The prevalence of lameness on New Zealand dairy farms: A comparison of farmer perception and mobility scoring

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Abstract

Several studies have compared the prevalence of lameness as perceived by farmers with the prevalence of lameness assessed using locomotion or mobility scoring. However all of these studies have been undertaken in housed cows; cows at pasture have not been studied. This study was designed to identify the difference between farmer perception of lameness and that identified by mobility scoring under New Zealand conditions in cows kept at pasture. Data were collected from 60 herds, 27 in the South Island and 33 in the North Island. All farms were visited on one occasion at the expected peak time for lameness, i.e. October/November for North Island farms and January / February for South Island farms. Data were collected via a questionnaire which included details on farm size, productivity and reproduction as well as general health. The latter included a farmer estimate of the number of lame cows which were currently on-farm. Whole herd mobility scoring, using the DairyCo 0 – 3 scale, was then used to estimate herd lameness prevalence. In the North Island, average herd size was 294 and average production was 357 kgMS/cow/year, while in the South Island the figures were 580 and 406 kgMS/cow/year, respectively. Of the 60 farms, lame cows were treated by farm staff only on 38 farms, by a combination of veterinarian and farm staff on 21 farms, and on one farm by veterinarians only. On average, farmers estimated that 2.2% of their herd was lame (range 0 to 20%), while mobility scoring identified that, on average, 8.1% of the herd was lame (mobility score ≥2) (range 1.2 to 36%). This means that on a herd basis, only 27.3 % (range 0 to 95%) of the cows with reduced mobility had been identified as lame by farm staff. There was no significant effect on herd size on this percentage (P=0.8), nor was there a significant differences between the two islands (South Island 28% ± SEM 4.2; North Island 23% ± 2.6). The prevalence of lameness in this study was much lower than that reported in housed cattle, but the percentage of cows with reduced mobility recognised as lame was very similar, even though in pasture-based cattle, farmers spend more time watching cows walk (to and from milking). This study shows that there is significant room for improvement in the detection of lameness on New Zealand farms, and suggests that routine mobility scoring, particularly at critical periods, could be a valuable tool for identifying lame cows.

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Chapter 1: Introduction

Lameness is a persistent problem on dairy farms worldwide, including in New Zealand. It is a serious welfare concern due to the pain and suffering it causes (Leach et al., 2010a) and because it significantly restricts the expression of normal behaviour (Rutherford et al., 2009). Clinical lameness also has a negative impact on milk production and fertility (Leach et al., 2010b, Alawneh et al., 2011). It is this combined impact of lameness on welfare and productivity which most concerns dairy farmers and is a major driver for improving lameness (Leach et al., 2010b). Economics alone is not a major motivator however, perhaps because the financial costs of lameness on farms are often unclear (Leach et al., 2010b).

One of the principal barriers to tackling lameness is the perception of the problem. Leach et al. (2010b) reported that, in the UK, 90% of the farmers did not perceive lameness to be a major problem on their farm, although the average prevalence of lameness on the farms in the survey, as identified by mobility scoring rather than farmer estimates, was 36%. Improved detection of lameness, so that farmer estimates better match actual lameness prevalence, could play a significant role in persuading farmers and farm staff on the importance of lameness on farm. Additionally, early diagnosis and treatment of lameness is likely to have a significant impact on the level of lameness in the herd and its impact (Colville et al., 2004).

Many different methods of lameness detection have been developed. There is currently much work going on in regard to automatic detection of lameness, but such systems are usually expensive and often not user-friendly (Nielsen et al., 2010; Pastell et al., 2008). Locomotion or mobility scoring, i.e. scoring the gait of the animal, is a cheaper alternative and has been widely used in research and on-farm (Whay, 2002). One of the earliest widely used systems of locomotion scoring was that used by by Manson and Leaver (1988). This was a 9-point system in which the first five scores (1 through 3 on the half point numbering scale) dealt with animals that were not clinically lame. The remaining scores (3.5 up) then depicted a deteriorating locomotion and worsening clinical lameness. The Manson and Leaver scoring system criteria are displayed in **Table 1a**. The key advantage of the system developed by Manson and Leaver (1988) was that it stressed the importance of identifying early signs of discomfort (Nordlund et al., 2004); however the nine-point system is complex and thus difficult for farmers to learn and impractical in field conditions. In addition, the large number of points on the scale can mean that within-observer repeatability and between-observer agreement are poor, particularly when the time available for observation is limited. Channon et al. (2009) compared the scores reported by five experienced observers assessing the gait of 83 Holstein-Friesian cows during a live on-farm session and then of 30 of those cows via video recordings of that session. They reported that there was high variability between observers during both the live and the video sessions, and this was repeated when within-observer variation was assessed. In both cases the proportional agreement, i.e. the number of scores which were the same divided by the number of animals scored were around 30% when the complete Manson and Leaver scoring system was used (mean 30 and 33%, for the within observer and between observer comparisons, respectively). However, analysis of the weighted kappa, which takes into account the proximity of the scores not just whether they agree, showed better agreement. This is consistent with the finding that collapsing the 9-point Manson and Leaver scale to a 2-point lame or not lame system increased proportional agreement, for both within and between-observer scoring, to >85%, showing that that observers were able to agree whether cows were lame or not, even if they disagreed as to the level of gait abnormality. This has been intrinsically recognised in most analyses of mobility scoring. For example the majority of the analysis and discussion in Manson and Leaver (1988) in regard to their score focussed on the comparison between cows which were clinically lame and those which were not, rather than on the proportion of cows at each score level. Increasing differentiating power by increasing the number of scores may thus, at least initially, seem attractive for research purposes, but, even for research purposes the extra levels usually get amalgamated before analysis, so there is little advantage to having a complex 9-point system such as that used by Manson and Leaver (1988).

Currently, the most widely cited locomotion scoring system is the 5-point scoring system introduced by Sprecher et al. (1997) (criteria displayed in **Table 1b**). This system focuses on back posture as well as on locomotion. In this system, scores 4 and 5 signify clinical lameness, scores 2 and 3 indicate sub-clinical lameness and score 1 normality. Although this is a more concise scoring system than Manson and Leaver's (1998), the distinction between scores 2 and 3 often relies on identifying back posture while standing. Since it can be difficult for an observer/farmer to watch all cows both walk and stand, (Nordlund et al., 2004) the use of back arching, as a significant criterion, can make the use of the full 5-point Sprecher system impractical and potentially inconsistent. This is particularly the case when trying to score mobility when cattle are based primarily at pasture. In such cases the majority of mobility scoring will be undertaken after milking when the cows are walking back to pasture, when there are usually only limited (and often no) opportunities to view cows standing.

The DairyCo mobility score (Barker et al., 2010) overcomes these objections as the scoring is based on locomotion alone. This scoring system uses a 0-3 scale, with a score of 0 indicating normal mobility, a score of 1 indicating a cow with moderate gait changes which should kept under further observation and scores of 2 and 3 lame cows that would benefit from treatment. This is a simple system (criteria summarised in **Table 1c**), and is designed for practical use on-farm (although it is robust enough to be used for research). This farm-focussed approach is clear from the design of the scoring sheet (DairyCo Mobility Score) which includes actions for farm staff that should be taken after the cow has been scored. So cows with scores 2 and 3 should both be examined and treated; the sheet states that score 3 cows 'will benefit from treatment' while score 2 cows 'are likely to benefit'. For score 0 and 1 cows, treatment is not recommended, but, particularly for score 1 cows, preventative trimming is suggested. These suggestions reflect the European dairy industry, where housing is a key component of the dairy system and where routine trimming has been shown to be an effective method of reducing lameness incidence (Manske et al., 2002); the benefit of routine trimming under NZ conditions is less clear (Bryan et al., 2011) and further research is required.

Table 1a: Manson and Leaver (1998) Mobility Scoring Criteria

Mobility Score	Criteria
1	Minimal ab-/adduction , no unevenness or tenderness
1.5	Slight ab-/adduction, no unevenness or tenderness
2	Ab-/adduction present/ uneven gait, maybe tender
2.5	Ab-/adduction present, uneven gait, tenderness
3	Slight lameness, normal behaviour not affected
3.5	Lameness obvious, normal behaviour not affected, difficulty in turning
4	Lameness very obvious, affecting normal behaviour, difficulty in turning
4.5	Behaviour considerably affected, unwilling to rise
5	Severely lame, adverse effects on behaviour and condition, extreme difficulty in rising, difficulty in walking

Table 1b: Sprecher et al. (1997) Mobility Scoring Criteria

Mobility Score	Criteria
0	Normal. Normal gait. Level back posture while walking
1	Mildly lame. Normal gait. Level back posture while standing, but back arched while walking
2	Moderately lame. Gait affected, short striding. Back arched while standing and walking
3	Lame. Back always arched. Only one deliberated step at a time, one or more limbs favoured.
4	Severely lame. Additionally, extreme reluctance to bear weight one or more limbs.

Table 1c: DairyCo (Barker et al., 2010) Mobility Scoring Criteria

Mobility Score	Criteria
0	Sound /"perfect" gait
1	Abnormal locomotion, but not favouring any particular limb/tender-footed gait
2	Lame and uneven or arched back
3	Severely lame with score-2 conditions and a very slow gait, "slower than human brisk walk"

Whichever system is used, scoring mobility identifies significantly more lame cows than farmer estimates or records. Wells et al. (1993) monitored lameness in 17 herds in Minnesota and Wisconsin using a 5-point system. This system was similar to Sprecher's 1-5 scale; however there was no emphasis on the cow's back posture while walking. Mobility scores ranged from 0-4 based on the severity of the gait abnormality, i.e. none, mild, moderate, severe and non-ambulatory. Wells et al. (1993) reported a mean lameness prevalence of 13.7% in summer and 16.7% in spring, which they reported was 2.5 times higher than the lameness prevalence estimated by herd managers. In a subsequent study, Espejo et al. (2006) evaluated lameness in 50 free-stall (cubicle yards) in Minnesota, using the scoring system devised by Sprecher et al. (1997), and found that the mean point prevalence of lameness was 24.6%, 3.1 times higher than farmer estimates. In the UK, Whay et al. (2003), who used a 4-point scoring system, similar to the DairyCo mobility score, reported a prevalence of lameness of 22.1%, almost four times higher than farmer estimates of 5.7%. More recently, Sárová et al. (2011), using a simple three point scale (0, not lame; 1 moderately lame; 2, severely lame) reported that, on dairy farms in the Czech

Republic, mean lameness prevalence was 31% and that this was over five times the mean estimated by farm mangers of 6%. These studies clearly show that in housed cows in the United States and Europe farm staff perceive there to be significantly fewer lame cows than are identified by locomotion scoring. Across the four studies discussed above, the mean proportion of lame cows detected by locomotion scoring which were not recognised as such by farm staff varied from 60 to 80%.

Such studies have not been undertaken in pasture-based systems such as those that predominate in New Zealand. It may be that lameness perception in such systems is better than in housed cattle. Firstly, lameness prevalence is much lower in New Zealand than in most housing systems (Mason et al., 2012), which reduces the risk of owner fatigue where the number of severely lame cows is so high that moderately lame cows are ignored (Driessen, 2007). Furthermore, cattle walk significant distances from pasture to the milking parlour, giving farm staff the opportunity to assess cow locomotion and identify those which are lame, at least once and usually twice a day. The principal aim of this study, therefore, was to use the 0-3 DairyCo mobility scoring system to estimate the prevalence of lameness on NZ farms and to compare this with farmer estimates of lameness prevalence, and to assess the relationship between lameness prevalence and other farm factors. In addition, alongside the on-farm assessment of lameness, the animal-based welfare examination developed by Whay et al. (2003) was used so that its suitability for use on-farm, under New Zealand conditions, could be assessed.

Chapter 2: Materials and Methods

Farm Visits

Sixty farms throughout New Zealand were visited during the 2010/11 season, 33 on the North Island, and 27 on the South Island. Farms were visited at the expected peak for clinical lameness; i.e. October / November in the North Island (Lawrence et al., 2011) and January/ February in the South Island (Gibbs, 2010). Farms were selected on the basis of nomination by local veterinarians. Each visit was conducted during a morning or afternoon milking and farmers were given a questionnaire to fill out on the day. The study consisted of two parts, 1) the questionnaire filled out by the farmer and 2) observations made by the observer.

Questionnaire

The questionnaire was based on that used by Whay et al (2003) and was designed to obtain information on general farm size (number of cows and hectares), calving season, average milk yield (kgMS), reproduction (empty rate and 6-week in-calf rate), average body condition score (BCS) and general health over the last 12 months (dull/sick cows, mastitis and milk fever cases, and sudden deaths or casualties). Famers were asked to indicate whether this health information was estimated or provided from records. Specific questions pertaining to lameness included the number of lame cows at the present time, who treats the lame cows and who trained that person. .

Observations

Observations were made as the cows exited the milking platform. Locomotion scoring was recorded on a flat even surface. The 4-point (0-3 score) DairyCo mobility scoring system was used. Additionally, 20% of the cows in each herd were observed to assess the herd's physical condition. Observations included the percentages of dirty flanks, dirty hind limbs, dirty udders, dull coat and BCS [1-9 scale] (McDonald and Roche, 2004). Those cows with a score below 3 were considered thin and above 7 were considered obese. All physical and lameness observations were made by a single trained observer.

Data Handling and Statistical Analysis

Data from the questionnaire and observations were compiled and entered into a Microsoft Excel spread sheet. The answers from the questionnaire and measurements taken from the observations were then grouped into five quintile bands, A to E, where each band contained 20% of the measurements, so that band A represented the top 20 percentile and E the bottom 20 percentile. Each category was independent so a farm could be in band A for one measurement, but band E for another.

For the analysis of lameness prevalence, all cows with a mobility score of 2 or 3 were recorded as lame. The prevalence of lameness for each farm was calculated by dividing the number of cows with scores 2 and 3 by the total number of cows in the milking herd. Pearson's correlation was used to assess the association between the measures. All statistical analyses were undertaken using PASW 18 (IBM).

Farm Performance Score

For each of the measurements taken by the observer on each farm, other than milk yield, a farm performance score was created based on the quintile the farm was in (band A=1, to band E=5). These scores were amalgamated to create a single overall farm performance score.

Chapter 3: Results

Farm Visits and Observations

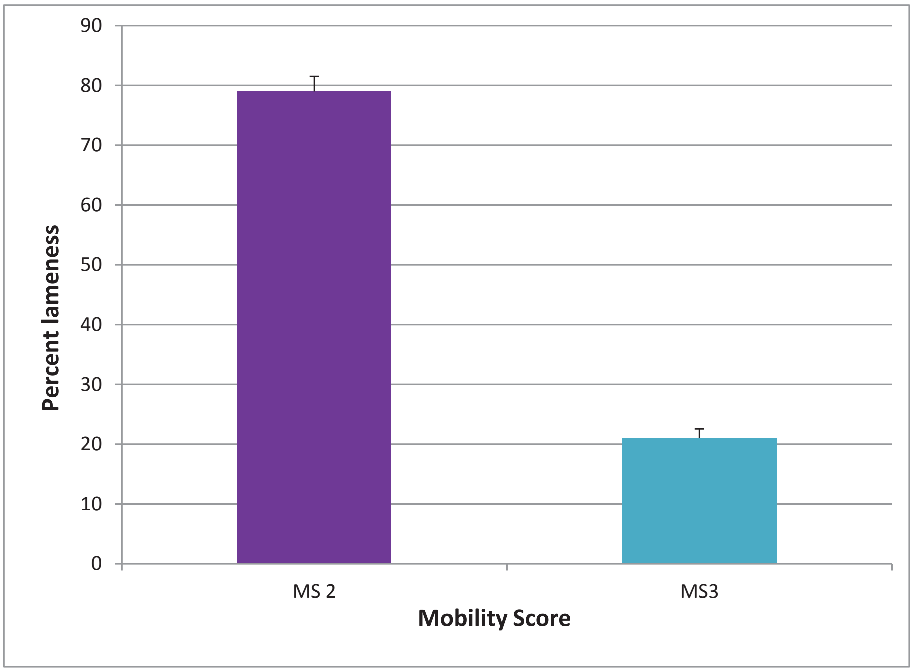
A total of 25,371 cows were observed; 9,710 cows on 33 farms on the North Island (NI) and 15,661 cows on 27 farms on the South Island (SI). Average herd size on the NI was 294 cows and on the SI 580 cows. All cows were on a predominately pasture-fed system, and milked through a herringbone or rotary milking parlour. Fifty-two of the 57 farms were spring calving, three were both spring and autumn calving and two farms, one on the NI and one on the SI, were solely autumn calving.

Actual Prevalence of Lameness versus Farmer's Perceptions of Lameness

Over all 60 farms, the mean point prevalence of lameness identified using mobility scoring was 8.3%. In contrast average lameness prevalence as estimated by farmers was 2.3%. Thus, on average, mobility scoring identified 3.7 times as many lame cows as farmer estimates. The number of lame cows was positively correlated to the total number of cows (r=0.646, P<0.0001).

Of the lame cows identified by mobility scoring, 21% were mobility score 3, 79% were mobility score 2 (**Figure 1).** For individual farms, the proportion of lame cows identified by mobility scoring that were score 3 ranged from 5 to 100%.

Figure 1: Percentage of lame cows with mobility score 2 and 3



Range of Measurements

Table 2 shows the data from the farm visits and questionnaire divided into 20% bands where band A represents the top 20%, down to band E, which represents the bottom 20%. For example, for observations of the cow's physical condition, in the bottom 40% of the herds (bands D and E,) 100% of the herd had dirty hind limbs and no thin cows BCS≤3 were seen in the top 60% of farms (bands A, B and C.) The top 20% of farms (band A) had a lameness prevalence ranging from 1.2 - 4 %, while the worst 20% (band E) had a prevalence ranging from 11.6 – 36%.

Table 2: Lameness and welfare results from direct observations and questionnaire data from farm records and/or farmer estimates on 59 dairy farms in New Zealand. For each measurement, results are divided into quintile bands where A represents the top 20% and E represents the bottom 20%. Each measurement is independent of the other measurements.

	SCORE CATEGORIES Top 20%				Bottom 20%
Measure	**A**	**B**	**C**	**D**	**E**
Observations of Physical Condition (%)					
Dirty Flanks	7.1 – 26.7	26.9 – 34.5	35.7 – 45.5	45.8 – 64.3	64.7 – 93.9
Dirty Hind Limbs	73.3 – 93	93 – 96.7	97.2 -100	100 – 100	100 – 100
Dirty Udders	0 – 13.5	14 – 21.2	21.8 – 32.1	31.2 – 41.2	41.7 – 69.6
Dull Coat	0 – 5.1	5.2 – 8.3	9.1 – 13.8	14.3 – 20	20 – 31.8
Thin Cow (BCS ≤3)*	0 – 0	0 – 0	0 – 0	0 – 0.3	0.3 – 3.1
Fat Cow (BCS ≥7)*	0 - 0	0 – 0	0 – 0	0 – 0	0 - 0
Prevalence of Lameness using Locomotion Scoring (%)					
Lame Cows	1.2 – 4	4.1 – 5.9	6.3 – 8.1	8.2 – 11.3	11.6 - 36
Farmer Estimates of Lameness (%)					
Lame Cows	0 – 0.5	0.5 – 1.1	1.1 – 1.8	1.9 – 3.5	3.5 - 20
Data from Questionnaire Estimates and Farm Records					
Lame Cows over the last 12 months	0 – 2.5	3.8 – 7.4	8.1 – 12.4	12.4 – 16.3	16.5 – 42.6
Dull / Obviously Sick Cows	0 – 0.8	0.9 – 1.6	1.9 – 2.5	2.5 – 3.3	3.6 – 16.7
Empty Rate	1 – 5.5	6 – 8.5	9 – 10	10 – 13	13 – 32
6-Week In-Calf Rate	95 – 86	86 – 78	76 – 70	70 – 67	67 – 21
Mastitis	1.1 – 5.1	5.6 – 7.7	8.6 – 11.3	12.2 – 20	20.4 – 38.3
Sudden Deaths / Casualties	0 – 0.8	0.8 – 1.2	1.3 – 2	2 – 2.8	2.9 – 6.1
Milk Fever	0 – 1	1.1 – 2.4	2.4 – 3.5	3.5 – 5.9	6.7 – 15.4

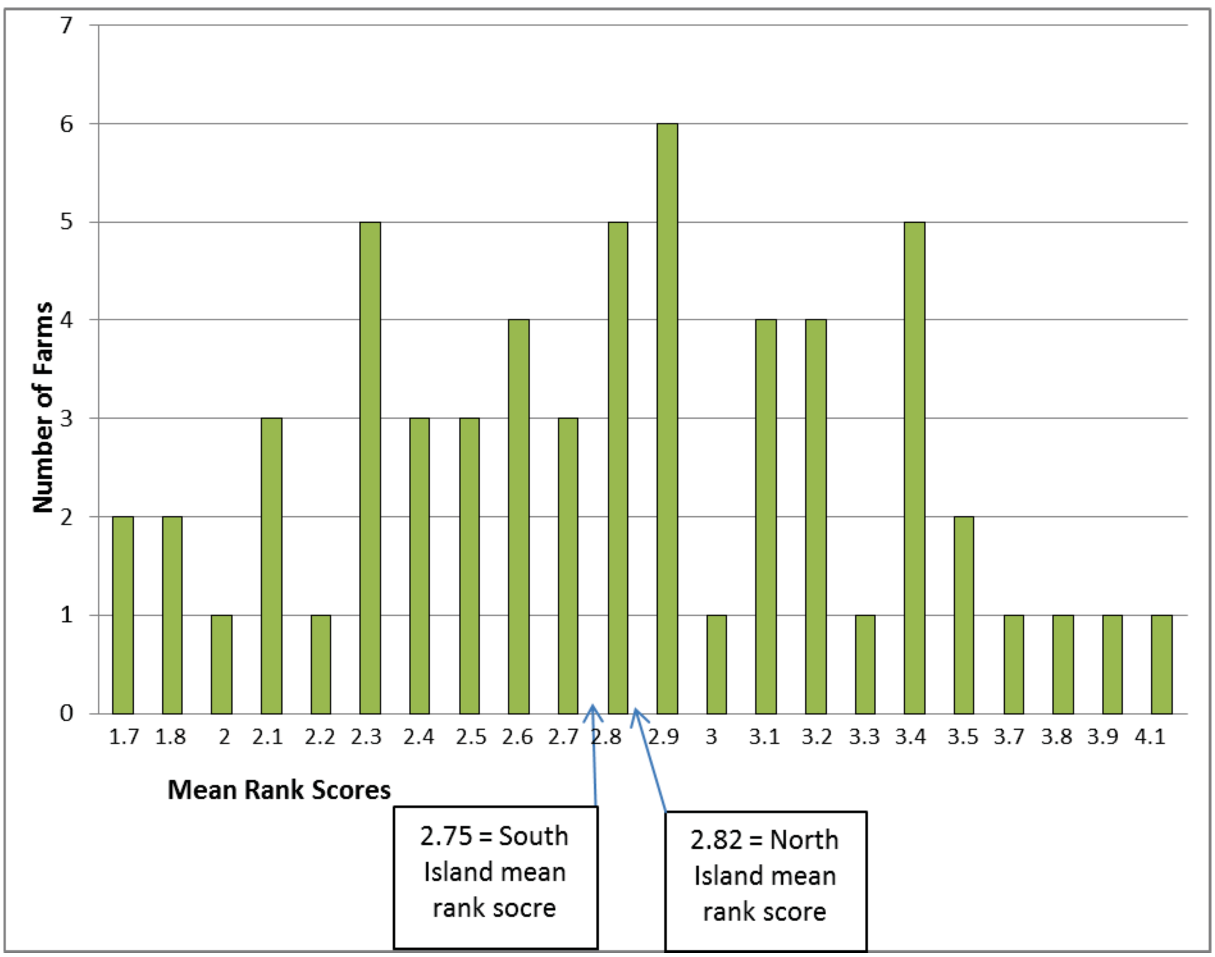
*BCS= Body Condition Score (DairyNZ Scale 1-10)

N=53-59; Empty rate: N=34

Farm Ranking

There was a wide range of scores. The minimum and maximum possible ranking scores were 1 and 5 respectively; the ranking scores for the study farms ranged from 1.7 to 4.1. This is shown in **Figure 2**, which also displays where the mean ranking scores for the North and South islands lie within the distribution. Overall, the mean ranking score was 2.79, with the mean for the NI and SI being 2.82 and 2.75, respectively, this difference was not significant (P>0.1).

Figure 2: Distribution of mean rank scores of measurements from Table 4



Observational Measurements and Cow Welfare Assessment

The questionnaire was filled in for 59 farms. The correlations from the farmer estimates and records in the questionnaire and lameness measurements and general observations (BCS, physical appearance, etc.) made by the observer were correlated and results are displayed in **Table 3**. The number of lame cows in the previous 12 months was related to the greatest number of factors (4) which include the number of cows in the herd, the number of lame cows detected using locomotion scoring, the percentage lameness thought by the farmer and the average milk yield. The 6-week-in-calf rate, although not significantly correlated to any other factor, did have a tendency to be related to lameness factors including the number of lame cows detected using locomotion scoring ($p=0.077$) and the percentage lameness missed by the farmer ($p=0.057$). Mastitis cases were not significantly correlated to any factors within this correlation. In terms of the cow's physical appearance, none of the measures were related to any measures of lameness, however, significant associations were reported between factors which included the cow's physical appearance, e.g. dirty hind limbs and dirty udders ($p<0.001$). Unexpectedly, dirty udders were also found to be correlated to the number of sudden deaths/casualties in the previous 12 months ($p=0.01$).

Table 3: Correlations of measurements (r-value (p-value)) used to assess dairy cow welfare on North and South Island dairy farms in New Zealand.

P12M = Cases occurring the previous 12 months | r-value (p-value) | P<0.05 – Blue P<0.01 – Red

	Number of cows	Number of lame cows observed - locomotion scoring	Lameness farmer thought (%)	Lameness farmer was off from prevalence (+/-) (%)	No. lame cows (P12M)	No. mastitis cases (P12M)	No. dull/ obviously sick cows (P12M)	Empty Rate (P12M) (N=34)	Average Milk Yield kgMS (P12M)	6-week in-calf rate (P12M)	No. sudden deaths/ casualties (P12M)	Dirty Flanks observed (%)	Dirty hind limbs observed (%)	Dirty udders observed (%)	Dull coats observed (%)
Number of cows	1	.05 (0.71)	-0.05 (.72)	-.08 (.57)	**0.32 (.01)**	-.23 (.090)	-.09 (.53)	-.22 (.21)	**0.28 (.036)**	-.10 (.43)	.19 (.14)	-.16 (.23)	**-.27 (.037)**	-.11 (.40)	-.20 (.12)
Number of lame cows observed - locomotion scoring		1	**0.79 (.000)**	**0.89 (.000)**	**0.34 (.008)**	.10 (.46)	.002 (.99)	-.02 (.91)	**.29 (.032)**	0.23 (.077)	.10 (.43)	.03 (.85)	.03 (.80)	-.01 (.93)	.12 (.37)
Lameness farmer thought (%)			1	**.37 (.004)**	**0.37 (.004)**	-.02 (.87)	-.02 (.92)	.13 (.47)	.22 (.09)	.08 (.57)	-.14 (.29)	-.13 (.33)	.03 (.82)	-.17 (.21)	.03 (.84)
Lameness farmer was off from prevalence (+/-) (%)				1	.18 (.18)	.16 (.25)	.02 (.91)	.005 (.98)	.22 (.10)	.25 (.057)	-.06 (.63)	.13 (.32)	.05 (.74)	.12 (.36)	.11 (.43)
No. lame cows (P12M)					1	.08 (.58)	.15 (.28)	.05 (.80)	**.42 (.001)**	.20 (.14)	.03 (.84)	-.07 (.58)	-.07 (.63)	.09 (.49)	-.03 (.81)
No. mastitis cases (P12M)						1	-.06 (.66)	-.09 (.63)	.18 (.21)	.20 (.15)	-.05 (.72)	-.03 (.82)	-.09 (.52)	-.02 (.92)	.06 (.65)
No. dull/ obviously sick cows (P12M)							1	**-.35 (.049)**	-.20 (.16)	.03 (.85)	-.06 (.67)	.14 (.33)	.11 (.42)	.05 (.72)	.03 (.81)
Empty Rate (P12M) (N=34)								1	.08 (.66)	-.04 (.84)	.27 (.12)	.07 (.68)	.18 (.31)	-.01 (.95)	-.13 (.48)
Average Milk Yield (P12M)									1	.16 (.25)	.11 (.43)	.18 (.19)	-.03 (.86)	.23 (.09)	-.11 (.40)
6-week in-calf rate (P12M)										1	.01 (.91)	.007 (.96)	.16 (.22)	.16 (.24)	.10 (.46)
No. sudden deaths/ casualties (P12M)											1	.15 (.27)	-.09 (.48)	**.32 (.01)**	-.11 (.40)
Dirty Flanks observed(%)												1	**.33 (.008)**	**.61 (.000)**	.23 (.07)
Dirty hind limbs observed(%)													1	**.43 (.000)**	**.28 (.029)**
Dirty udders observed(%)														1	.15 (.24)
Dull coats observed(%)															1

Personnel treating lame cows and their training

Fifty-eight out of 59 farmers treated their own lame cows, of which 38 identified farm staff as the only personnel treating lame cows on their farm. Twenty reported that lame cows were treated by a combination of farm and veterinary staff and only one famer reported that their veterinarian was the sole person treating lame cows (**Table 4**). Of the 58 farmers who indicated they treated lame cows, 25 identified other farmers as the person who trained them, both through gathering information from past employers (farmers), and through the passing of knowledge from generation to generation on a single farm; while 38 reported receiving training from veterinarians, although this tended not to be planned training, just watching what veterinarians did and picking up techniques.

Table 4: Farmer responses to the questionnaire questions of "Who treats your lame cows" and "Who trained that person to treat them." Included is the total number of farms that responded to each question.

Question	Response	Total
"Who treats your lame cows?"	Farmer only	38
	Veterinarian only	1
	Farmer and Veterinarians	20
"Who trained farm staff to treat lame cows treat them?"	Farmers	15
	Veterinarians	25
	Course	4
	Farmer and Veterinarians	8
	Veterinarians and Course	3
	Farmers, Veterinarians and Course	2
	Nobody	2

Recorded and Estimated Cases from Questionnaire

The results from the farm questionnaire were obtained from both farmer estimates and recorded incidences from farm records. **Table 5** shows the number of responses for each measure, and the number which came from farm records and which came from farmer estimates.

Table 5: Total Recorded, Estimated and Overall Counts to Questions from Questionnaire Measurements

Measure	Recorded	Estimated	Total
Lame Cows in the last 12 months	7	52	59
Dull / Obviously Sick Cows in the last 12 months	7	48	55
6-Week In-Calf Rate	8	26	34
Milk Yield	10	36	46
Milk Fever	11	48	59
Sudden Deaths / Casualties	14	45	59
Mastitis	16	41	57
Empty Rate	18	35	53

Lameness Comparisons

Figures 3 through 9 illustrate lameness comparisons amongst different measures included in the farm questionnaire. Measurements compared to the percentage of lame cows include empty rate, 6-week in-calf rate, mastitis cases, number of cows, milk yield, sudden death/casualties, and milk fever cases.

Figure 3: Percentage of lame cows vs.empty rate

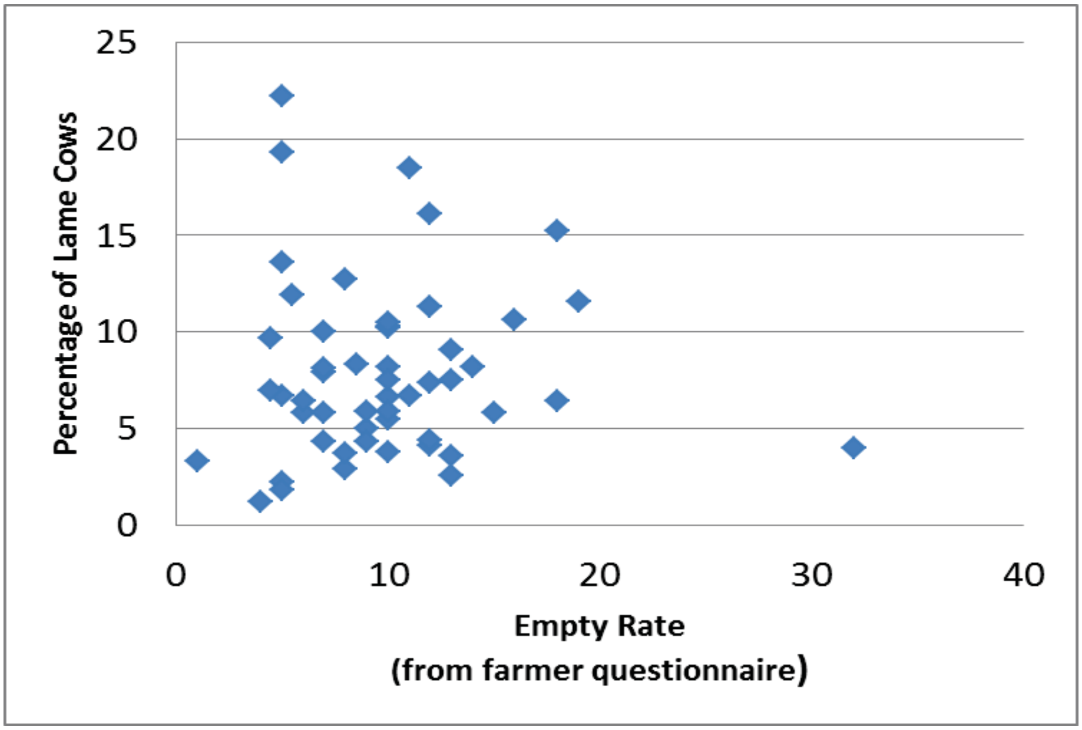


Figure 4: Percentage of lame cows vs. 6-week in-calf rate

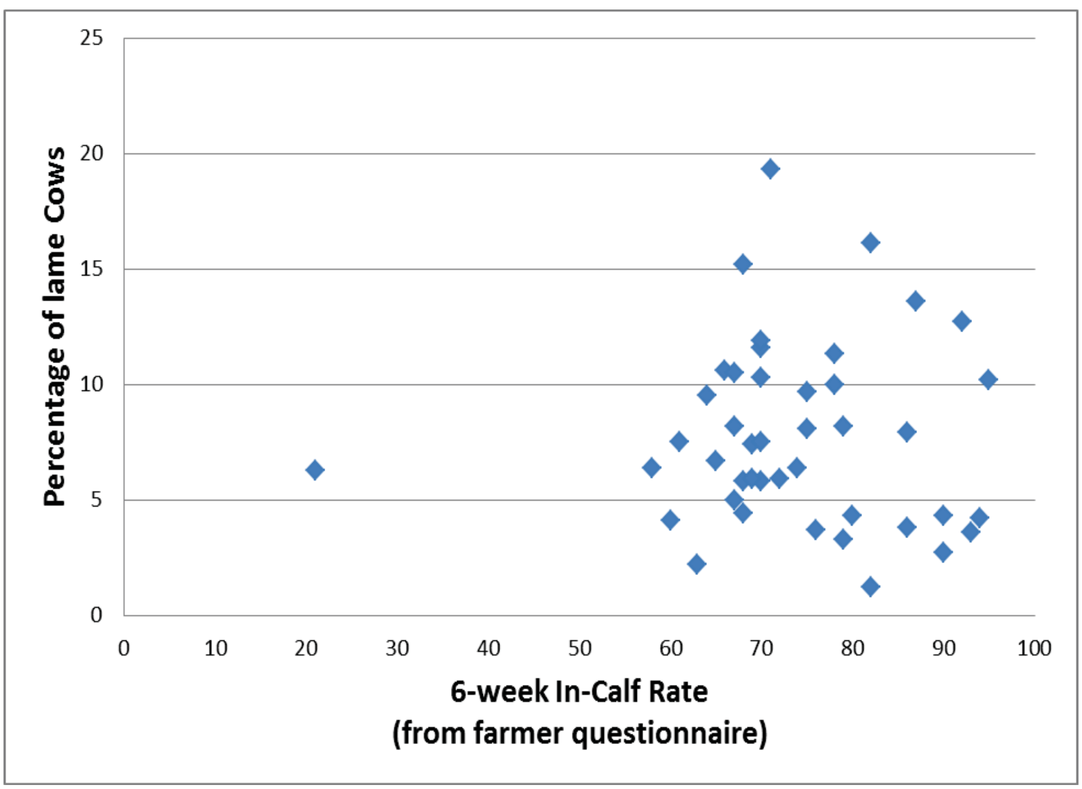


Figure 5: Percentage of lame cows vs. mastitis cases (%)

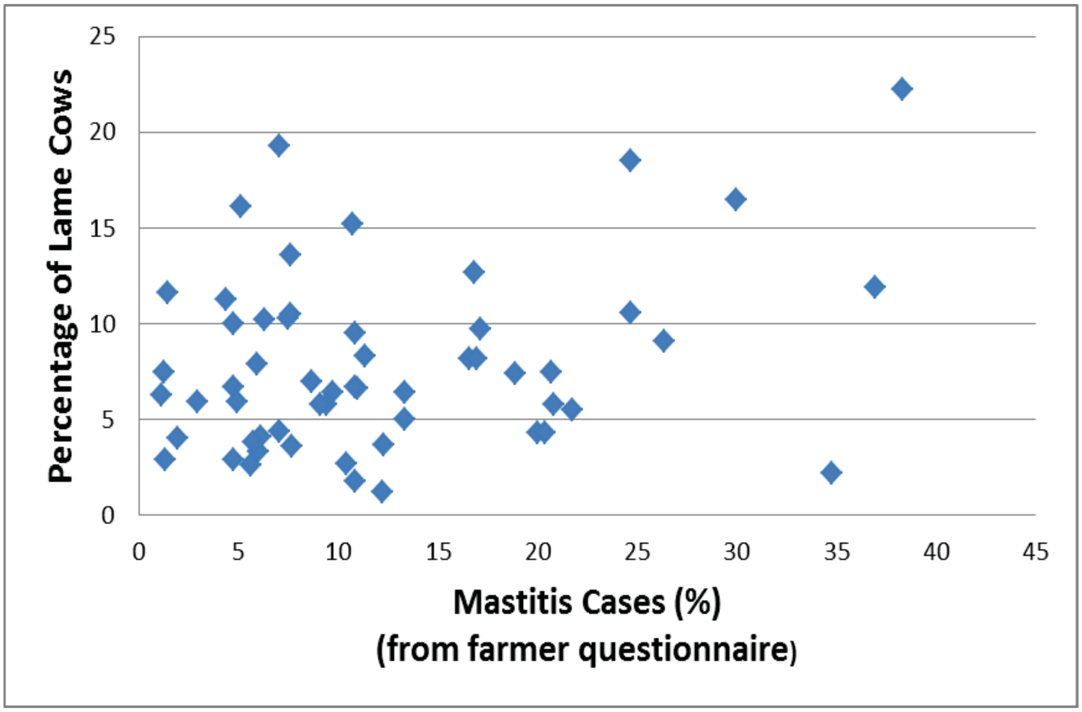


Figure 6: Percentage of lame cows vs. number of cows

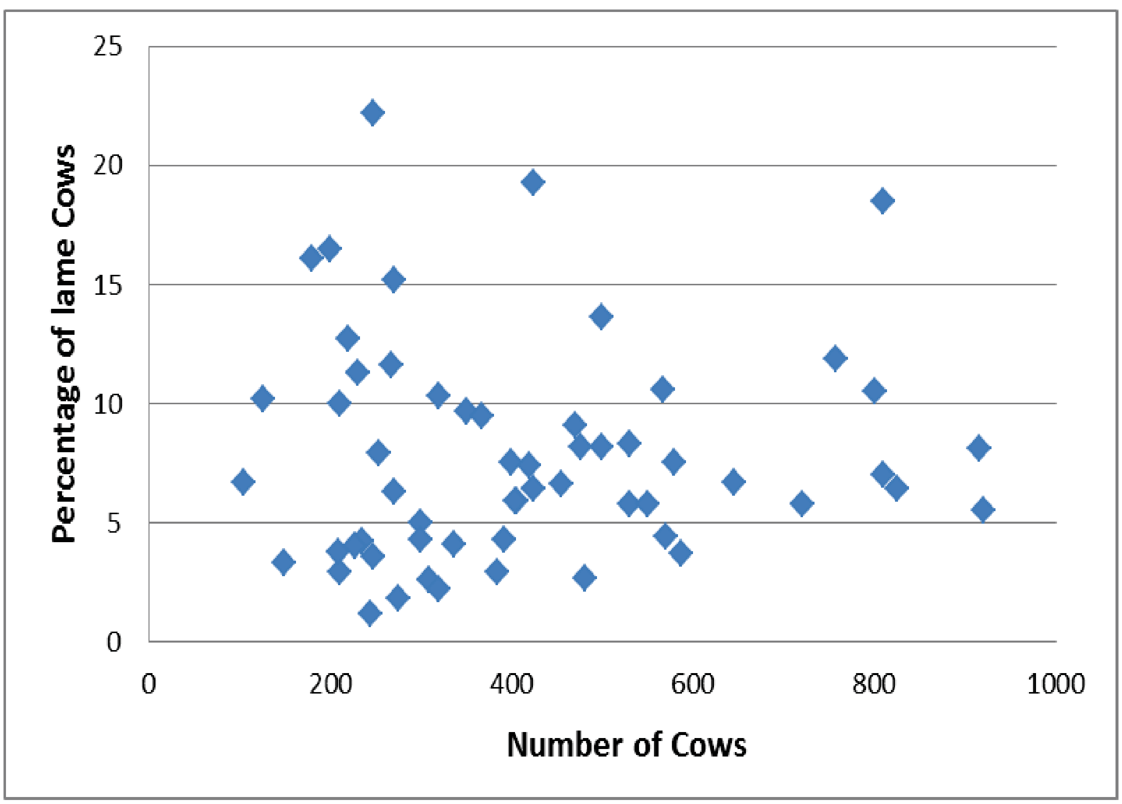


Figure 7: Percentage of lame cows vs. milk yield (kgMS)

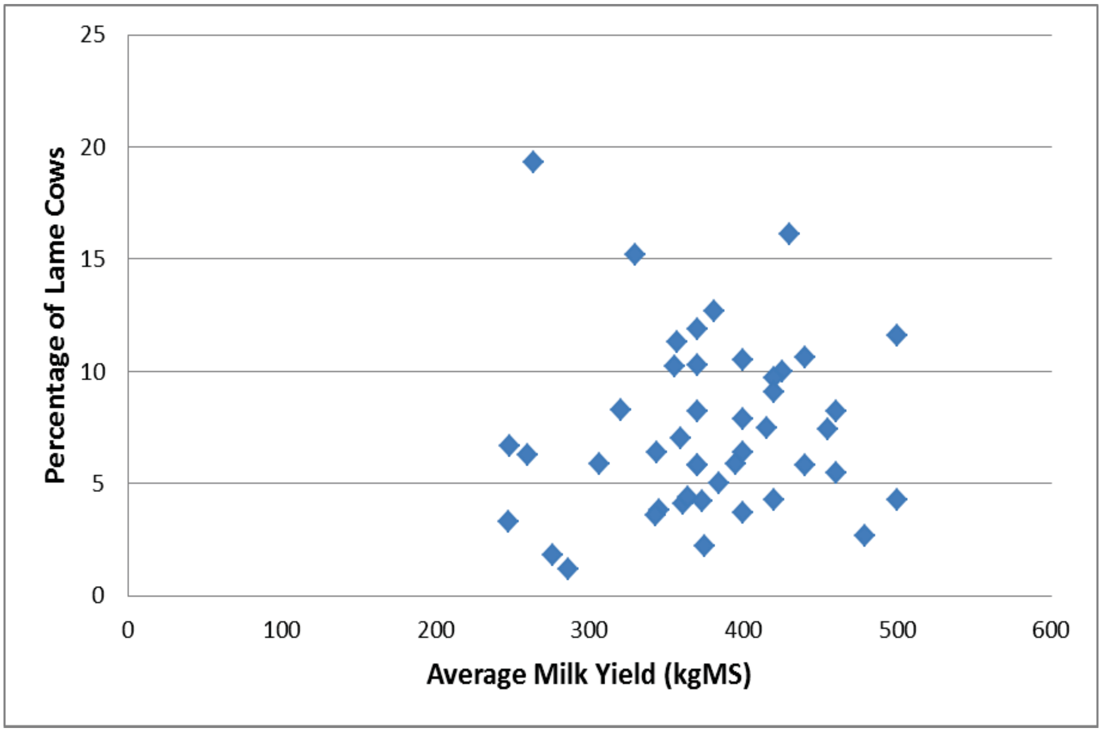


Figure 8: Percentage of lame cows vs.sudden death/casualty cases (%)

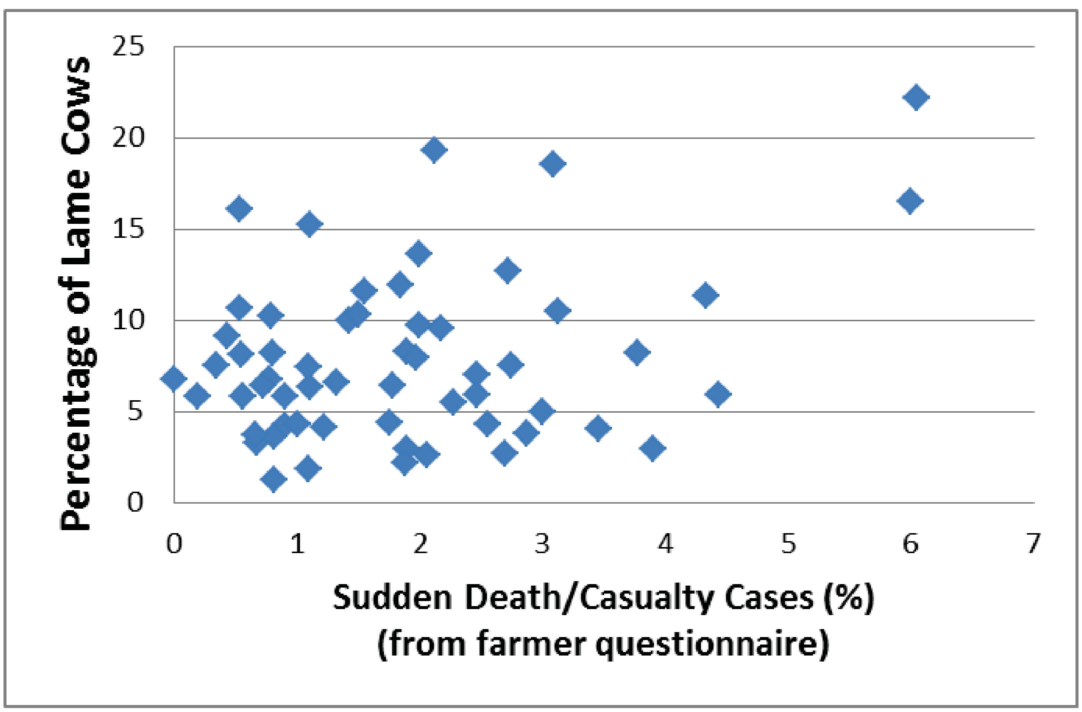
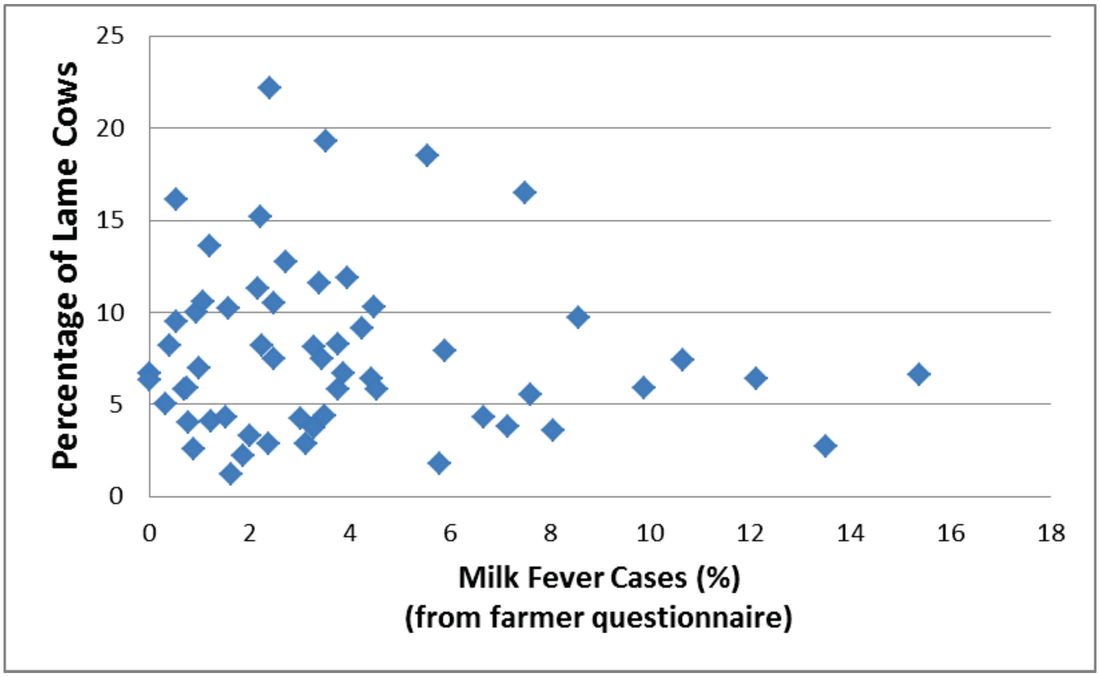


Figure 9: Percentage of lame cows vs. milk fever cases (%)



North Island and South Island Lameness Comparison

There was no significant difference in the prevalence of lameness between the North Island and the South Island using either mobility scoring or farmer estimates. The North Island had an overall prevalence of 8.9% (95% CI 6.4 to 11.5%) with farmers only estimating a prevalence of 2.5% (95% CI 1.1 to 3.6%) while the South Island had an overall prevalence of 7.5% (95% CI 6.2 to 8.8%) and farmers estimating a prevalence of 2.1% (95% CI 1.3 to 3.1%). These values are summarised and illustrated in **Figure 10** and **Table 4**.

Figure 10: Difference in the prevalence of lameness (using locomotion scoring) and farmer's perceptions between the North Island and South Island

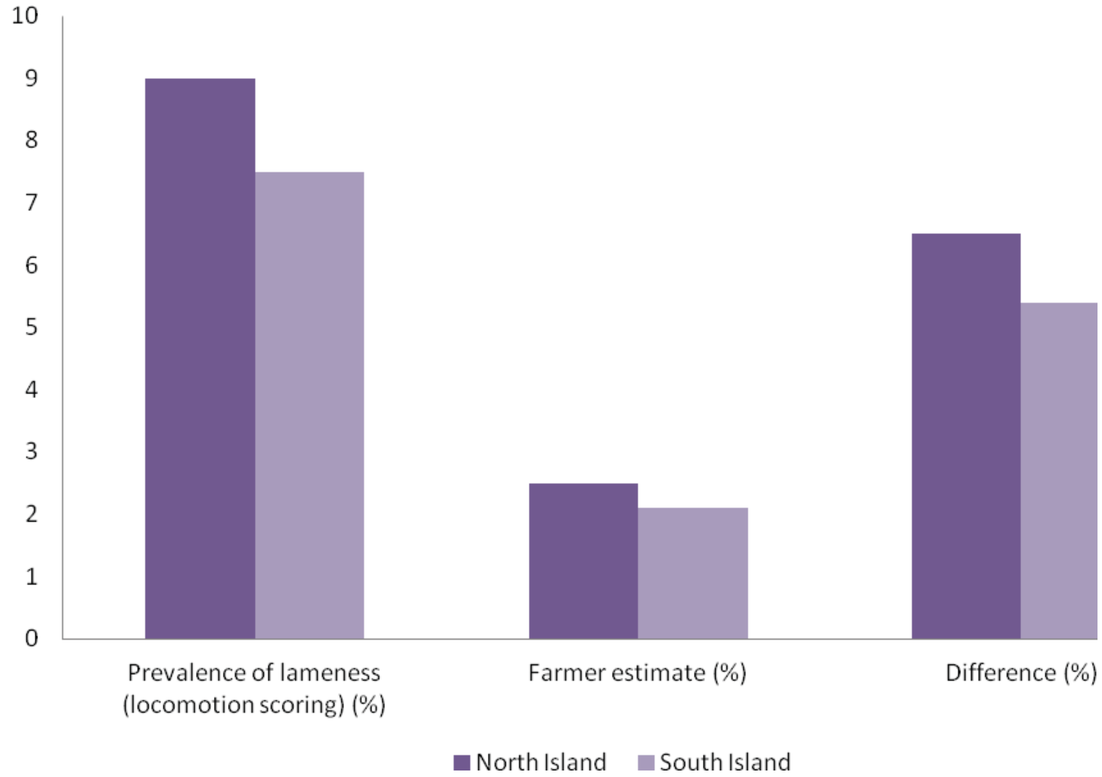


Table 4: Difference in the prevalence of lameness (using locomotion scoring) and farmer's perceptions between the North Island and South Island alongside overall mean

	Prevalence of lameness (locomotion scoring) (%; SEM)	Farmer estimate of lameness (%; SEM)	Difference (%; SEM)
North Island	9 (1.26)	2.4 (0.62)	6.5 (0.8)
South Island	7.5 (0.635)	2.1 (0.45)	5.4 (0.55)
Mean	8.3 (0.76)	2.3 (0.4)	6 (0.51)

Chapter 4: Discussion

The farms chosen for this assessment were a convenience sample, based on recommendations from local veterinarians, and, additionally, although farms on both Islands were visited, not all dairying areas were included. So it is possible that these farms are not representative of New Zealand dairy farming, as a whole. However, it is the largest study of its kind in New Zealand. Size and productivity measures from this study were similar to those in the 2010-11 Dairy NZ Dairy Statistics (statistical findings obtained from the 17 districts throughout New Zealand) (New Zealand Dairy Statistics). A compiled list of average herd sizes and milk yields from farms in the study and statistics from DairyNZ 2010-11 is displayed in **Table 14**. Although the correspondences are not exact, similarities to DairyNZ averages support the study's sample size and support that suggestion that this survey is representative.

Table 5: North Island, South Island and Average Statistics from study and DairyNZ Dairy Statistics 2010-11

	Size (cows/herd)		Productivity (kgMS/cow)	
	Study	Dairy NZ Statistics 2010-11	Study	Dairy NZ Statistics 2010-11
North Island	294	325	357	319
South Island	580	582	406	362
Mean	422	386	377	334

The questionnaire used was based on one used in the UK (Whay et al 2003). Its application under NZ conditions was found to be simple except for the measurement of flight distance which was not achievable at pasture within the time constraints. Additionally, no animal had hock injuries in this study, confirming that such injury is not of significance in pasture-based cattle. However, although the questionnaire collected details on many aspects of cattle welfare, the main focus of this study was lameness. The prevalence of lameness on the New Zealand dairy farms (8.1%) was lower than recorded in studies performed in the US (14 to 25%; Wells et al. (1993) ; Espejo et al. (2006), UK (22.1%- 36%; Whay et al. 2003; Barker et al 2010) and Czech Republic (31%; Sárová et al. (2011). Nevertheless, despite this low lameness prevalence, lameness levels as detected using mobility scoring were 3.7 times higher than what farmers perceived. This is similar to the findings of Whay et al. (2003), on UK dairy farms, that the prevalence of lameness identified by mobility scoring was almost 4 times higher than thought by herd managers. This conclusion , therefore, does not support the hypothesis that the lower prevalence of lameness in New Zealand dairy cattle, combined with the opportunity to watch the cows walk to and from the milking parlour twice a day, increases the ability of farm staff to recognise lameness.

With the average herd size in this study of 422 cows, and a lameness prevalence of 8.1%, there would be approximately 34 lame cows / herd (using mobility scoring). Out of those cows, approximately 9 would be considered lame by the farmer (lameness prevalence 2.2%), leaving the remaining 25 unidentified as lame. Thus on the average NZ farm, 75% of cows which are lame at any one time are not identified as lame. This ratio is an alarming welfare concern for New Zealand dairy farms. Introducing mobility scoring systems into farm practices or incorporating them on a more regular basis could prove beneficial in identifying lame cows more quickly and lessening the welfare concern.

Mean farmer estimates of lameness prevalence at 2.2% were similar to the percentage of lame cows with a mobility score 3 (1.7%.) This suggests that farmers might have principally picking up score 3 cows and that most of the difference between mobility scoring and farmer estimates was due to farmers not recognising moderately lame cows (i.e. those with a score of 2). This suggestion is supported by the fact that cows which are severely lame (score 3) walk slower than the main herd, which could mean that they are more likely to be found at the back of the herd while walking to the milking parlour, where they may be more easily recognised as lame by farm staff. However, this change in milking order has not been shown to occur in practice. Lame cows are more commonly found at the back of the herd when walking to the parlour, but the increased lameness prevalence is a consequence of walking order rather than a cause (Sauter Louis et al., 2004). Indeed Sauter-Louis et al. (2004) reported that walking order was very stable and provided no evidence that it was obviously affected by lameness. Furthermore, it is not only the most severely lame cows which get treated. Alawneh et al. (2012) reported that 75% of moderately lame cows (i.e. cows with a maximum score of 3 on the Sprecher 0-4 scale) were presented for lameness treatment, showing that farm staff can recognise moderately lame cows (score 2 on the DairyCo system) and also recognise that they need treatment. The study reported by Alawneh et al. (2012) was a single farm study so it needs repeating on more farms across New Zealand, but its results suggest that, contrary to the hypothesis outlined above, the difference in lameness prevalence estimated by mobility scoring and farmer perception is because farmers recognise lame cows later rather than because they are never recognising

60% of lame cows. This suggests that it should be relatively easy to train NZ dairy farmers to use the DairyCo mobility system to identify lame cows as it is likely that most are already recognising cows of score 2 and 3, and that what is needed is regular mobility scoring by trained staff to identify lame cows earlier.

Farms in this study were visited during expected period for peak for clinical lameness in spring-calving herds (North Island - October / November and South Island - January/ February). If the study were repeated at a different time, e.g. in late lactation, there may be slightly different results, both due to there being fewer lame cows, lowering the prevalence, but also because farm staff may have more time to recognize and treat lame cows, which may reduce the threshold at which lame cows are recognised.

The efficiency of the DairyCo system recognizing more lame cows versus farmer perceptions is displayed in the range of measurements in table 2. Farmer prevalence ranged from 0 to 20% whilst when locomotion scoring was used, lameness prevalence ranged from 1.2 to 36%. After introducing a locomotion scoring system into a farm's practice, farmer's perceptions of lameness would be likely to increase because they know what to look for, and they will have a better understanding that it is not just severely cows which need treatment and which cost money. This is when the simplicity of the DairyCo system becomes important. Farmers may be more willing to regularly mobility score their herd if the guidelines are simplistic and practical.

Thirty-eight out of 59 farmers treated their lame cows by themselves and 20 farms by a combination of themselves and veterinarians. From conversation, farmers typically attempt to treat their lame cows themselves and then if it becomes too much or the lameness is too severe, they call upon the veterinarian. When asked who trained that person who treats them, many farmers responded veterinarians (21), another farmer (15), or a combination of farmer and veterinarians (8.) Other answers revealed that they took a course; there was no training, or a combination of the answers. By veterinarians providing information pertaining to lameness, offering readily available courses, or simply allowing them to watch and ask questions while working, farmers may gain more knowledge pertaining to lameness and be able to detect and rectify it more quickly. Providing farmers with a reliable and practical tools to detect lame cows (DairyCO mobility scoring system) they will better be able to detect lame cows with a score 2 and treat them before they become a score 3. Although clinical lameness is known to have a significant impact upon milk yield and productivity (Green et al., 2002), many farmers may be hesitant to call upon veterinarians to treat their lame cows because of costs associated. By detecting a lame cow in the early stage, using a simple, yet efficient mobility scoring system, and rectifying the problem, the chances it will turn into a severely lame cow and require veterinary treatment is low.

There is a general underestimation and perhaps reluctance of farmer's to admit lameness levels. This may have a connection to farm records and estimated and recorded cases; noted in **Table 5**. The numbers of lame cows had the least amount of recorded cases and the greatest number of estimated cases. Due to farmers not keeping records of their lame cows, estimating lameness may prove to be difficult. Records of lame cows may not be kept as regularly because the treatment delivered does not have a direct impact upon milk sales – in contrast to mastitis where treatment requires milk withhold and the rate of farmers producing records was more than twice that of lameness.

Comparisons amongst the data from the questionnaire and observations made on the day of the visit were used not only to assess welfare, but also reveal which/if any were factors related to lameness measures. Results revealed, that none of the physical attributes measured (i.e. dirty flanks, dirty udders, dull coats) were related to any lameness factors. Cleanliness of cows may be more aesthetics, than detrimental to a cow's gait and the prevalence of lameness. Mastitis however may be influenced by cleanliness of cow, particularly dirty udders. However, no significant correlations were found for mastitis cases either. Although not significant at the 5% level, the proximity of the empty rate p-value to 0.05, for two measures in particular (number of lame cows observed using locomotion scoring and percentage the farmer was off from the prevalence) suggests that larger scale studies are needed. In particular the association between 6-week in-calf rate and lameness needs further investigation, as only 34/59 farms in this study provided a figure for such analysis, even though this is now the industry standard figure for herd fertility.

The absence of an association between herd size or milk production and lameness in this dataset is good news as it suggests that increasing production and herd size does not have to result in increased rates of lameness. This lack of an effect was also reflected in the comparison between the North and South Island which showed no effect of island – indeed the larger herds of the SI tended to have lower levels of lameness, even though both islands were visited at the expected time of peak lameness prevalence

Chapter 5: Conclusion and Recommendations

Farmers identified fewer lame cows (2.3% prevalence) than reported by an observer using locomotion scoring (8.3% prevalence.). Of those lame cows identified by the observer, cow mobility scores were mostly score 2 (79%) and fewer score 3 (21%). Although the overall prevalence of lameness was lower in the pasture based system than housed systems, farmer perceptions of lameness were similar. At the herd level, farmers only recognized about 25% of cows with reduced mobility, the remaining 75% of lame cows were unidentified as better. Thus, farmer recognition of lameness In New Zealand's pasture based system appears to be similar to that reported in housed cows.

No differences were found between the North Island and South Island in lameness prevalence or lameness recognition. No significant relationship between lameness prevalence and other factors, such as herd size, cattle cleanliness and mastitis rates, was found at the 5% level, though the relationship between lameness prevalence and some fertility measures were almost significant at the level. Framer recording of disease levels was poor especially of lames with most farmers relying on estimates for such information.

This study suggests that there is significant room for improvement in the detection of lameness on New Zealand farms, and routine mobility scoring, particularly at critical periods, could be a valuable tool for identifying lame cows.

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Appendix 1: Questionnaire

Name ___________________________________

Address __________________________________

____

E-mail Address ____________________________

Home or Mobile Number (_______)______________________

Please answer the following questions to the best of your ability, indicating the source of the information as either an estimate (estimated) or from your herd records (recorded) by circling the appropriate means.

Total number of cows ____________________

Total number of lame cows (Present time) _______________

Total amount of hectares_________________

Average BCS ________________________

Circle: Autumn or Spring Calving

<u>In the previous 12 months</u>:

Number of Lame Cows_______________ estimated recorded

Who treats your lame cows? ____

Who trained that person to treat them? ________________________________

Number of Dull/Obviously Sick Cows ___________ estimated recorded

Average Milk Yield ___________________ estimated recorded

Empty Rate _________________ estimated recorded

6-Week In Calf Rate __________________ estimated recorded

Number of Cows with Mastitis ________________ estimated recorded

Number of Sudden Deaths or Casualties___________ estimated recorded

Number of cows with Milk Fever ______________ estimated recorded