

# AN INCALF PERSPECTIVE OF REPRODUCTIVE PERFORMANCE AT THE LINCOLN UNIVERSITY DAIRY FARM

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## Summary

- Reproductive performance at Lincoln University Dairy Farm (LUDF) has improved incrementally over a seven year period. Like any new herd in the South Island, this has taken time and effort.
- In 2009, the LUDF herd achieved a 6-week in-calf rate of 74%, and a 5-star rating on the *InCalf Fertility Focus* report, with minimal hormonal intervention, in line with industry targets for reproduction.
- This performance debunks the perception that high reproductive performance cannot be achieved under the grazing management principles applied at LUDF, to achieve the farms objective “to harvest as much metabolisable energy (ME) as practicable”.
- Challenges remain in some key management areas, particularly those limiting conception rate and performance beyond week six of mating. A study to investigate conception rate issues at LUDF and in other large South Island herds is now underway.
- As reproductive performance improves, the challenge remains to manage risk in all key management areas, to maintain good overall performance.

## Introduction

At Lincoln University Dairy Farm (LUDF) nutritional management of the herd, has been driven by strict adherence to a set of grazing management principles and practices, that maximise pasture quality, such as achieving consistent grazing residuals of around 1500 kg DM/ha or 7-clicks (Clark et al., 2009) . Since LUDF adopted these practices in 2003 the farms productivity and business profitability increased significantly, and this has been well communicated to dairy farmers at focus days, discussion groups and in the farming media.

The LUDF grazing residuals are viewed by some farmers as excessively low, in comparison to the lax or lenient grazing residuals they might allow their milking herd at home. Farmers in both islands have heard reports of, or have a perception of, the reproductive performance level of the LUDF herd. These views are often reported in terms of a “high empty rate”.

The association some farmers make between “low” grazing residuals and “high” empty rates leads to believe a “cause and effect” exists, that the grazing and nutritional management of the LUDF dairy herd must be causing a “high empty rate”. Farmers believing this “cause and effect” would be

reluctant to adopt the grazing management principles demonstrated by LUDF. They may already have reproductive performance problems with their own herd, so “Why change grazing management if it were to make that problem worse?”

This belief is unfortunate and may be costing these farmers a lot of foregone operating profits. So let’s put the record straight by viewing the reproductive performance in LUDF herd through the perspective of the InCalf programme.

## **Measuring reproductive performance**

Dairy farmers face a myriad of performance measures. Unfortunately, the many ways used to describe reproductive performance in New Zealand dairy herds are often inappropriate and inconsistent, such as:

1. Using a partial measure of calving pattern, (days from Planned Start of calving to Midpoint of calving), as an indicator of how quickly the cows got in calf in the previous mating season.
2. Using a % of total cows scanned empty, as the only measure of herd reproductive performance, irrespective of how many weeks of mating was used.

Many farmers “buy” the good calving pattern they desire from a herd with poor reproductive performance. Costs include culling late calvers, buying early calvers, calving induction, and bringing in a high replacement rate of first calving heifers.

Ask three experts to calculate empty rate for a herd and you will get three different answers, followed by a pointless debate on which of these was the correct answer. Many dairy farmers are distracted by these debates from considering overall herd reproductive performance, the opportunities for improvement and the underlying areas that should be addressed.

### ***InCalf programme and Fertility Focus report***

Since 2008, New Zealand dairy farmers have access to the InCalf programme through a memorandum of understanding between DairyNZ and Dairy Australia (Burke 2008a; 2008b; Blackwell, 2008). InCalf has established a robust way to describe and assess overall herd reproductive performance, and identify key drivers of that performance, based on research studies in several hundred seasonal calving dairy herds in Australia and New Zealand (Morton, 2010; Xu and Burton, 2003).

InCalf also indicates areas of management that are likely to be contributing to the underlying cause of a certain level of reproductive performance attained, pointing to areas where there is scope for improvement. This approach is captured in the ***InCalf Fertility Focus*** report which is available to all New Zealand dairy farmers, and offers a concise and consistent means to assess a herd’s reproductive performance.

The two measures of overall herd reproductive performance used by InCalf in the *Fertility Focus* report are:

- 6-week in-calf rate
  - % of cows pregnant after six weeks of mating
- Empty rate
  - % of cows not pregnant at the end of a mating period

The 6-week in-calf rate is the best overall measure and tells us how quickly cows became pregnant by about half way through mating, when most or all AB mating is occurring. At six weeks of mating, herds with good or poor reproductive performance are most differentiated. By end of week six, top performing herds have “**three-quarters (78%)**” of the herd pregnant, average herds have “**two-thirds (68%)**” of the herd pregnant, and poor performing herds have “**barely half (57%)**” of the herd pregnant (Xu and Burton, 2003).

Empty rates give no indication of how quickly cows get in calf and must be used with 6-week in-calf rate to assess overall performance. To assess the empty rate, you need to take account of the length of the herd’s mating period. InCalf has established targets for empty rate depending on length of mating period. These are tabulated in *The InCalf Book for NZ Dairy Farmers*, p. 27). For example, an empty rate of 10% is double the target for a 15-week mating, but is a ‘top result’ for just 9 weeks mating.

The 6-week in-calf rate depends on two important drivers, the **3-week submission rate** and **conception rate**. InCalf targets a 90% 3-week submission rate and a 60% conception rate. Definitions of InCalf measures are in *The InCalf Book for NZ Dairy Farmers* (Burke, 2008a).

## **LUDF reporting of reproductive performance**

The LUDF management team have reported the herd’s reproductive performance in detail to farmers at regular focus days over the last seven seasons. The way empty rate has been reported may have confused farmers. LUDF reported how they have calculated empty rate to farmers at the Focus Day on 8<sup>th</sup> May 2008. ([www.siddc.org.nz](http://www.siddc.org.nz))

The method used by LUDF results in a “**conservative**” estimate of the percentage of cows not-in-calf at end of mating. The common method used by farmers, results in an “**optimistic**” estimate of the percentage of cows not-in-calf at end of mating. The difference is related to how the pregnancy status is viewed of cows present at start of mating that have been culled between start of mating date and pregnancy testing date. LUDF have also reported empty rate standardised at 12 weeks, even though mating went for as long as 15 weeks.

## ***InCalf Fertility Focus approach***

The InCalf approach is to view empty rate results as a best estimate based on available recorded data, for the observed “weeks of mating” with a range indicated within the brackets. *Fertility Focus* reports empty rate if there are sufficient individual cow pregnancy test records entered into the farmers electronic records (MINDA, Mistro, or InfoVet). *Fertility Focus* might report for example:

Empty rate - the % of cows not pregnant after 12 weeks of mating

Your herd = 11% (10 -13%); aim for 6%,

Star rating \* (1-star which is a below average result)

- 11% is the best overall estimate based on a statistical survival analysis.
- 10% is the most “optimistic” estimate assuming all culled cows were pregnant when culled.
- 13% is the most “pessimistic” estimate assuming all culled cows were empty when culled.
- 6% is the target a farmer in the top quartile might expect to achieve after a 12 week mating period

LUDF have reported empty rate since around 2005 in conservative or “pessimistic” terms, as indicated by the 13% number in the example above. Farmers often report their herd’s empty rate like the 10% example above, so they have been viewing their results in “optimistic” terms, often irrespective of weeks of mating. Consequently many farmers might interpret LUDF results worse than their own, when their respective results might be similar if calculated on the same basis.

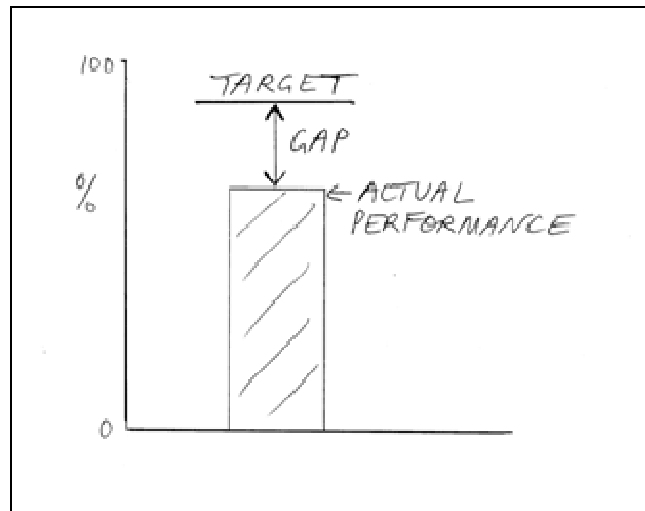
## ***Fertility Focus traps for the unwary***

Be aware that all cows not confirmed pregnant or empty, are considered by *Fertility Focus* to be not-in-calf or empty until records confirm their reproductive status by pregnancy testing. This applies to cows coded “doubtful” from an early scan and awaiting rechecks. It also applies to any cows not recorded culled, that have no pregnancy test records. These are common causes of *Fertility Focus* reporting higher than expected empty rates. Before the pregnancy status of all cows is accounted for, the empty rate shown on *Fertility Focus* report will overstate the final result.

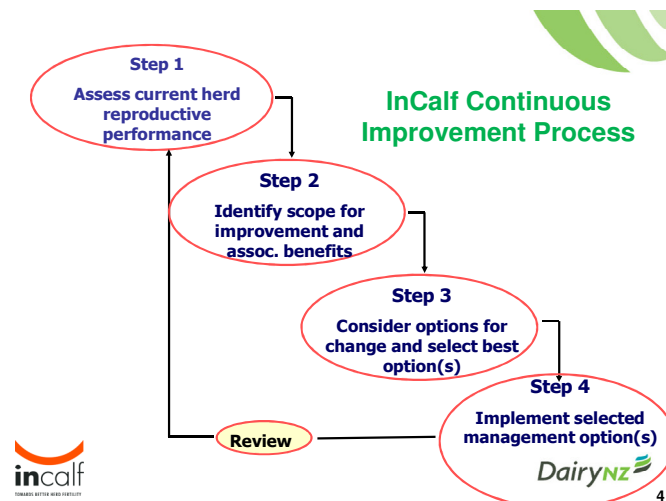
## ***Assess the performance gap and the scope for improvement***

Rather than debate which is the “true” number, farmers should realise their opportunity to improve firstly 6-week in-calf rate, then empty rate for the length of mating.

Farmers and advisers should “assess the performance gap” between their actual overall reproductive performance and achievable targets, for 6-week in-calf rate and empty rate (Figure 1). Then start to develop a strategy to deliver measurable improvement in future, following the InCalf continuous improvement process (Figure 2). With InCalf adviser support, select options and plan actions that deal with the underlying cause of the herd’s reproductive performance gaps. Then review progress referring back to *Fertility Focus* next year.



**Figure 1.** The Performance Gap concept used in InCalf Farmer Action Group programme



**Figure 2.** The InCalf 4-step continuous improvement process

## Reproductive performance of LUDF herd

LUDF records are reported for seven seasons using InCalf measures for overall reproductive performance, the 6-week in-calf rate and empty rate. The two drivers of 6-week in-calf rate, the 3-week submission rate and conception rate are also reported.

We compare actual performance with achievable targets defined by InCalf in *The InCalf Book for NZ Dairy Farmers* (Burke, 2008a), and reported on *Fertility Focus* report. We identify performance gaps - the difference between actual and target performance. The InCalf star ratings on *Fertility Focus* highlight these performance gaps, where 1-star indicates a large gap, 3-stars a moderate gap, and 5-stars little or no gap.

**Table 1.** The 6-week in-calf rate at LUDF compared to InCalf 78% target

(Fertility Focus has calculated 6-week in-calf rate in 2008 and 2009; otherwise results were manually calculated from pregnancy test data.)

Mating Season	2003	2004	2005	2006	2007	2008	2009
Actual 6-week in-calf rate	61%	52%	65%	67%	66%	67% (67-68%)	74% (74-75%)
InCalf target	78%						
InCalf star rating	*	*	*	*	*	*	*****
Performance gap	17%	26%	13%	11%	12%	11%	4%

Table 1 shows 6-week in-calf rate is below 68%, with 1-star ratings in all years except 2009. A 1-star rating represents an “below average result”, with barely two-thirds of cows pregnant after six weeks. In 2009 the 6-week in-calf rate improved to 74% or three-quarters of all cows pregnant after six weeks, which is close to InCalf target, and a 5-star result.

The performance gap reduced from 11% in 2008 to 4% in 2009. This 7% improvement in 6-week in-calf rate is worth a lot to LUDF. Using the *InCalf Economics of Reproduction tool* ([www.dairynz.co.nz/incalf](http://www.dairynz.co.nz/incalf)) we estimate this improvement to be worth an additional \$18,600 or \$115/ha in operating profit.

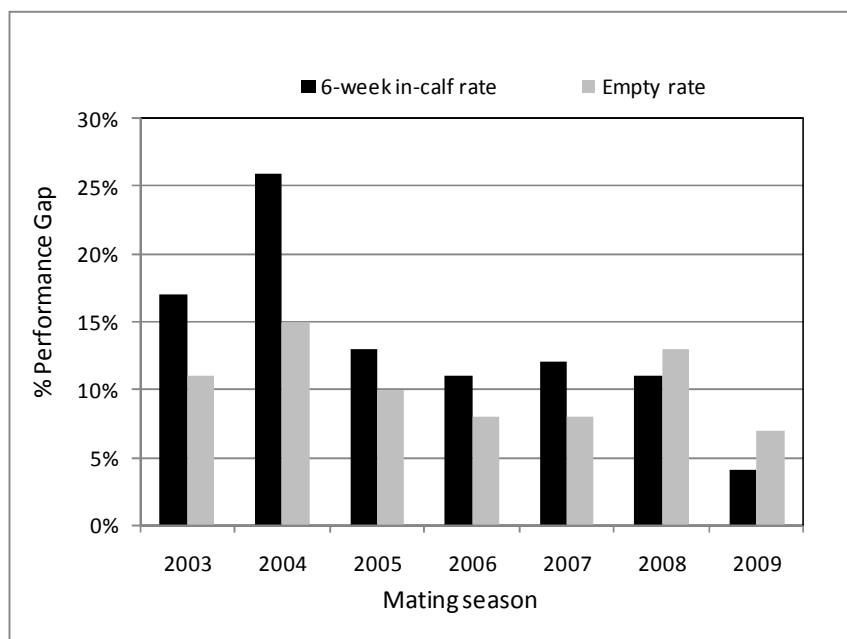
**Table 2.** The empty rate at LUDF compared to InCalf targets

(Fertility Focus has calculated empty rate in 2008 and 2009; otherwise results were manually calculated from pregnancy test data using the LUDF team method. Weeks of mating on Fertility Focus was 11 weeks based on aged pregnancy testing. Actual weeks of mating reported by LUDF was 10 weeks.)

Mating Season	2003	2004	2005	2006	2007	2008	2009
Weeks of mating	12					11	
Empty rate	17%	21%	16%	14%	14%	21% (21-22%)	13% (13-14%)
InCalf target	6%						
InCalf star rating	*	*	*	*	*	*	*
Performance gap	11%	15%	10%	8%	8%	13%	7%

Table 2 shows LUDF results for empty rate, compared against InCalf targets of 6% for 11 and 12 weeks of mating (*The InCalf Book*, p 27). The 1-star ratings represent “average or below average results” given the length of mating.

The empty rate gap in 2009 is the lowest of all years, but still some distance from target.



**Chart 1.** Performance gaps for 6-week in-calf rate and empty rate at LUDF

Chart 1 indicates incremental improvement over time on both 6-week empty rate and empty rate, but highlights a persistent performance gap beyond week six of mating that is still to be understood and resolved at LUDF. The challenge is still to close remaining performance gaps and capture further economic benefits. (Note greater performance gaps on Chart 1 indicate lower 6-week in-calf rate or higher empty rate).

### ***Drivers of the 6-week in-calf rate***

To understand where the performance gaps are flowing from we should look next at the two drivers of the 6-week in-calf rate, which are shown in level two of the *Fertility Focus* report:

- 3-week submission rate
  - Percentage of cows receiving at least one insemination or mating in the first 3 weeks of mating
- Conception Rate
  - Percentage of inseminations that resulted in a positive pregnancy test

**Table 3.** The 3-week submission rate for LUDF herd compared to InCalf target

Mating Season	2003	2004	2005	2006	2007	2008	2009
3-week Sub. Rate	84%	84%	85%	86%	87%	92%	90%
InCalf target	90%						
InCalf star rating	***	***	***	***	***	*****	*****
Performance gap	6%	6%	5%	4%	3%	0%	0%

Table 3 indicates the team has a strong focus on achieving the 90% target 3-week submission rate. These submission rate results have been supported by non-cycling hormonal intervention, except in 2009.

**Table 4.** The conception rate for the LUDF herd compared to InCalf targets

(In the absence of pregnancy test results in 2005 to 2007, *Fertility Focus* calculates a non-return rate (NRR) from mating data, as a proxy measure of conception rate. The target NRR of 64% was used to generate the performance gap for these three years)

Mating Season	2003	2004	2005	2006	2007	2008	2009
Non-return rate (NRR)			51%	48%	44%		
Aim above NRR *	64%						
Conception Rate	44%	40%				40%	57%
InCalf Target	60%						
InCalf star rating	*	*	*	*	*	*	***
Performance gap	16%	20%	13%	16%	20%	20%	3%

Table 4 indicates the LUDF herd has an ongoing challenge achieving conception rates in excess of 45%, except in 2009 when performance was a massive improvement at 57%. This led to the question of “what factors affect conception rate?”, and what is unusual in large South Island herds that often results in chronically low conception rates.

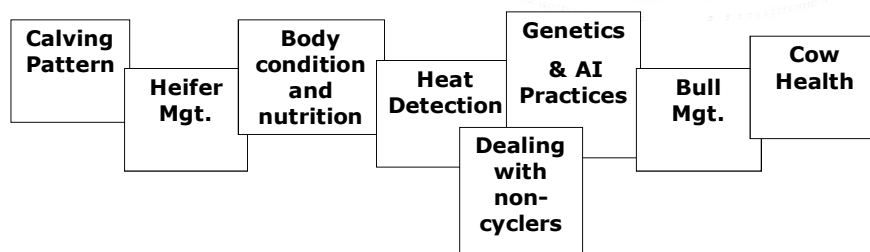
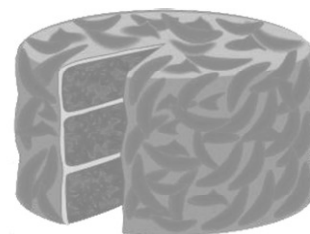
A study, funded by DairyNZ, MAF Sustainable Farming Fund, LUDF and SIDE is now underway to identify the underlying reasons for chronically low conception rates that are apparent in many large South Island herds, such as LUDF.

## Areas of management with scope for improvement

How can any herd achieve target submission rate (90%) and conception rate (60%) at the same time, to achieve the InCalf 6-week in-calf rate and empty rate targets? Let’s consider each of the eight key management areas InCalf identifies in Figure 3 to explain a given level of herd reproductive performance.

## Herd Fertility

- Is like a cake
- Herd management areas  
- 8 ingredients in NZ





**Figure 3.** The eight management areas (‘ingredients of the herd fertility cake’) identified as being the most influential on dairy herd reproductive performance in New Zealand (Morton, 2010; Xu and Burton, 2003).

### ***Calving pattern***

Calving for about 10% of the herd was induced at LUDF in 2001 and 2002. This was prior to the adoption of a ‘zero-induction’ policy for the 2003 calving and LUDF has remained a zero-induction herd ever since. The early move not to use inductions to tighten calving pattern was in response to industry demands to reduce, and possibly eliminate, the need for this intervention (Bodeker, 1998), as well as farmer demands to demonstrate how a zero-induction policy would work. A strategy for a sustainable zero-induction policy was tested using the DairyNZ Whole Farm Model. This exercise showed that a proposed plan for having synchronised AB mated heifers calving earlier than the main herd would mitigate for a zero-induction policy (Beukes, 2005).

This strategy was adopted and has been very successful at LUDF, shifting calving pattern from the 1-star ratings in 2003 to mostly 5-star ratings from 2005 onwards. The establishment of this stable and desirable calving pattern, particularly for young cows, has had flow on benefits for other performance areas, such as a consistent reduction through seasons in the percentage of cows without a pre-mating heat. As the calving pattern has improved it has been appropriate to delay the herd Planned Start of Calving from 29 July 2007 to 2 August 2008 and to 8 August in 2009 (Clark, 2009) to retain the same mean calving date.

### ***Heifer Management***

The consistent 5-star calving pattern for heifers reflects good heifer rearing and mating at 15-months of age. The 5-star rating in 3-week submission rate for first calvers (all years from 2005 onwards) follows this great calving pattern, but also suggests that management of the first calvers in early lactation is also working well for LUDF. The 93% 3-week submission rate achieved by first calvers in 2009 was achieved without non-cycling treatments.

Beyond 2004, heifer management has not been limiting herd reproductive performance at LUDF. It has been noted, however, that the 2009 bull mating of heifers resulted in a poor fertility result which will affect calving pattern and possibly put at risk submission rate in 2010.

### ***Heat detection***

The heat detection indicator on *Fertility Focus* report is an early alert to possible missed heats, but cannot indicate when cows are inseminated to false heats. This indicator uses the 3-week submission rate of early calved (calved 8 weeks or more by PSM), mature (older than four years) cows. It assumes that 95% of these cows should be submitted in the first 3 weeks to indicate a ‘top result’ in heat detection performance. This measure should be interpreted along with the prevalence of

non-cycling because a serious non-cycling problem will distort its value as an indicator of heat detection.

The heat detection indicator on *Fertility Focus* reports going back to 2003 suggest that ‘missed heats’ have never been a real problem with the LUDF herd. There is evidence, however, of excessive ‘false inseminations’ such as during the 2008 mating. This may have been a consequence of testing of a prototype automatic heat detection system which resulted in an excessive number of inseminations per pregnancy during the 10 weeks of AB mating.

In 2009, the 90% pre-mating cycling rate, the 74% 6-week in-calf rate and 57% conception rate were achieved using standard best-practice heat detection procedures. A very normal pattern of return interval analysis indicated heat detection in 2009 was very good during the 6-week AB mating period, even though the *Fertility Focus* heat detection indicator was just below 3-star trigger level. It was also noted that some of these early calved mature cows were mated for the first time at around 22 to 24 days after the PSM, a likely reason for them not being submitted in the first 3 weeks.

#### *Dealing with non-cyclers*

Pre-mating heat detection is carried out routinely to assess the level of pre-mating cycling activity and to identify non-cycling cows for possible early treatment. Early intervention of non-cyclers has traditionally been performed. The exception was the 2009 mating where 90% of cows had a recorded pre-mating heat, so there was no case to use non-cycling treatments.

**Table 5.** The pre-mating cycling rate at LUDF over seven seasons

<b>Mating Season</b>	<b>2003</b>	<b>2004</b>	<b>2005</b>	<b>2006</b>	<b>2007</b>	<b>2008</b>	<b>2009</b>
Pre-mating cycling rate	66%	68%	77%	70%	80%	78%	90%
InCalf target	85%						
InCalf star rating	***	***	*****	***	***	*****	*****
<b>Performance gap</b>	<b>19%</b>	<b>17%</b>	<b>8%</b>	<b>15%</b>	<b>5%</b>	<b>7%</b>	<b>0%</b>

The pre-mating cycling rate has improved over the last seven years, exceeding for the first time in 2009 the 85% InCalf target. Not only does this mean that there are fewer ‘subfertile’ non-cyclers to deal with, it also indicates the herd (cyclers included) at the start of mating is highly fertile, having effectively achieved a 90% submission rate before mating even started! Maintenance of a tight calving pattern, especially for young cows, and a low level of non-cycling will be key for LUDF to continue achieving a 5-star 6-week in-calf rate and working further to close the empty rate gap.

### *Genetics and AB practices*

There was a strong perception around 2005 that the genetics in the herd was limiting reproductive performance. The breed composition has since shifted away from Holstein Friesian to a cross bred herd, using Jersey and Kiwicross AB over synchronised heifers and a relatively high replacement rate (typically 24% up to 27% in 2009). After years of heavy culling against infertility, there should be little reason why genetics are now limiting reproductive performance.

Herd average Fertility BV (and average reliability) in March 2010 is 1.6/32, and average Liveweight BV is 0/34, both typical of animals in the national herd. Herd BW is 120/49 and PW is 139/66, indicating that the LUDF herd is in the top 10% of NZ herds genetically, and is exploiting a good deal of hybrid vigour for both production and reproduction.

AB inseminations at LUDF are performed by a professional technician who is monitored and verified to be optimising conception rates as much as the AB technician can possibly achieve.

### *Bull management - and performance after week six*

Like many South Island herds, bull management presents challenges to LUDF to the extent that in 2008 the herd was mated entirely to AB for 10 weeks. In 2009, bulls followed six weeks of AB but failed to get as many cows in calf as they could have, leaving 13% of cows empty. Those same bulls were initially used for yearling matings with poor in-calf rates for the heifers. Performance beyond week six was similarly poor in 2008 without any bulls, suggesting that historically low in calf rates beyond six weeks mating may also include some failure on the cows part, or management unrelated to bulls, during this period. This issue will be looked at more closely during the 2010 mating.

### *Cow health*

The LUDF animal health policy is to have a healthy herd, and to invest proactively to minimise any cow-health issues. The *InCalf Individual Cow Health tool* ([www.dairynz.co.nz/incalf](http://www.dairynz.co.nz/incalf)) was used in 2008 to assess whether any abnormally high prevalences of animal health problems might be influencing herd level reproductive performance. Assisted calving was the only area identified with more than normal health problems, and possibly the result of proactive management by farm-staff.

Neospora and BVD have historically been considered as possible risks to reproductive performance at LUDF, as has been the case with many large herds with apparently high empty rates. Investigations were undertaken but nothing conclusive was found. In spring 2009, following a bulk milk test, the herd was vaccinated for BVD pre-mating to minimise this potential risk.

### *Body condition score (BCS) and nutrition*

Historical BCS records for the seven seasons at LUDF are not in a form easily comparable to InCalf targets, which requires a minimum 70 cows scored randomly at key times, so that the herd BCS profile, as well as average, can be assessed against InCalf targets.

Management practice at LUDF is diligent in applying drying off decision rules and differential mob management to achieve BCS targets at calving. Strategic drying-off and extra care of light and young cows has been a feature of LUDF to ensure these BCS and calving targets are met.

There is no evidence that LUDF has failed to achieve BCS 5 at calving, or very close to the optimal condition score range 5.0 to 5.5. It is probable that the improved 6-week in-calf rate in 2009 is associated with a herd BCS average and BCS profile that does meet the InCalf target of 5.0 to 5.5 at calving, with not more than 15% of cows below 5.0, and not more than 15% of cows above 5.5.

Routine BCS recording of the whole herd is now being assessed monthly (since November 2009) to ensure this management area is not a major contributor to reduced reproductive performance. Pre-mating 2009 BCS was recorded at average 4.5 with only 2% of the herd less than BCS 4.0, well exceeding InCalf targets at mating. The herd did not appear to lose excessive condition (more than 1.0 BCS) from calving to mating. This may or may not have been supported by once-daily milking for up to three weeks from calving.

Grazing management practices at LUDF are scrutinised rigorously by the management team at the weekly farm walk, by visiting dairy farmers and via the SIDDC website. Pre-grazing and post-grazing pasture masses are assessed daily to ensure cows feed intake allocations are met, along with the achievement of pasture utilisation targets. Grass silage supplements are fed only as required to fill pasture feed gaps to maintain intakes and achieve grazing management targets, with reference to the weekly feed wedge assessment. Varying amounts of grass silage can be introduced or removed rapidly as required, because it is the same feed type as pasture.

Attempts to analyse milk production indicators to assess herd nutrition in comparison to published nutritional checks in *The InCalf Book for NZ Dairy Farmers* has demonstrated the limitations of this approach with pasture based systems, especially the fat % and protein:fat ratio. This concurs with Australian expert opinion on pasture-based diets (J M Morton *pers. comm.*). Study of individual lactating cows has shown that rumen function is not abnormal under LUDF management on high quality, pasture diets (Gibbs 2008; Gibbs 2009).

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- [www.siddc.org.nz](http://www.siddc.org.nz)

