**The impact of reduced mobility score in the pre-breeding period on the fertility of dairy cattle in a seasonally breeding pasture-based system**

**Summary**

The impact of reduced mobility score on the fertility was assessed in 130 cows on a split-calving pasture-based New Zealand farm. For this research the 130 cow autumn-calving herd was analyzed. The breeding season of 9 weeks consisted of 6 weeks AI followed by 3 weeks of natural mating. Forty cows had a locomotion score (LCS) of 2 or 3 for more than 2 times during the prebreeding period. Nineteen of these cows did not get pregnant in the breeding season.

There was found a significant relation between average LCS and not getting pregnant in the breeding season and there was found also a significant relation between more than 2 times LCS 2 or 3 during the prebreeding period and not getting pregnant in the breeding season. There was found no significant relation between more than 4 times LCS 2 or 3 during the prebreeding period and not getting pregnant in the breeding season.

**Introduction**

Lameness is the third most important problem on many modern dairy farms after mastitis and reproductive failure. Lameness negatively impacts dairy herds by contributing to reproductive inefficiency and causing economic losses1. Lame cows resume normal post-partum activity significantly more slowly than their non-lame cohorts 2, are mounted less frequently and express oestrus with lower intensity (Walker et al 2010) and have significantly reduced conception rates 3.

Lameness has been classified as the most important welfare problem in dairy cows and its observation is the most representative animal-based indicator of welfare in dairy cattle. 4.

Morris et al. 2008 shows that lameness reduced the proportion of cows that ovulated and the synergistic effect of high Somatic Cell Count (SCC) and lameness reduced that proportion further. However, follicular growth and maximum follicular diameter were unaffected by high SCC, low BCS or lameness. 5

Overall, the proportion of animals that ovulated was depressed only in the lame animals. However, in the presence of both lameness and high SCC, the proportion of ovulating animals was lower than with each condition alone. Dominant follicles grew at the same rate to the same maximum diameter and ovulated at the same time as healthy animals. 5 The study of Morris et al. 2008 supports the hypothesis that lame cows are less likely to ovulate. 5 This could be related to Melendez et al. 2003 who suggests that there is a greater incidence of ovarian cysts in lame cows.9

Garbarino et al. 2004 suggests that some lame cows have a delayed return to regular ovarian/ ovulation cyclicity in the early post-partum period.2

Morris et al. 2011 shows that the failure of lame cows to express estrus and ovulate is associated with a reduced LH pulse frequency, lower estradiol concentrations or responsiveness to estradiol, and the absence of an LH surge. 6 Those animals in the study of Morris et al. 2011 that did ovulate (100% Healthy cows and 50% of all Lame cows) had similar progesterone profiles in the following luteal phase. This indicates that the low pregnancy rate in lame cows is due to failure of ovulation and not due to failure of luteal support during the early luteal phase.6

Morris et al. 2011, suggests that lameness, mediated by an associated low LH pulse frequency, either tends to delay the formation of a good follicle, and hence may delay optimum corpus luteum growth and function.2 On the contrary Mann et al. 2001 shows that the successful maternal recognition of pregnancy in cows depends on the presence of a sufficiently well developed embryo producing sufficient quantities of IFN-tau, which is, in turn, dependent on an appropriate pattern of maternal progesterone secretion.7

Morris et al. 2011 shows also that in the period of 30-80 days post-partum, there was a graded effect of lameness in dairy cows, ranging from a total shut-down of ovarian activity (not even responding to exogenous hormonal stimulation) to ovarian activity being unaffected by lameness.6

In this study fewer lame cows ovulated and the interval from prostaglandin (PG)injection to ovulation was shorter in lame cows. In a subset consisting of 20 animals, the LH pulse frequency was similar in ovulating animals (Lame and Healthy) but lower in Lame non-ovulators. An LH surge always preceded ovulation but lameness did not affect the interval from PG to LH surge onset or LH surge concentrations. Before the LH surge, estradiol was lower in non-ovulating cows compared to those that ovulated and estradiol concentrations were positively correlated with LH pulse frequency. An interesting finding of this study was that lame ovulating cows had a less intense estrus than healthy cows, although lame cows began estrus and stood-to-be-mounted earlier than healthy cows.6

In the early post-partum period of healthy cows, FSH provokes initial follicle growth. Adequate LH pulses then stimulate estradiol production by late follicular phase dominant follicles and this is followed sequentially by estrus behavior, an LH surge, ovulation and formation of a functional corpus luteum (defined as one producing maximum progesterone concentration for 12-15 d). The formation of a functional , good quality corpus luteum with a mature progesterone profile requires a functional dominant follicle.10

Sood et al. 2009 shows that lameness affects the reproductive performance of cows. In this study lameness did not affect the dominant follicles that developed but failed to ovulate, but more the number of small follicles hints at some perturbance in the follicular dynamics of lame cows that need to be addressed in the light of the mechanisms governing follicular dynamics. In conclusion, the presence of lameness did not affect the characteristics of the follicles at the origin of the wave, selection and the growth as well as regressing phases of the dominant follicles. The dominant follicles developed but fail to ovulate in both the non lame and the lame cows. The lame cows, however, tended to have a higher number of small follicles which needs to be substantiated with the mechanisms dictating follicular dynamics. 11

Lameness has been recognized as a serious problem to dairy economics through reduced reproductive and production potential and increased culling rate of the affected cows. The mean prevalence of clinical lameness was 24.6%, which was 3.1 times greater, on average, than the prevalence estimated by the herd managers on each farm. 12 This research of Espejo et al. 2006 indicates that producers tend to underestimate the prevalence of lameness in their herds.

Gibbs 2010 found that the mean annual incidence of lameness in 43 South Island dairy farms with a mean herd size of 718 cows was 26,2%, with a range of 4.3-64.4%. The peak incidence of lameness was observed during the summer months, from approximately 120 days after the start of calving. The annual incidence of lameness in this study was greater than previously reported for comparable pasture based systems in the North Island or Australia, and the timing of peak incidence of lameness reported contrasted with other New Zealand and international report where peak incidence was reported within 90 days in milk. The greater annual walking distances that are feature of large, pasture based herds in the South Island may be an influential factor in the results reported in this study.14

The study of Lawrence 2011 showed that as the high level of sole injury appears to be related to a pasture-specific problem; it is also not surprising that the link between heifers and sole injury has not been commonly reported before. The etiology of this link is unclear. The time series analysis further strengthened the conclusion that the three diseases (white line disease, sole injury and axial disease) have different risk factors, as, even in the strongly seasonal New Zealand system, there were significant differences in seasonality between them. 16

In the study of Whay et al. 2003 the prevalence of lameness in the first-lactation cows was 12.8% and the prevalence increased on average at a rate of 8 percentage units per lactation. Underconditioned cows had a higher prevalence of clinical lameness than normal or overconditioned cows. 4

Alawneh et al. 2012 performed research on the interval between detection of lameness by locomotion scoring and treatment for lameness. In this study all cows which had a locomotion score LCS >3 were presented for lameness treatment subsequently, although >40% were treated more than three week after being identified as lame. Only 75% of events where cows had an LCS of 3 were followed by treatment, with the majority of those occurring weeks later. Overall, the estimated median interval length from the onset of a LCS >2 (3) to lameness detection was 28 days (95% CI=21-48). As with previous studies which have shown that farmers are better at detecting severely lame cows than moderate lame cows, this study shows that cows with an LCS of 4 or 5 were more likely to be treated for lameness than those with an LCS of 3 and that this treatment was likely to be given more quickly.

The main impact of farmer-recognition of lameness is not that lame cows are never recognized, but that this recognition and subsequent treatment, is delayed. Scoring of the locomotion on a regular basis is strongly recommended in reducing this delay but it is not practicable on the large farms which predominate in New Zealand. 18 Nevertheless use of locomotion scoring helps to identify cows at earlier stages of lameness, and hence treatment results in faster recovery and reduced treatment costs. 13 Cows that have been lame for several weeks require more inseminations per pregnancy and have a lower pregnancy rate to the first insemination after calving. 3,8

As mentioned before lameness has been shown to contribute to reproductive inefficiency and an increased risk of culling in dairy cows. Sprecher et al. 1997 developed a 5-point lameness scoring system that assessed gait and placed emphasis on back posture. The objective of this study was to determine if this system predicted future reproductive performance and the risk of culling. The study was conducted at a commercial dairy farm with a herd size of 66 primiparae and pluriparae cows with a history of declining reproductive efficiency and an increasing prevalence of lameness. All cows received an initial lameness score during bi-weekly visit preceding completion of their 60-day voluntary waiting period. Cows were enrolled in the experiment when their voluntary waiting period was completed without the owner declaring an intention to cull. Lameness scoring continued at 4-week intervals and ceased with conception or culling. Among those enrolled cows, 51 (77.3%) became pregnant and 15 (22.7%) were culled. Most of the culled cow (73.3%) were never serviced. Lameness, defined as lameness score >2, was prevalent. The number and percentage of cows with mean lameness score >3 at first service and in total were 14 (24,5%) and 24 (36,4%), respectively. The number and percentage of cows with mean lameness score >2 at first service and in total were 27 (49.1%) and 43 (65.2%), respectively. At first service, the lameness score mean, standard deviation, median, and range were 2.50, 1.05, 2.00, and 1 through 3, respectively. Having a lameness score > 2 predicted that a cow would have extended intervals from calving to first service and to conception, spend or be assigned to more total days in the breeding herd, require more services per pregnancy and be 8.4 times more likely to be culled.1

In the study of Hernandez et al. 2005 time to conception was compared among cows classified as non-lame, moderately lame and lame. In cows classified as lame, time to conception was compared among cows that were classified as lame with low, medium, or high cumulative locomotion scores. In this study the period of 8 weeks postpartum was chosen as the interval of interest because the incidence (60%) of lameness was highest during that time of period and because the synchronization program protocol was initiated at 58 to 63 days postpartum, the end of the voluntary waiting period on the study farm. 154 (31%), 214 (43%), and 131 (26%) cows were classified as non-lame, moderately lame, and lame, respectively. Most cows classified as lame had laminitis (54%) or disorders of the claw (33%). 17

Hernandez et al. 2005 shows that median time to conception was 36 to 50 days longer in lame cows than in non-lame cows. The risk of conception failure appeared to increase in lame cows with high scores, compared with cows with low scores, but the difference was not significant (P=0.07) Among lame cows, the median time to conception was 66 days longer in cows with high cumulative locomotion scores (200 days) than in cows with low scores (134 days). The effect of lameness on ovarian activity have been described; in a previous study conducted in the same herd used in this study, cows that were lame during the first 35 days postpartum had 3.5 times the odds of delayed ovarian cyclicity as non-lame cows. In that study, they hypothesized that because lame cows lose more body condition (and hence remain in a prolonged state of negative energy balance) during the early post-partum period, they are at higher risk of delayed resumption of estrous cycling than non-lame cows. 17 Other studies showed that underconditioned cows had a higher prevalence of clinical lameness than normal or overconditioned cows. 4,12,13

Lame cows with delayed ovarian cycling during the pre-breeding postpartum period would be expected to have a longer calving-to-conception interval when lameness is not resolved. 17

The data from Alawneh et al. 2011 suggest that the impact of lameness on fertility in pasture-based systems is similar to that recorded in housed cattle. Overall, in this study the risk of conception was reduced by a factor of 0.78 compared with non-lame cows and the median days from PSM to conception was 10 days longer for lame cows than non-lame cows (40 vs. 30 days). In a seasonal system, this delayed time to conception will have significant impact on the length of the subsequent lactation and thus the economic productivity of the cow. 15

The New Zealand dairy industry is based on the conversion of pasture into milk and it is highly seasonal. Most research on the relationship between lameness and fertility has focused on housed dairy cattle in non-seasonal systems. To extrapolate these results to seasonal pasture-based systems may not be warranted, because the differences between the systems may affect the relationship between lameness and fertility. Because the risk factors for lameness and seasonality of disease may be different in non-seasonal systems which use housing.

Also timing of peak lameness post partum is important as it is likely that the financial impact of lameness is dependent, in part, on when a cow becomes lame. For example, the costs associated with lameness of a cow that is clinically lame during the breeding season are likely to be higher compared to cows that become lame when already pregnant. 16

Only limited information is available that has focused on the impact of lameness in seasonal systems.

More data on the relationship between reproduction and lameness in seasonal pasture-based systems are required.

**Aim of the study**

A pilot project looking at the association between lameness and fertility under New Zealand conditions, in particular whether cows with reduced locomotion scores have reduced fertility.

**Hyposthesis**

Cows with reduced locomotion scores have reduced fertility.

**Materials and Methods**

A prospective cohort study was performed, using *n* = 144 mixed age dairy cows that calved between March and June 2011 in a dairy herd in Palmerston North, New Zealand.

*Reproductive management*

Planned Start of Calving (PSC) started on 19 March 2011 and Planned Start of Mating (PSM) started on 10 June 2011. Artificial Insemination (AI) was performed for the first 6 weeks, followed by a further 3 weeks of natural breeding. Pregnancy diagnosis was performed using a combination of rectal palpation and ultrasound examination after the end of the 9-week mating period. Date of conception for each cow that was confirmed to be pregnant was defined as the date of the last recorded breeding event.

*Data collection*

All cows were individually locomotion scored (LCS) as they left the milking parlour after the afternoon milking, twice weekly during the prebreeding postpartum period, by one trained student/technician using the method described by DairyCo©. At each scoring moment around 80 % of the cows were scored. The DairyCo-method is a 4-point lameness scoring system that assesses gait and posture.

Table 1 DairyCo© Mobility Score

|  |  |  |
| --- | --- | --- |
| **Lameness score** | **Clinical descripton** | **Assessment criteria** |
| **0** | Good mobility | Walks with even weight bearing and rhythm on all four feet, with a flat back |
| **1** | Imperfect mobility | Steps uneven (rhythm or weight bearing) or strides shortened; affected limb or limbs not immediately identifiable. |
| **2** | Impaired mobility | Uneven weight bearing on a limb that is immediately identifiable and/or obviously shortened strides (usually with an arch to the centre of the back) |
| **3** | Severely impaired mobility | Unable to walk as fast as a brisk human pace (cannot keep up with the healthy herd) and signs of score 2. |

The LCS data were collected in a datasheet in Microsoft Excel 2010© and the reproduction data were collected from the software programme Infovet© which is a management programme for New Zealand Veterinarians.

*Statistical analysis*

The statistical data analysis was performed with IBM SPSS 20©. For the analysis of the data the cows were separated in three different groups.

* + A group of cows which were scored more than 2 times LCS 2 or 3 during the prebreeding period.
	+ A group of cows which were scored more than 4 times LCS 2 or 3 during the prebreeding period, this was to analyze if a longer period of reduced mobility score had an effect on fertility.
	+ A group consisting of all the cows with the individual average LCS during the pre-breeding period

The groups were analyzed for Calving-Conception interval, PSM-Conception interval and Pregnant or not Pregnant in the breeding season, by using independent-samples T-Test and Chi-square Test.

**Results**

In total 144 cows were enrolled in this study from which 14 cows were excluded on the basis of incomplete data. Table 2 provides a summary of the descriptive statistics for the Calving to Planned Start of Mating (PSM) interval, Calving Interval, Planned Start of Mating (PSM) to Conception interval, Calving to Conception interval, and Average Locomotion Score (LCS) for the group of cows used in this study.

Table 2: Descriptive statistics of Calving to Planned Start of Mating (PSM) interval, Calving Interval, Planned Start of Mating (PSM) to Conception interval, Calving to Conception interval, and Average Locomotion Score (LCS).

|  |
| --- |
| **Statistics** |
|  | Calving – PSM(days) | Calving Interval(days) | PSM – Conception(days) | Calving – Conception(days) | Average LCS |
| N | Valid | 130 | 100 | 100 | 100 | 130 |
| Missing | 0 | 30 | 30 | 30 | 0 |
| Mean | 72,88 | 399,96 | 44,48 | 117,96 | ,780096 |
| Median | 76,50 | 391,00 | 35,00 | 109,00 | ,714286 |
| Minimum | 20 | 334 | 0 | 52 | ,0000 |
| Maximum | 104 | 554 | 205 | 272 | 3,0000 |
| Percentiles | 25 | 62,00 | 372,00 | 19,00 | 90,00 | ,262500 |
| 50 | 76,50 | 391,00 | 35,00 | 109,00 | ,714286 |
| 75 | 89,00 | 410,75 | 48,25 | 128,75 | 1,182353 |

The distribution of calving to conception interval for the group of cows used in this study is showed in figure 1. The study was performed in a split calving herd. The open cows after the breeding season from the autumn calving herd are moved to the spring calving herd, this explains the fact that there are cows with an extended calving to conception interval.



Figure 1: Distribution of Calving to Conception interval (days)

The distribution of PSM to conception interval for the group of cows used in this study is showed in figure 2. The study was performed in a split calving herd. The open cows after the breeding season from the autumn calving herd are moved to the spring calving herd, this explains the gap between 60 and 110 days.



Figure 2: Distribution of PSM to Conception interval

No clear relationship between the calving to conception interval and het average LCS was observed for the cows used in this study. The results are showed in figure 3.



Figure 3: Scatter plot of Calving to Conception interval in relation with the Average LCS

A significant relation was found between cows that scored more than 2 times a LCS 2 or 3 during the pre-breeding period and not getting pregnant during the breeding season (P<0.05). In total 40 cows scored more than 2 times LCS 2 or 3 and 19 of these cows did not conceive during the breeding season. The statistic analysis is showed in table 3.

Table 3: Chi-Square Test for the cows that scored more than 2 times a LCS 2 or 3 during the pre-breeding period in relation with pregnant or not in the breeding season.

|  |
| --- |
| **More than 2 times LCS 2 or 3 \* Pregnant in breeding season Crosstabulation** |
| Count |
|  | Pregnant in breeding season | Total |
| 0 | 1 |
| More than 2 times LCS 2 or 3 | 0 | 23 | 67 | 90 |
| 1 | 19 | 21 | 40 |
| Total | 42 | 88 | 130 |

|  |
| --- |
| **Chi-Square Tests** |
|  | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
| Pearson Chi-Square | 6,098a | 1 | ,014 |  |  |
| Continuity Correctionb | 5,136 | 1 | ,023 |  |  |
| Likelihood Ratio | 5,928 | 1 | ,015 |  |  |
| Fisher's Exact Test |  |  |  | ,016 | ,012 |
| Linear-by-Linear Association | 6,051 | 1 | ,014 |  |  |
| N of Valid Cases | 130 |  |  |  |  |

No significant relation was found between cows that scored more than 4 times a LCS 2 or 3 during the pre-breeding period and not getting pregnant during the breeding season (P>0.05). In total 32 cows scored more than 4 times LCS 2 or 3 and 19 of these cows did not conceive during the breeding season. The statistic analysis is showed in table 4.

Table 4: Chi-Square Test for the cows that scored more than 4 times a LCS 2 or 3 during the pre-breeding period in relation with pregnant or non-pregnant during the breeding season.

|  |
| --- |
| **More than 4 times LCS 2 or 3 \* Pregnant in breeding season Crosstabulation** |
| Count |
|  | Pregnant in breeding season | Total |
| 0 | 1 |
| More than 4 times LCS 2 or 3 | 0 | 28 | 70 | 98 |
| 1 | 14 | 18 | 32 |
| Total | 42 | 88 | 130 |

|  |
| --- |
| **Chi-Square Tests** |
|  | Value | df | Asymp. Sig. (2-sided) | Exact Sig. (2-sided) | Exact Sig. (1-sided) |
| Pearson Chi-Square | 2,541a | 1 | ,111 |  |  |
| Continuity Correctionb | 1,895 | 1 | ,169 |  |  |
| Likelihood Ratio | 2,462 | 1 | ,117 |  |  |
| Fisher's Exact Test |  |  |  | ,130 | ,086 |
| Linear-by-Linear Association | 2,522 | 1 | ,112 |  |  |
| N of Valid Cases | 130 |  |  |  |  |

A highly significant relation was found between the average LCS during the pre-breeding period and not getting pregnant during the breeding season (P<0,01). Cows that not conceived during the breeding season have a significant higher average LCS (1,06) than the cows that conceived during the breeding season (average LCS 0,65). Cows with a higher average LCS have a higher risk of not getting pregnant during the breeding season. The statistic analysis is showed in table 5.

Table 5: Independent Samples T-Test of Avarage LCS and Pregnant or Non-Pregnant during the breeding season.

|  |
| --- |
| **Group Statistics** |
|  | Pregnant in breeding season | N | Mean | Std. Deviation | Std. Error Mean |
| Average LCS | 0 | 42 | 1,061387 | ,7210145 | ,1112549 |
| 1 | 88 | ,645843 | ,5341892 | ,0569448 |
| **Independent Samples Test** |
|  | Levene's Test for Equality of Variances | t-test for Equality of Means |
| F | Sig. | t | Df |
|
| Average LCS | Equal variances assumed | 2,198 | ,141 | 3,690 | 128 |
| Equal variances not assumed |  |  | 3,325 | 63,251 |
| **Independent Samples Test** |
|  | t-test for Equality of Means |
| Sig. (2-tailed) | Mean Difference | Std. Error Difference |
|
| Average LCS | Equal variances assumed | ,000 | ,4155434 | ,1126009 |
| Equal variances not assumed | ,001 | ,4155434 | ,1249815 |
| **Independent Samples Test** |
|  | t-test for Equality of Means |
| 95% Confidence Interval of the Difference |
| Lower | Upper |
| Average LCS | Equal variances assumed | ,1927433 | ,6383435 |
| Equal variances not assumed | ,1658072 | ,6652796 |

No significant relation was found between PSM to conception interval or calving to conception interval and cows that scored more than 2 times a LCS 2 or 3 (P>0.05). Moreover there was no significant relation between calving to conception interval or calving to conception interval and cows that scored more than 2 times a LCS 2 or 3 (P>0.05).

Table 6: Independent Samples T-Test of PSM to Conception interval and Calving to Conception interval in relation with cows who had more than 4 times a LCS 2 or 3 during the pre-breeding period.

|  |
| --- |
| **Group Statistics** |
|  | More than 2 times LCS 2 or 3 | N | Mean | Std. Deviation | Std. Error Mean |
| PSM - Conception | 0 | 75 | 42,48 | 42,819 | 4,944 |
| 1 | 25 | 50,48 | 57,589 | 11,518 |
| Calving - Conception | 0 | 75 | 114,23 | 40,588 | 4,687 |
| 1 | 25 | 129,16 | 49,383 | 9,877 |
| **Independent Samples Test** |
|  | Levene's Test for Equality of Variances | t-test for Equality of Means |
| F | Sig. | t | df |
|
| PSM - Conception | Equal variances assumed | 3,636 | ,059 | -,739 | 98 |
| Equal variances not assumed |  |  | -,638 | 33,294 |
| Calving - Conception | Equal variances assumed | 1,297 | ,257 | -1,507 | 98 |
| Equal variances not assumed |  |  | -1,366 | 35,442 |
| **Independent Samples Test** |
|  | t-test for Equality of Means |
| Sig. (2-tailed) | Mean Difference | Std. Error Difference |
|
| PSM - Conception | Equal variances assumed | ,462 | -8,000 | 10,824 |
| Equal variances not assumed | ,528 | -8,000 | 12,534 |
| Calving - Conception | Equal variances assumed | ,135 | -14,933 | 9,909 |
| Equal variances not assumed | ,181 | -14,933 | 10,932 |
| **Independent Samples Test** |
|  | t-test for Equality of Means |
| 95% Confidence Interval of the Difference |
| Lower | Upper |
| PSM - Conception | Equal variances assumed | -29,480 | 13,480 |
| Equal variances not assumed | -33,493 | 17,493 |
| Calving - Conception | Equal variances assumed | -34,598 | 4,732 |
| Equal variances not assumed | -37,117 | 7,250 |

No significant relation was found between PSM to conception interval or calving to conception interval and cows that scored more than 4 times a LCS 2 or 3 (P>0.1). Moreover there was no significant relation between calving to conception interval or calving to conception interval and cows that scored more than 4 times a LCS 2 or 3 (P>0.1).

Table 7: Independent Samples T-Test of PSM to Conception interval and Calving to Conception interval in relation with cows who had more than 4 times a LCS 2 or 3 during the prebreeding period.

|  |
| --- |
| **Group Statistics** |
|  | More than 4 times LCS 2 or 3 | N | Mean | Std. Deviation | Std. Error Mean |
| PSM - Conception | 0 | 79 | 43,76 | 45,893 | 5,163 |
| 1 | 21 | 47,19 | 50,988 | 11,126 |
| Calving - Conception | 0 | 79 | 115,90 | 42,635 | 4,797 |
| 1 | 21 | 125,71 | 45,407 | 9,909 |
| **Independent Samples Test** |
|  | Levene's Test for Equality of Variances | t-test for Equality of Means |
| F | Sig. | t | df |
|
| PSM - Conception | Equal variances assumed | ,827 | ,365 | -,297 | 98 |
| Equal variances not assumed |  |  | -,280 | 29,195 |
| Calving - Conception | Equal variances assumed | ,250 | ,618 | -,925 | 98 |
| Equal variances not assumed |  |  | -,892 | 30,050 |
| **Independent Samples Test** |
|  | t-test for Equality of Means |
| Sig. (2-tailed) | Mean Difference | Std. Error Difference |
|
| PSM - Conception | Equal variances assumed | ,767 | -3,431 | 11,534 |
| Equal variances not assumed | ,782 | -3,431 | 12,266 |
| Calving - Conception | Equal variances assumed | ,357 | -9,816 | 10,610 |
| Equal variances not assumed | ,380 | -9,816 | 11,009 |
| **Independent Samples Test** |
|  | t-test for Equality of Means |
| 95% Confidence Interval of the Difference |
| Lower | Upper |
| PSM - Conception | Equal variances assumed | -26,319 | 19,457 |
| Equal variances not assumed | -28,511 | 21,649 |
| Calving - Conception | Equal variances assumed | -30,871 | 11,240 |
| Equal variances not assumed | -32,297 | 12,666 |

**Discussion**

During the breeding period there has been a severe outbreak of lameness of more than 30 cows which may have affected the results of this study.

Cows that did not conceive during the breeding season showed a significant higher average locomotion score (LCS) than the cows who conceived during the breeding season (LCS 1,06 vs. LCS 0,65). Cows with a higher average locomotion score during the pre-breeding period have a higher risk of not getting pregnant during the breeding season.

Also a significant relation was found between cows that scored more than 2 times a LCS 2 or 3 during the pre-breeding period and not getting pregnant in the breeding season (P<0.05). These cows had a reduced locomotion score for at least one week and these cows have a significantly higher risk of not getting pregnant during the breeding season.

On the other hand there is no significant relation between cows who had more than 4 times a LCS 2 or 3 during the prebreeding period and not getting pregnant during the breeding season (P>0,1). So these cows had a reduced locomotion score for at least 2 weeks and these cows have no significant higher risk of not getting pregnant during the breeding season.

A significant relation was found between the average LCS and not getting pregnant in the breeding season. Also a significant relation was found between more than 2 times a LCS 2 or 3 during the pre-breeding period and not getting pregnant in the breeding season. On the contrary no significant relation was found between more than 4 times a LCS 2 or 3 during the pre-breeding period and not getting pregnant in the breeding season.

It is remarkable that more than 2 times a LCS 2 or 3 has a significant relation with not getting pregnant in the breeding season and that more than 4 times a LCS 2 or 3 does not have this significant relation. One may expect that more than 4 times a LCS 2 or 3 should have a significant relation with not getting pregnant in the breeding season as well. When there is a significant relation between reduced mobility score and fertility one may expect that more than 4 times a LCS 2 or 3 is even more significant related to not getting pregnant in the breeding season than more than 2 times a LCS 2 or 3. The fact that more than 2 times a LCS 2 or 3 does have a significant relation with getting pregnant in breeding season and more than 4 times a LCS 2 or 3 does not have this significant relation could be explained by the small group of cows in this research project.

No similar analyses have been undertaken for pasture-based cattle in New Zealand. Overall, it seems to be that there is a trend in the relation between reduced mobility score and fertility and that makes sense. In a seasonal system a higher risk of not getting pregnant in the breeding is a higher risk for culling and this affects the economic productivity of the cow.

This research has been done on only one farm with 144 autumn calving cows. When you take into account that there were 4.8 million cows in the national milking herd of New Zealand in 2011 and the average herd size of dairy cattle is 386 in 2011, this small group of cows is not really representative for New Zealand.

In conclusion more data on the relation between reduced mobility score and reproduction in seasonal pasture-based systems are required.

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**APPENDIX**

**Introduction of a seasonally breeding pasture-based system in New Zealand**

In a seasonal breeding pasture-based system desirable calving pattern has been defined that at least 87% of the total number of cows of a dairy herd calves during the first 6 weeks with a limited number of late-calving cows. Late-calving cows are hard to get in calf and excessive numbers reduce herd reproductive performance. Many herds suffer from reduced reproductive performance because calving periods are spread over more than 8 weeks.

Good planning is required to take a spread calving pattern and make it more compact. The process begins by selecting the dates when mating will start and stop, and then ensuring that the majority of cows will get in calf during the fist 6 weeks of mating and any induction of parturition is managed according to the ‘Induction Code of Practice’ established by DairyNZ and The New Zealand Verterinary Association.

The link between the cow’s calving and mating dates is influenced by the policy to achieve a 365 days calving interval. A normal pregnancy is 40 weeks so conception must occur within 12 weeks after calving if she is to calve on or before the same date next year. As a cow’s normal cycle is 3 weeks, it makes sense to divide a herd’s calving calving dates into 3-week blocks in relation to the Planned Start of Calving date (PSC). These also relate to the intervals from calving to Planned Start of Mating date (PSM).

The table shows the compassion between these intervals.

Calving date and calving to Planned Start of Mating date (PSM) interval

|  |  |
| --- | --- |
| **Calving Group** | **Calving to PSM** |
| **Very early – before PSC** | **More than 12 weeks** |
| **Early – 1st 3weeks** | **9-12 weeks** |
| **Mid – 2nd 3 weeks** | **6 – 9 weeks** |
| **Late – 3rd  3 weeks** | **3-6 weeks** |
| **Very Late – within 3 weeks of PSM or later** | **Less than 3 weeks** |
| **Planned Start of Calving (PSC); Planned Start of Mating (PSM).** |

**Estimating herd reproductive performance**

**6-week in-calf rate**

This parameter provides the best calculated information for the overall reproduction performance of a herd. The actual 6-week-in-calf rate can only be calculated reliably if pregnancy testing is performed.

How to calculate:

1. Select all cows that were present at Planned Start of Mating date. This is the total number of cows.
	* Include all cow calved before and during the mating period
	* Exclude death and all culling cows
2. Estimate the number of cows that became pregnant during the fist 6 weeks of mating confirmed by pregnancy testing performed early after artificial insemination (AI).

6-week-in-calf rate = Number of cows pregnant in the first 6 weeks of mating x 100

 Total number of cows

**Empty rate**

This parameter provides calculated information of the percentage of non-pregnant cows at

the end of mating.

This measure excludes the yearling replacement heifers. The empty rate for this group can be calculated in the same way, but consider it separately from the milking herd. Likewise, empty rate for any carryover cows should also be considered separately.

How to calculate:

1. Select all cows that were present at Planned Start of Mating date. This is the total number of cows.
	* Include all cows calved before and during the mating period.
	* Exclude deaths and all cows that you did not intend to be mated.
2. From the pregnancy testing results, count how many of these cows did not become pregnant. This is the number of cows not pregnant.

Empty rate = Number of cows not pregnant x 100

 Total number of cows

**3-week submission rate**

A good 3-week submission rate must be achieved if 6-week in-calf rates are to be good.

How to calculate:

1. Select all cows that were present at Planned Start of Mating date. This is the total number of cows.
	* Include all cows calved before and during the mating period
2. Exclude deaths and all culling cows
3. How many of these cows had at least 1 insemination or mating to a natural bull in the first 3 weeks of mating? This is the number of cows inseminated in first 3 weeks of mating.
	* Cows are only counted once. Don’t count how many inseminations were performed in the first 3 weeks as some cows may have had two inseminations in that period.

3-week submission rate = Number of cows inseminated in first 3 weeks of mating x 100

 Total number of Cows

**Conception rate**

It will be difficult to achieve a good 6-week in-calf rate unless conception rate is satisfactory.

Conception rate = Number of inseminations that resulted in pregnancy x 100

 Number of inseminations

**Pre-mating cycling rate**

Top farmers achieve a pre-mating cycling rate of 85% by ensuring that well-reared heifers calve early, maintaining a compact calving, meeting condition score and efficient heat detection.

If the pre-mating cycling rate is less than 65%, you have a non-cycling problem. This could be a result of deficiencies in pre-mating heat detection and/or the presence of too many genuine non-cyclers.

How to calculate pre-mating cycling rate:

1. Select all cows that were present at the Planned Start of Calving date, and exclude any deaths since calving. This is the total number of cows.
2. How many of these cows had at least on recorded pre-mating heat between calving and the Planned Start of Mating date? Cows are only counted once if they had more than one pre-mating heat.

Pre-mating cycling rate = Number of cows observed on heat x 100

 Total number of cows

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 **Reference: DairyCo©**