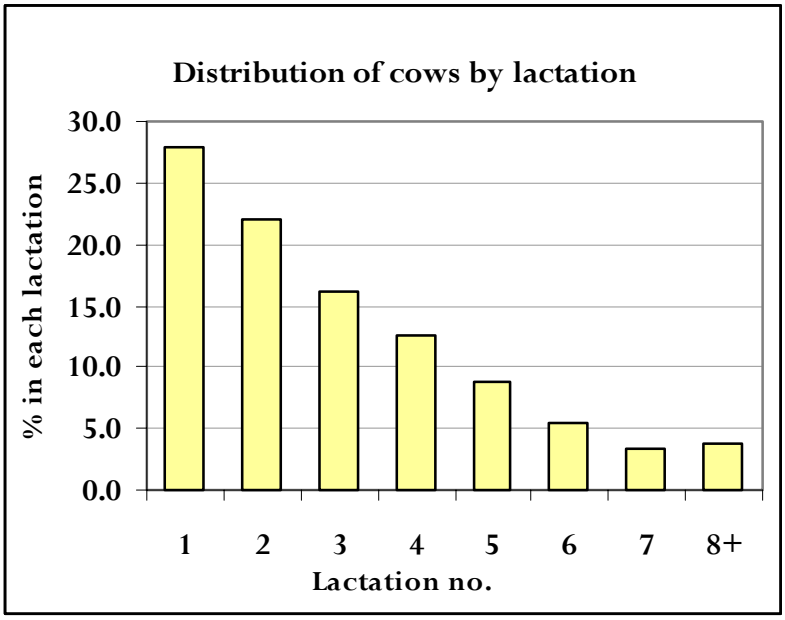
TABLE 2

GENERAL STATISTICS FOR THE ANALYSIS GROUP

Number of herds	317
Total number of cows	30,782
Average herd size	97
Average yield (305 day kgs)	7,016
Total number of culls	7,514
Average lactation age	3.03

- At 3.03 the average lactation age of the Analysis Group herds aligns very closely with the NMR/ADC quoted figure for recorded Holstein Friesian herds of 3.04

FIGURE 2 – AGE DISTRIBUTION OF COWS IN THE HERD



- The age distribution of the Analysis Group herds aligns closely with the figures quoted by NMR/ADC

- 65.9% of cows in the Analysis Group are in the first three lactations. This compares to the NMR/ADC figure for all Holstein Friesians of 67.1%

CULLING RATE

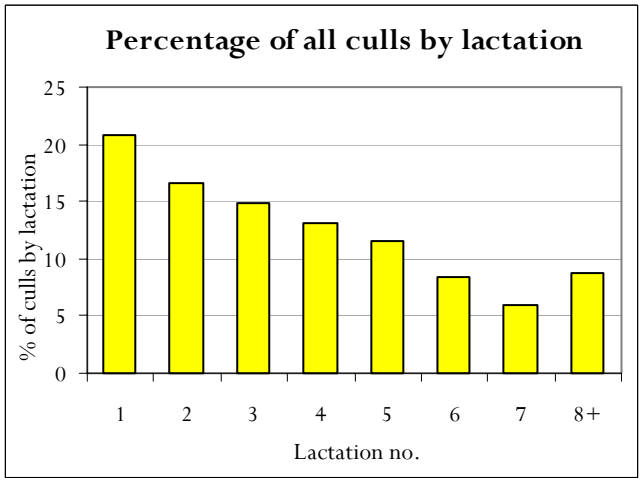
A key initial measure in the quest to improving herd longevity is the overall culling rate.

TABLE 3 CULL RATE

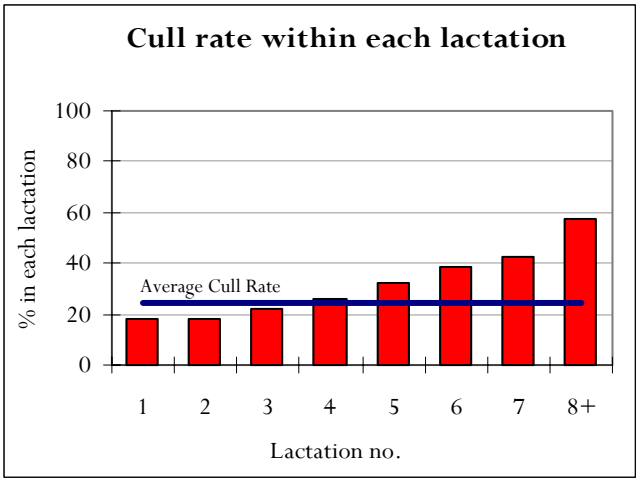
	No. of herds	Culling Rate
All Herds	1098	26.11%
Analysis Group	**317**	**24.41%**

- The figures above illustrate the distortion caused to the overall culling rate by the cohort scheme and illustrates the need to use the subset of herds that were unaffected by the scheme.
- The culling rate of 24.4% is slightly higher than that shown in previous studies both within the UK and in other European countries. Esselmont and Kossaibati (1997) quote an overall culling rate of 23.8% in their study of 50 Daisy herds. Sol *et al* (1984) report a rate of 22.1% in their three year study of thirty Dutch dairy farms.

FIGURES 3 & 4 -THE DISTRIBUTION OF CULLS WITHIN THE ANALYSIS GROUP HERDS



- The highest percentage of culls are in the first lactation with 20.9% of all culls (the number of culls in first lactation divided by total culls) and 52.3% of culls come from the first three lactations.
- However figure four shows that nearly 66% of cows in the herd are in the first three lactations, which means that…….

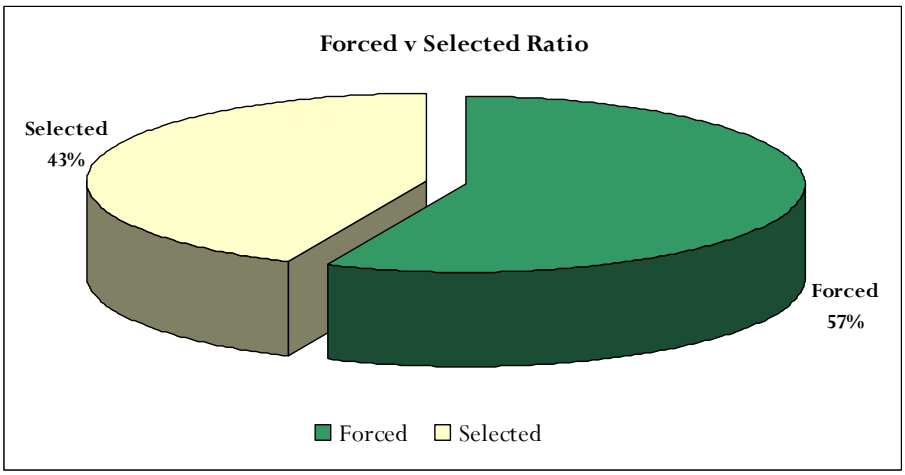


- The *rate* of culling is lowest in the early lactations (the number of culls in first lactation divided by the number of first lactation animals)

CONTROL OF CULLING

Overall culling rate clearly has a major effect on the average lifespan within a dairy herd. However control of culling for involuntary or "forced" reasons is vital to ensuring that better quality, more productive cows can be retained in the herd and allowing a higher level of management choice in the selection of culls.

FIGURE 5 – RATIO OF FORCED TO SELECTED CULLING FOR ANALYSIS GROUP HERDS

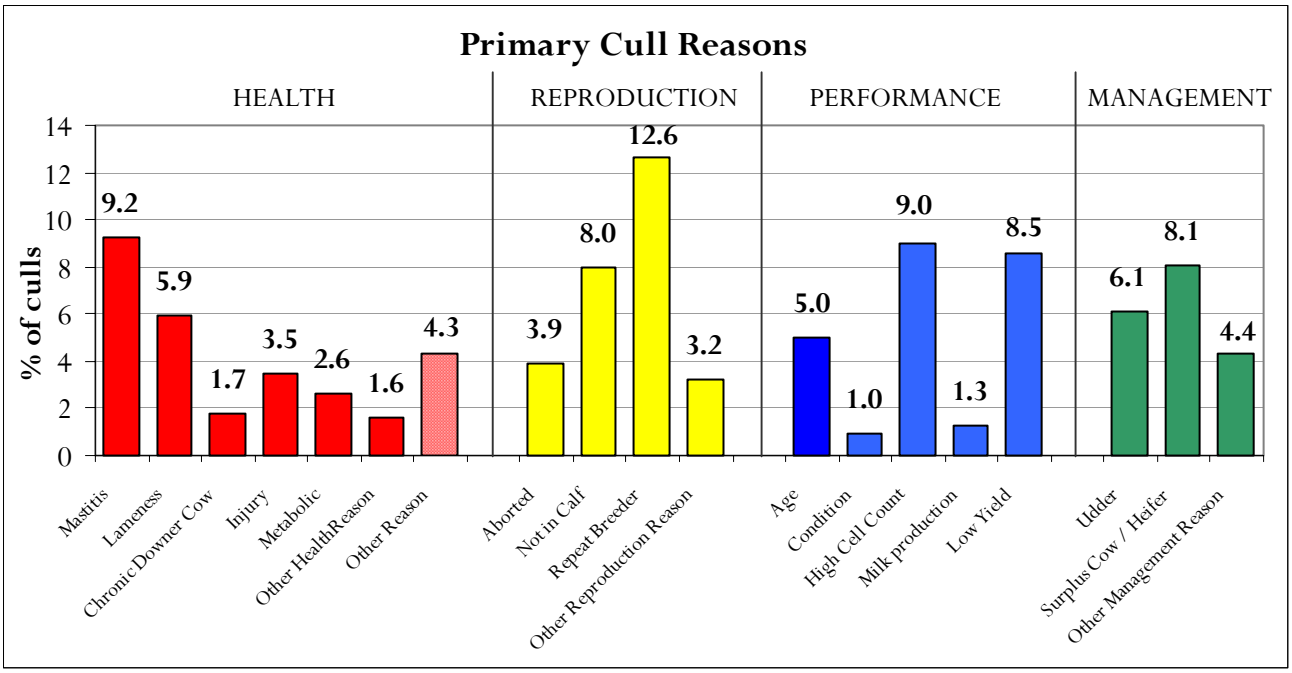


- The average herd in the Analysis Group lost 57% of its culls for involuntary or "forced" reasons, leaving 43% being removed from the herd by choice.
- Forced cull rates are examined in more detail later in the report.

REASONS FOR COWS LEAVING THE HERD

Figure 6 shows the proportion of animals leaving for each of the primary culling reasons. The full list of culling reasons used on farm during the study period is provided in the Appendix.

FIGURE 6 – REASONS FOR LEAVING THE HERD



1 "Other Reason" is included in the health section as 66% of these culls were for health related problems

- Fertility related reasons are the major cause of cows being lost with 20.6% of all culls being culled for either "not in calf" or "repeat breeder".
- Mastitis is the second highest reason for culling at 9.2% of all culls
- The highest voluntary or "selected" reason for culling is "high cell count" at 9.0% which means that mastitis related culling reasons total 18.2%
- The third highest forced culling reason is lameness at 5.9%. This represents the animals that have had to be removed from the herd for this reason. Underlying this figure is the implication that the *incidence* of lameness within herds sufficient to produce this many culls is high. Recent studies suggest that in many herds incidence levels of 55% are not uncommon (Logue,1999).
- Fertility, mastitis related reasons and lameness together account for 44.7% of all culls. For most average herds these are the areas requiring attention to improve herd longevity.

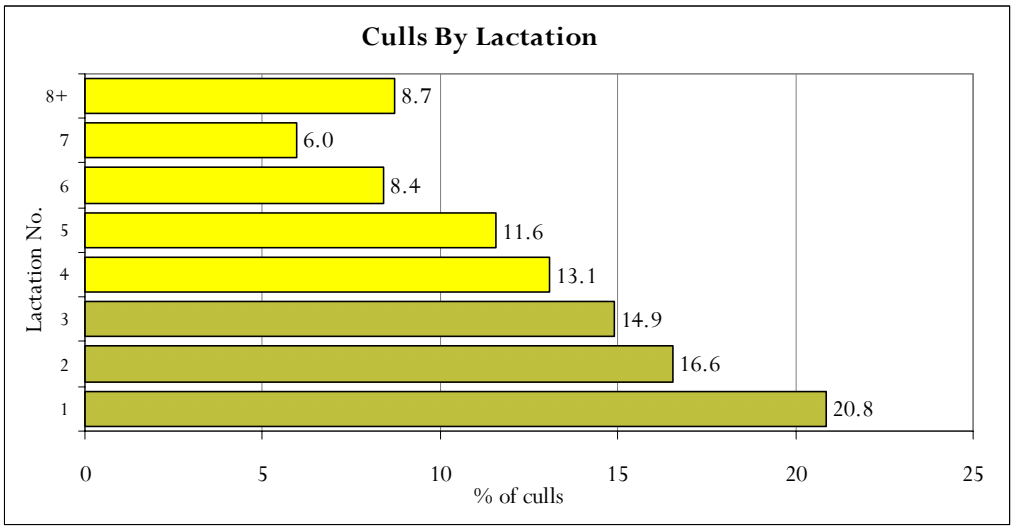
SECONDARY REASONS

If there was a reason in addition to the primary reason given, participants were asked to supply this as a secondary reason. Of the total culls, 44.2% were given a secondary reason. Of these high cell count and mastitis each accounted for 9.75% of the secondary reasons given. Low yield accounted for 8.9% and age 8.4%. There were some common associations, for example, for culls given the primary reason of age, 17.7% had high cell count as a secondary reason and culls for lameness had conformation legs/feet at 12.3% as a secondary reason. Similarly culls for legs / feet had 15.4% with lameness as the secondary reason.

AGE AT CULLING

For many herds, genetic progress is being severely restricted by the very high level of culling of animals within the first three lactations. Figure 7 shows the proportion of all culls leaving the analysis group herds from each lactation.

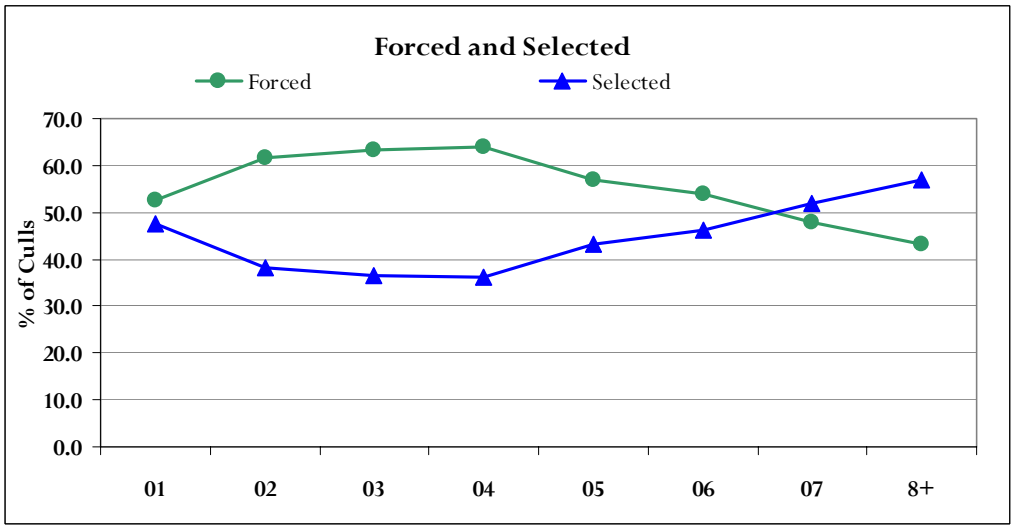
FIGURE 7 – PROPORTION OF CULLS FROM EACH LACTATION



- 52% of culls are from the first three lactations.

While some herds choose to sell young cows in milk, the level of forced culling by lactation shown in Figure 8 shows that for many herds culling of younger animals is far from being a matter of choice.

FIGURE 8 – FORCED AND SELECTED CULLING BY LACTATION

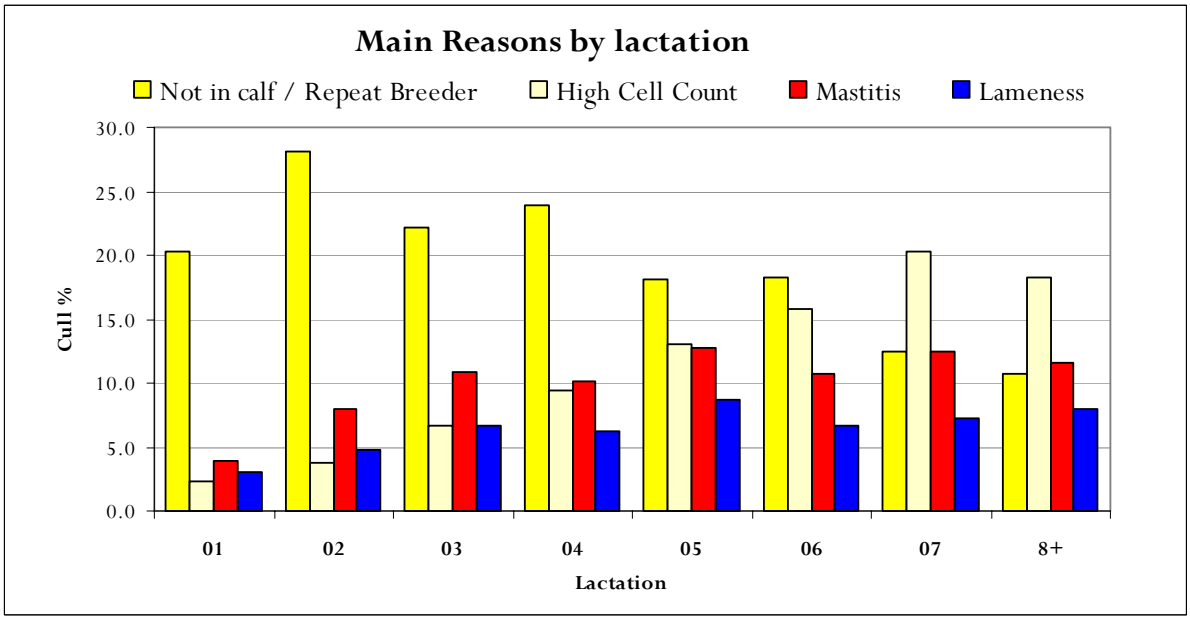


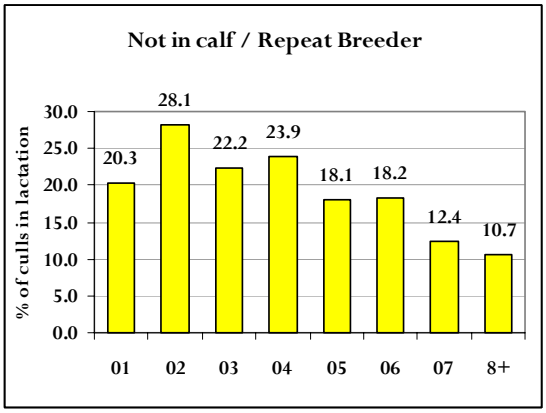
This graph shows that the proportion of selected culls is higher in first lactation than subsequent lactations up to the seventh lactation. This reflects the potentially expensive practice of bringing new heifers into the herd for assessment before selling as in-milk animals. Careful examination of the true costs of rearing against the sale value is required to ensure this is a profitable practice.

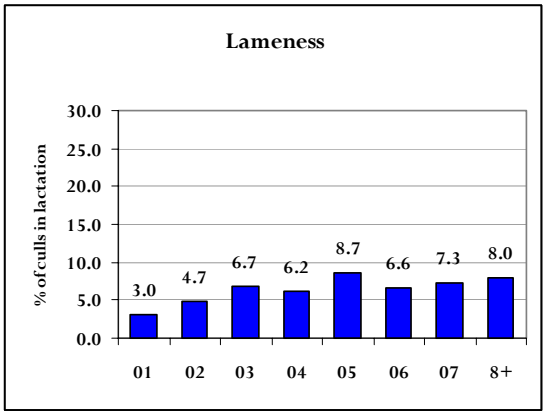
REASONS FOR CULLING BY LACTATION

The reasons why animals were removed from the herd varied with lactation age indicating that different management priorities are required for each age group. For example younger animals tended to be culled predominantly for reproduction related reasons whilst in older animals mastitis related reasons predominated.

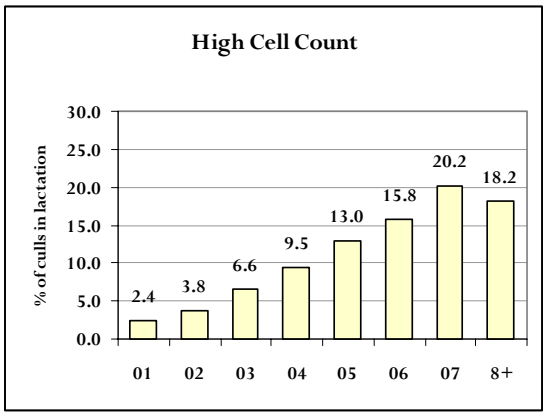
FIGURE 9 – REASONS FOR LEAVING BY LACTATION

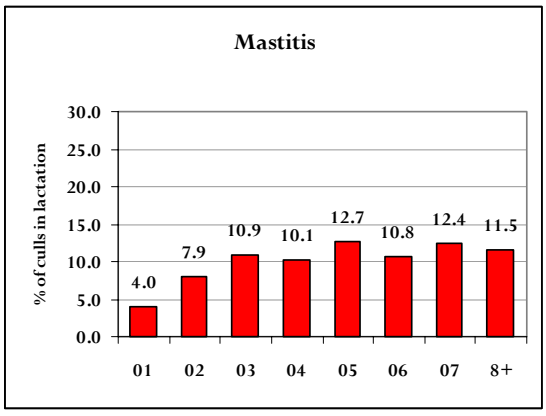






- In each of the first four lactations, over 20% of culls left for reproduction related problems
- Culling for lameness was greater from the third lactation onwards averaging 7.2%
- From the fifth lactation mastitis and high cell count each accounted for over 10% of culls



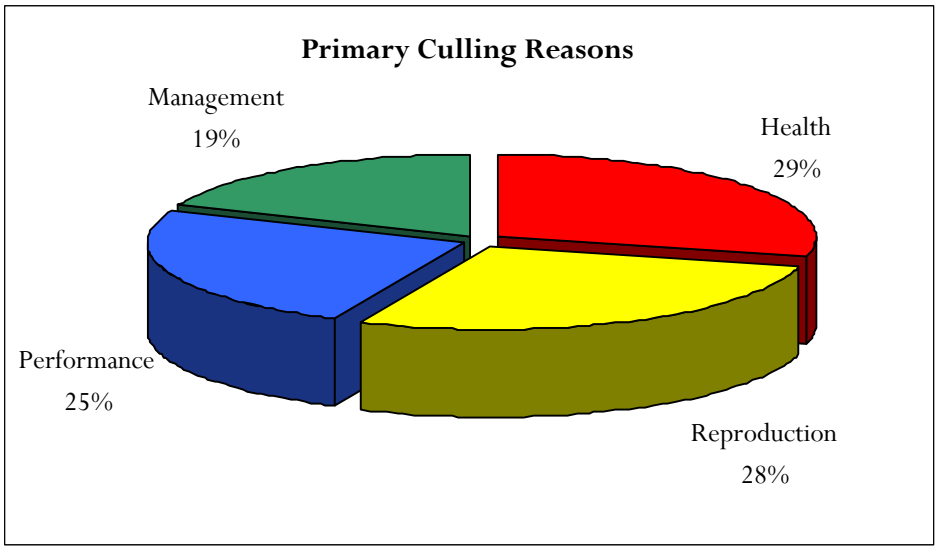


MANAGEMENT FACTORS ASSOCIATED WITH CULLING

This section examines the reasons for cows leaving the herd under the broad selection criteria of Reproduction Problems, Health Problems, Performance and Management.
Management practices associated with these reasons for culling are discussed.

The relative shares that each of these criteria takes of the overall culls is illustrated below.

FIGURE 10 - PROPORTION OF CULLS IN EACH CULLING REASON



- Reproduction problems account for 27.8% of all culls
- Health related culling represents 28.9%
- Performance criteria account for 24.8%
- Management factors select 18.5% of all culls

Addressing each of these areas in turn, culling reasons have been related to management practices (drawn from the farming system questionnaire) where relevant trends or statistically significant associations were found.

TABLE 4

REPRODUCTION PROBLEMS	% of culls
Aborted	3.9
Calving Difficulties	1.9
Not in Calf	8.0
Not seen bulling	1.4
Repeat Breeder	12.6
	27.8

Time set aside for heat detection

In response to the question "when do you observe cows for bulling" almost all herds indicated they did so during general herd work, but only half the herds said they set aside specific time.

TABLE 5

"When do you observe cows bulling?"		% of herds	
During general herd work		92.8	
At milking times		86.4	Observation period in minutes
Specific time set aside in:	Morning	20.1	14.4
	Afternoon	18.7	14.2
	Night	53.1	16.5
No specific time set aside at any time		44.2	

- Compared to the average culling for "not seen bulling" (1.4%) herds that do not set time aside specifically for heat detection lose significantly more cows through failing to see them bulling at 1.99%
- Stott, Veerkamp and Wassell (1999) suggest that oestrous detection rates of only 40% are achievable during the course of other dairy work without dedicated observation. To achieve a target of 70% detection, the equivalent to two man-hours per day observing oestrous behaviour is required.

Cows per man

Herds with lower numbers of cows per man (18-46 cows) culled significantly less repeat breeders.

Use of oestrus detection aids

There were no significant differences in reproduction problems between those that used oestrus detection aids and those that did not.

Use of conception aids

Herds using conception aids have significantly increased culling for repeat breeders at 14.03%.

This initially surprising result indicates that these herds may be trying to overcome an inherent infertility problem or other management problem and does not suggest that conception aids give rise to more repeat breeders.

However these same herds have significantly fewer culls for not seen bulling at 0.98%

Herds using conception aids have other figures which suggest that their management approach is geared to achieve better results. For example these herds are able to cull more for low yield and significantly less for poor condition or high cell count.

Yield

The majority (79%) of cows culled for "not seen bulling" come from herds yielding less than 7100 kgs. This may reflect more on the approach taken by higher yielding herds, where a higher level of reproduction problems occur leading to more attention being given to oestrous detection.

The highest yielding herds (>7751 kgs) culled significantly less than expected for "not in calf" but this group had a significantly extended calving interval at 393 days compared with all other groups at 388 days.

Herd Size

There is a trend for smaller herds (<76 cows) to cull significantly less cows due to abortions at 2.22% of culls. Larger herds (>145 cows) cull significantly more cows for abortion at 5.45% of all culls.

Larger herds culled significantly more repeat breeders but significantly less for "not in calf". While medium sized herds (104-144 cows) culled significantly more than expected for not in calf. Medium sized herds culled less for "not seen bulling", while large herds (>145 cows) culled more than expected.

Housing System (Cubicles v Loose Housing)

This does not have any significant effect on any of the fertility related factors. However in loose housed herds 15.18% of culls were repeat breeders compared to 12.15% in cubicle housing.

Cubicle surface

Herds housed in cubicles with concrete beds cull significantly more cows for "not seen bulling". This suggests that cubicle comfort is an important factor if a cow is to display visible signs of oestrus. Higher levels of culling for lameness in concrete bed cubicle housed cows has also been identified (see Health Problems). This suggests that there is likely to be a higher incidence of lameness in these herds which may have an influence on the cows' willingness to show standing heat.

TABLE 6

HEALTH PROBLEMS - Infectious	% of culls
Infectious Disease	0.9
Mastitis	9.2
	10.1

Yield

Yield does not show a strong association for culling for mastitis but the lower yielding herds tended to cull more cows for mastitis.

Housing System

Loose housed herds had significantly more culls for mastitis at 15.04% of culls compared to 8.58% for cubicle housed cows and 9.05% for herds with both cubicles and loose housing.
Loose housed herds also had significantly higher numbers of culls for high cell count with 12.77%.

TABLE 7 HERD AVERAGE CELL COUNT BY HOUSING TYPE (ANOVA)

Herd average somatic cell counts by housing system	Cell Count	St Dev
Cubicle Housed	150	61.46
Loose Housed	192	52.59
Combination of cubicles and loose housing	145	52.55

- Loose housed herds had a significantly ($P<0.05$) higher average cell count

Looking in more detail at the **type of cubicle bed surface** shows significant benefits in terms of lower herd average cell count and lower culling for high cell count in herds using cubicle mats.

TABLE 8 HERD AVERAGE CELL COUNT BY CUBICLE BED TYPE (ANOVA)

Herd average somatic cell counts by housing system	Cell Count	St Dev
Cubicles with concrete beds	154	61.59
Cubicles with mats	139	52.70
Cubicles with other surfaces	153	61.50

Herds indicating that the main cubicle surface type was mats had a significantly lower ($p<0.05$) herd average somatic cell count than concrete or other surfaces. This ties in with these herds culling less for high cell count.
Participants were asked to indicate the cubicle surface material on which the cows lie for their main cubicle type. Due to the low numbers using mattresses, tarmac, chalk or earth, these were all considered together as "other surfaces".

TABLE 9

HEALTH PROBLEMS – Non infectious	% of culls
BSE	0.7
Lameness[1]	5.9
Chronic Downer Cow	1.7
Injury	3.5
Metabolic disorders[2]	2.7
Other Reason	4.3
	18.8

Note 1: Lameness has been included as 'non infectious'. Participants were not asked to specify the nature of the lameness leading to culling

Note 2: "Metabolic disorders" includes: hypomagnesaemia, milk fever, ketosis and other metabolic disorders

Yield

Herds yielding less than 7,100 kgs recorded significantly more culls for lameness at 7.45%, while high yielding herds culled significantly less than expected at 3.43% .

There is a trend for increased culling for metabolic disorders as yields rise. High yielding herds (>7,751 kgs) culled significantly more for metabolic disorders at 4.09% - almost twice the average rate.

Housing System

Lameness culling was significantly less than expected in herds using loose housing at 2.84% compared to 6.39% in cubicle housed herds.

Cubicle Surface

Herds using cubicles with concrete surfaces recorded significantly more culls than expected for lameness at 7.44%.

Distance to grazing

Significantly more cows were culled for lameness (9.38%) than expected in herds walking more than 800 metres average distance to their main grazing area. Herds walking less than 800 metres culled below the average cull rate for lameness of 5.9%.

Different track surfaces did not show significant differences in culling for lameness however those herds that indicated that grass was the main walking surface culled less for lameness at 4.62% .

TABLE 10

PERFORMANCE	% of culls
Age	5.0
Condition	1.0
High Cell Count	9.0
Low Yield	8.5
Milk production	1.3
	24.8

"Milk production" encompasses slow milker and poor milk quality culling reasons

Yield

The highest yielding herds (>7751 kgs) cull significantly less than expected for age at 3.61% compared to low yielding herds culling significantly more for age at 6.2%. This is because higher yielding herds have a lower average lactation age at 2.9 while the lower yielding herds average 3.2 lactations

Cows per man

Herds with 18-46 cows per man culled significantly more cows for age. This may reflect the higher level of individual attention and possibly lower stress levels achieved in herds with low cow numbers per man.

Housing System

Loose housed herds culled significantly more cows than expected for high cell count at 12.77 which is associated with these herds also having a higher average somatic cell count% (see table number 6 in Health Problems –Infectious).

TABLE 11

MANAGEMENT	% of culls
Conformation: Legs / Feet	2.3
Conformation: Udder / Teats	3.6
Conformation: Other	0.2
Lying out of Cubicle	0.5
Out of Calving Pattern	0.3
Over Quota / Herd Reduction	1.9
Surplus Cow / Heifer	6.2
Temperament	1.0
Udder: 3/4 Cow	2.5
	18.5

Herd Size

Smaller herds (<76 cows) cull significantly more for the "surplus" reasons (over quota/herd reduction, surplus cow/heifer) reflecting the more limited options available to smaller herds to manipulate production against quota.

Yield

Higher yielding herds exploit the opportunity to sell surplus animals. While the average herd culls 6.2% of culls as surplus stock, there is a trend from low yielding herds culling less than expected as surplus stock at 2.6%, through to the highest yielding herds culling significantly more than expected at 9.5%.

FARMER RECOMMENDATIONS

LONGEVITY AUDIT

The first step in improving longevity within a herd is to establish the current position by benchmarking key figures for the herd against group averages.

Once a factor has been measured, it can be managed and priority areas identified for attention.

TABLE 12

			Group average	Your herd
1	Overall culling rate %		24.41	
2	Forced culling rate %		13.9	
3	Ratio of Forced to Selected culls		57:43	
4	Percentage leaving for the four main culling reasons:	Not in calf / repeat breeder	20.6	
		Mastitis	9.2	
		Lameness	5.9	
		High Cell Count	9.0	
5	Proportion of animals culled in first three lactations %		52.3	
6	Average lactation age of herd		3.03	

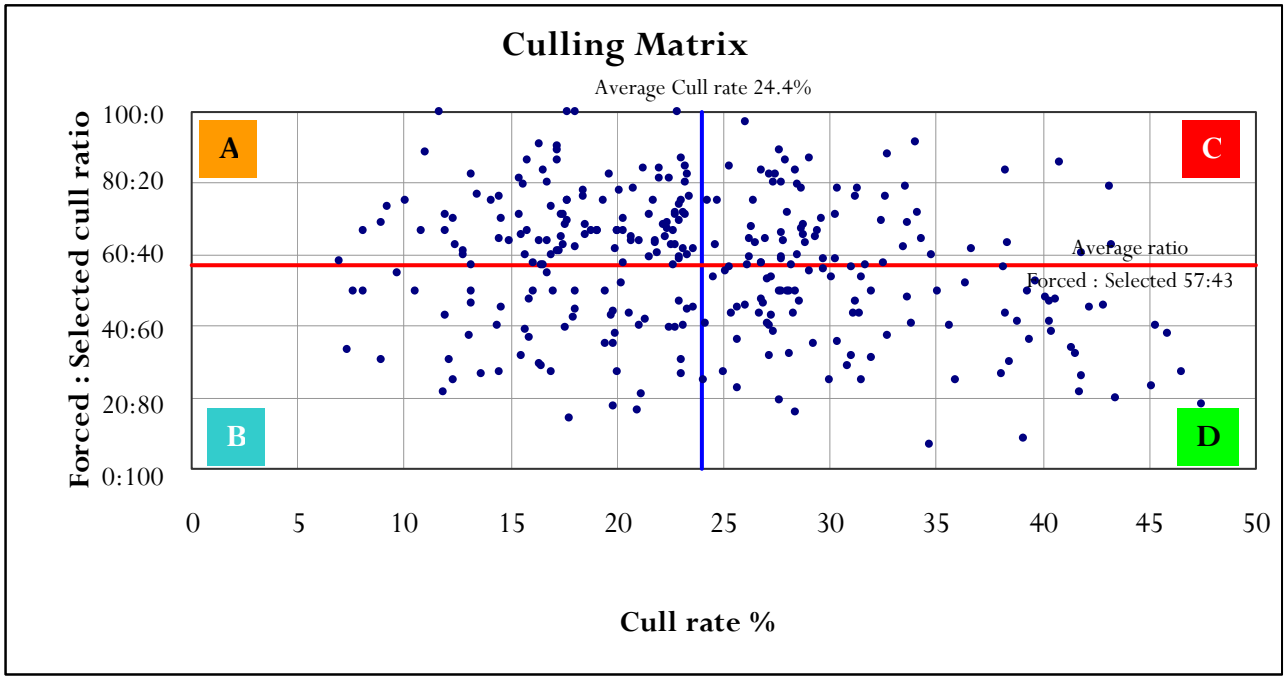
Note: The above figures are for the Analysis Group

To complete the longevity audit, prepare a list of all cows leaving the herd in the last 12 months. For each one identify the reason for leaving from the list in the Appendix.

1. To calculate overall culling rate:
   Take the total number of culls over the 12 month period and divide by the rolling average herd size for the same period.
2. Forced culling rate:
   The total number of culls leaving for a forced reason divided by the rolling average herd size.
3. Ratio of Forced to Selected culls:
   Categorise all culls into "Forced or Selected" culling reasons (see cull list in the appendix).
   Calculate the ratio between "Forced and Selected"
4. The percentages leaving for each of the main culling reasons:
   Calculated by taking the totals for each reason divided by the total number of culls.
5. The proportion of culls that are in their first three lactations:
   The number of culls in lactations 1 to 3 divided by the total culls.
6. Average lactation age:
   Calculated using the latest set of NMR records for the herd.
   Total all the lactation numbers and divide by the number of cows with a lactation age.

Using the calculated figures for the herd's Cull Rate and Forced:Selected Ratio plot the herd result on the culling matrix. (overleaf)

FIGURE 11 – CULLING MATRIX Herds plotted from the analysis group



- Herds in quadrant A have a below average culling rate but above average levels of forced culls. The low cull rate may imply that this is a good quadrant to be in, but herd improvement is the lowest of all quadrants because the majority of cows leaving are not by choice.
- Herds in quadrant B are below average on both cull rate and forced level so herd turnover is low but the majority of cows leaving are in the control of the herd manager.
- Herds in quadrant C have above average scores for both culling rate and forced culling.
- Herds in quadrant D have a high turnover of animals but this is through choice as the level of forced culling is below average.
- Longevity in herds that consistently appear in quadrants A and B will be greater than those in C and D.

If the year analysed is considered to be unusual, for example many cows left for an unusual reason, it will be worth analysing a further year.

SETTING AND ACHIEVING GOALS

Having established the position of the herd, set a herd strategy to achieve your optimum position on the Culling Matrix. For example a herd in quadrant C will want to initially move down into quadrant D (reduce the level of forced culls) and more than likely move towards quadrant B (reduce overall culling rate).

To achieve this - Draw up **a priority action list**.

Address the biggest problems first. All the problems cannot be fixed at once. Re-examine your herd results in table 11 to identify the main reasons for cows leaving the herd.

CONTROLLING FORCED CULLING

Once priority areas have been identified use the "Management Factors Associated with Culling" (page 10) section of the report and examine these against the situation on your farm.

Implementing changes highlighted in this section of the report will have a positive impact on reasons for cows leaving the herd and reduce the forced cull ratio.

SELECTING A CULLING RATE

Only after a strategy has been established to minimise losses through "Forced" reasons should the overall culling rate be examined.

An above average culling rate is not necessarily a bad thing provided it is a matter of management choice. Herds that choose to have a high culling rate could achieve more rapid genetic improvement provided the incoming animals are of a higher quality than the outgoing.

If the animals being selected to leave are all from the first lactation, it is important to establish that:

a) their sale value more than exceeds their rearing costs
b) this policy is not at the expense of long term herd improvement and profitability

CONCLUSIONS

DISCUSSION

Longevity is clearly a major concern to practical dairy farmers as evidenced by the tremendous level of interest in, and support for, this project.

The ultimate aim of controlling herd longevity is to achieve better financial returns. This section of the report takes the findings of the study and models potential financial returns from herds with various levels of control of herd replacement.

It appears that there are three major factors that influence herd lifespan:

- Management approach
- Pursuit of genetic improvement
- Appreciation of the benefits of a controlled replacement policy

Management Approach

Clearly there are some herds in the study where health and other problems, beyond the control of the herd manager, have had a devastating effect, not least BSE, leading to very high culling rates. However many farms seem unwilling to really address the biggest cause of cow wastage (losses through fertility related reasons) with a positive change of management approach. Fertility related losses remain at a depressingly high level despite earlier studies which have shown similar percentages of culling for fertility to those revealed by this study (Esselmont and Kossaibati 1997). Ever increasing yield levels have been suggested as the underlying cause, but the findings of this study do not support this argument. It is more to do with recognising the need to give time to cow observation.
For example even within this population of volunteer participants only half indicated that they set time aside specifically for the key activity of oestrus observation and yet the average herd continues to lose nearly one in every three culls for reproduction failure.

Pursuit of Genetic Improvement

The use of high index bulls has led to tremendous increases in the genetic potential in most UK herds. However for many, this pursuit of genetic gain has meant mature cows have been removed from the herd to create space for heifers. While this new generation may have the *potential*, they are unproven. There is little doubt that improved genetics will result in financial benefits in the long term, but the price being paid by many herds in the shorter term, is very low lactation ages and high levels of culling of early lactation animals, that fail to deliver their potential. (In the average herd over 50% of culls are in the first three lactations).

The benefits of controlled culling

It seems the potential financial benefits that accrue from increased control over herd replacement are not fully appreciated.

A MODEL OF POTENTIAL FINANCIAL PROGRESS

The short-term benefit of being in control of culling is illustrated in Table 1, where the cost of replacing a cow with a heifer is shown to be around 2.6 pence per litre for a 7000 litre herd.

To demonstrate the long-term financial benefits, a number of herd scenarios based on the project findings have been modelled. These show the potential benefits of control of culling and choice of replacement rate over a ten year period.

Taking the four quadrants identified in the Culling Matrix on page 19, and adding two more herd scenarios (E and F) with the average culling rate, we can model six groups:

A –High Forced : Selected ratio (70.45 : 29.55) and Below average culling rate (18%)
B –Low Forced : Selected ratio (42.50 : 57.50) and Below average culling rate (18%)
C –High Forced : Selected ratio (70.45 : 29.55) and Above average culling rate (33%)
D –Low Forced : Selected ratio (42.50 : 57.50) and Above average culling rate (33%)
E –High Forced : Selected ratio (70.45 : 29.55) and Average culling rate (24.4%)
F –Low Forced : Selected ratio (42.50 : 57.50) and Average culling rate (24.4%)

Each of these model herds has the same starting point,

TABLE 13

Herd average £PIN	£20
£PIN of Year 1 replacement heifers entering herd	£35
£PIN of bulls – Year 1	£80

All the model herds use the same bulls throughout the 10 year timespan, starting with bulls with a £PIN of £80 and increasing in genetic merit by 10% annually.

Modelling £PIN Progress

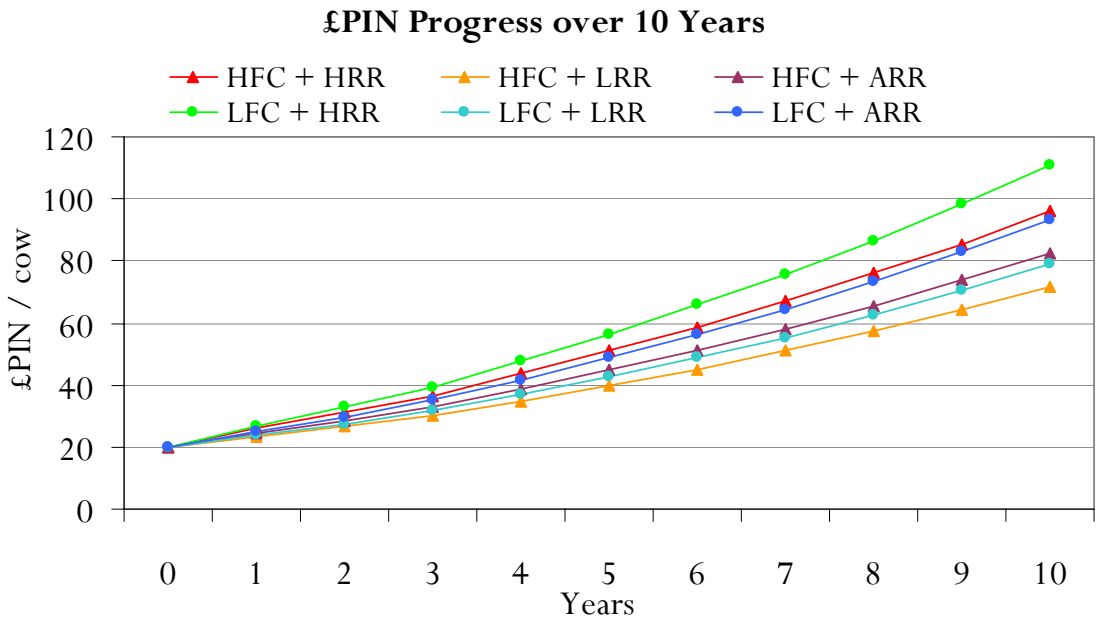
The level of control of culling has a major influence on the genetic progress within the herd.

The model assumes that a Forced Cull will have a £PIN value equivalent to the herd average because Forced Culls are random across the herd.

Selected culls are in the choice of the herd manager and for the purposes of this model have been taken to be half the average £PIN value of the herd, to reflect the manager's freedom to choose animals of below average potential.

The potential differences in £PIN progress are illustrated in Figure 12.

FIGURE 12 – £PIN PROGRESS **Potential differences in £PIN over 10 years**



- Herds with a high replacement rate where culling is under control (LFC+HRR) achieve the greatest increase in £PIN over the ten year period
- The herd replacing the lowest number of animals but with a high level of forced culls (HFC+LRR) makes the slowest progress
- The difference between these two herds after ten years in average £PIN value is £41 (£70 - £111)

So how do these differences in genetic progress manifest themselves in improved financial returns?

It has been suggested that a £1 PIN increase will give a benefit of £5 improvement in margin over purchased feed. The model uses this but goes on to take account of the differences between the herds in terms of net herd replacement cost.

The following values have been used in the next stage of the model

TABLE 14

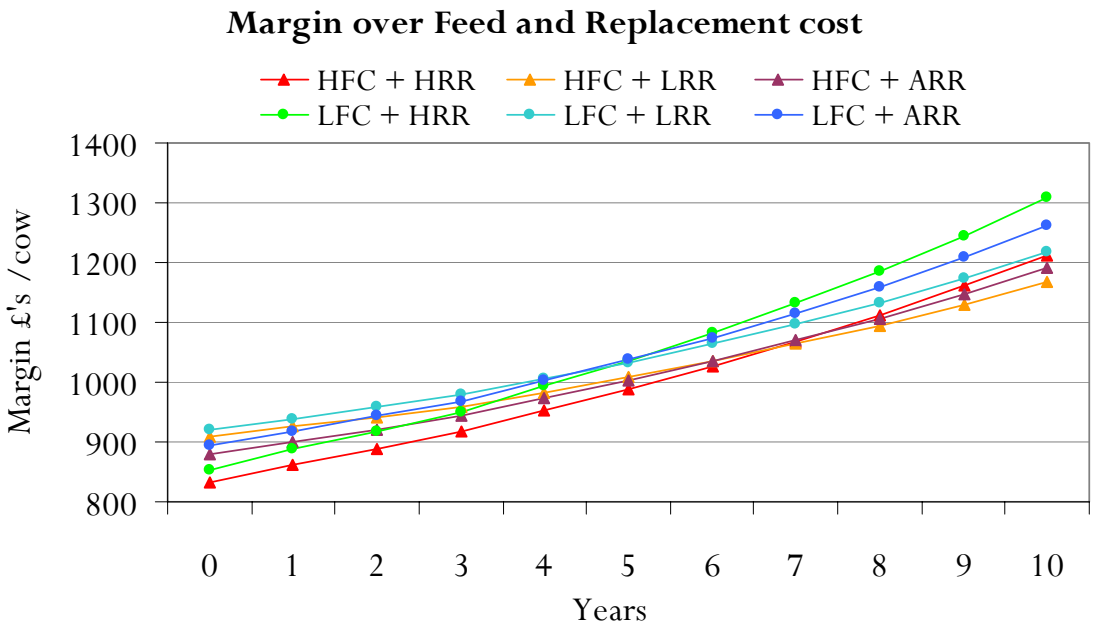
Margin over Purchased Feed – Year 1	£/cow	£1000
Value of replacement heifers	£/head	£800
Culls leaving for Forced reasons	£/cull	£230
Culls leaving for Selected reasons	£/cull	£450

The value of cull sales, in each year, in each herd is calculated from the ratio of forced to selected culls.

For example in herds with low forced culling, 42.5% of the culls were valued at £230 with the remainder at £450 per head. The value of forced culls represents an average for cows sold for slaughter including casualties, while the value used for selected culls includes the value of cows sold for further productive life.

Figure 13 shows the progress in margin over purchased feed and herd replacement cost achieved over the ten year period.

FIGURE 13 – MARGIN PROGRESS Potential differences in margin over purchased feed and replacement costs



- At the start point in year zero, the herd with low forced culling and low replacement rate (LFC + LRR) achieves the best margin reflecting a relatively high cull value and low replacement cost.
- The herd with high forced culling and high replacement rate (HFC + HRR) has the lowest margin.
- Over the ten year period the relative positions change so that the herd with low forced culling and high replacement rate achieves the highest margin over purchased feed and herd maintenance cost.

This study shows that the traditional benchmark of replacement rate alone is a wholly inadequate measure. For replacement rate to be a useful measure it must be related to the ratio of forced to selected culling.
The cost of a forced cull is more than simply the difference between its cull value and the cost of the replacement heifer. The decision to cull an animal will be the final act following a period of expenditure on veterinary treatments to try to rectify the problem. For example the range in the level of incidence of lameness has been shown to be very wide between herds (Logue 1999). Some herd managers will treat a clinically lame animal, whilst another will cull it. Clearly this means the exact cost of a forced cull will vary between herds (and between culling reasons). These "pre-culling" costs are outside the boundaries of this study.

To make controlled progress it is essential for the herd manager to benchmark the ratio of forced to selected culls within the replacement rate. The model shows the financial benefit of low forced culling. The three herds with highest margins had the lowest levels of forced culling.
In a 100 cow herd the cumulative benefit over the ten year period of the higher margins achieved each year amounts to £57,200.

FURTHER STUDIES

The information gathered in this study is a unique combination of production data and farming system information. There is clearly scope, with little or no extra data collection, for further studies and modelling of the routes to, and benefits from, improved herd longevity. Linking culling records to the level of incidence of health problems within herds with above and below average levels of forced culling would identify management practices to reduce veterinary costs and improve herd retention.

GLOSSARY OF TERMS

Within this report a number of terms have been used to describe the statistics and results. To ensure clarity definitions are provided below.

Analysis group

Black and white herds with no cohorts and with over 70% of culls with a recorded reason.

Average Calving Interval

Average of all latest calving intervals for cows within a herd that have a minimum 2 lactation and a 305 day lactation that has ended within the study period.

Average herd size

Average of total animals in the dairy herd at each NMR weigh date that falls within the study period.

Average lactation age

Any animal that has completed a 305-day lactation in the study period is used. The lactation number at that point in time is used to calculate the average lactation age for the herd. The last lactation is produced from the max 305-end date for each animal.

Average Yield

Each NMR qualifying lactation that ended in the study period averaged for the herd.

Culling rate

The total number of cows leaving the herd (for all reasons) during the study period / the average herd size expressed as a percentage

Forced cull rate

The count of "Forced" culls / the average herd size

Forced culling ratio

Number of forced culls recorded / the total culls in the year.

Selected cull rate

The count of "Selected" culls / the average herd size

Selected culling ratio

Number of selected culls recorded / the total culls in the year.

Study Period

1st of November 1997 to 31st of October 1998

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Kingshay Farming Trust would like to thank each producer who has supported this project and taken part in the cull recording exercise.
We are also very grateful for the hard work of the NMR contractors and staff in collecting cull information for this survey and providing data.
We also would like to thank Dr John Eddison and Dr John Kirk for their assistance with the statistical analysis of the results contained in the report.

STATISTICAL ANALYSIS

Two statistical methods have been used in the analysis of these data.

Analysis of variance (ANOVA) has been use to determine significant differences on some of the data reported. Where this method has been used it is clearly stated.

Chi-Square test for association has been used to determine where significant deviations from the expected values were evident. Where the standard residual is greater than +1.96 or less than -1.96, a significant deviation from the expected result is assumed.

All statistical analysis has been undertaken using Minitab Statistical Software.

Consultation on statistical analysis methods has come from Drs. Eddison and Kirk of Seale-Hayne, Faculty of Agriculture, University of Plymouth.

APPENDIX

CONTENTS OF APPENDICES

APPENDIX 1 THE COST OF REPLACING A COW WITH A HEIFER

The methods used to derive the figures used in Table 1 are summarised below

Animal

Replacement heifer value of £800 – source: Kingshay members

Cull value

Average value £350 per head

Derived from:

57% Forced culls @ £230per head

43% Selected culls @ £450 per head

Yield effect

Herd average yield 7000 litres (average yield of Study Herds)

Split of cow/heifer yields derived from:

Cows: 76% of the herd 7315 litres

Heifers: 24% of the herd 6000 litres

Feed input:

It has been assumed that feed costs will be the same because a heifer will be fed the same level of concentrates as a mature cow to allow for growth in its first lactation. This means that the cost of the yield loss between the cow and heifer will be the gross value of the litres lost.

Calf effect

The average value of a calf from a cow is assumed to be of more value than a calf from a heifer, being better grown and to a more valuable beef sire.

Cost per litre

24 per cent (average culling rate of Study Herds) of £775 divided by the average yield per cow