Monitoring liveweight to optimise health and productivity in pasture fed dairy herds

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— Abstract —

Technological advances now make it possible to continuously record and monitor a range of outcomes on dairy farms including individual cow milk yields, environmental temperature and rainfall. These facilities enhance the ability of herd managers to recognise deviations from what is accepted as normal, prompting timely corrective intervention. The objective of this thesis is to demonstrate how liveweights recorded using walkover weighing (WoW) technology can provide information that can be used to better-manage a range of activities on dairy farms, particularly reproduction and herd health.

Analysis of daily WoW recorded over the first 100 days of lactation have shown that the standard deviation of daily LW measurements across parities was 17 kg on average. A near perfect association between liveweights measured statically and WoWs (concordance correlation coefficient 0.99, 95% CI 0.99 to 1.0) was observed. After controlling for the effect of liveweight at calving and long term liveweight change using a mixed-effects linear regression model, the autocorrelation between WoWs recorded on successive days was 0.21, decaying to zero by eight days. This study showed that by using a standalone automatic WoW system positioned in the exit race of a rotary milking parlour, it was possible to record LWs of individual cows on a daily basis and, with controlled cow flow over the weighing platform (allowing for sufficient succession distance to prevent congestion), results were similar to those recorded using conventional, static weighing techniques.

Two observational studies were conducted to investigate the relationships between LW, LW change (ΔLW) and clinical lameness. In the first study, LW loss in the first 50 days in milk increased the risk of a lameness event being diagnosed after 50 days in milk by a factor of 1.80 (95% CI 1.00 to 3.17). The risk of lameness was greatest for high yielding cows that lost excessive LW (risk ratio 4.36, 95% CI 4.21 to 8.19). The second study quantified ΔLW immediately before and after the diagnosis of lameness events. For lame cows, liveweight decreased up to three weeks before the date of diagnosis and for up to four weeks after. The total liveweight loss arising from a single lameness episode was, on average, 61 kg (95% CI 47 to 74 kg). The results of this study show how liveweight records for individual animals can be used to enhance a herd manager's ability to detect lame cows and present them for treatment. Prompt detection and treatment of lame cows presents an opportunity to shorten recovery times, with positive follow-on effects in terms of animal welfare.

ΔLW was assessed as a means for enahancing the sensitivity and specificity of oestrus detection. The sensitivity and specificity of detecting true oestrus events using ΔLW combined with tail paint and visual observation was 0.86 and 0.94, respectively. The effect of ΔLW in the first four weeks after calving (ΔLW_{long}) and LW change around the time of the Planned Start of Mating (ΔLW_{short}) on the time taken for cows to conceive relative to the Planned Start of Mating was quantified. Planned Start of Mating to conception intervals were influenced by LW change during both of these periods, though ΔLW_{short} had a greater effect compared with ΔLW_{long}. The findings of this study better define the impact of long- and short-term liveweight change on reproductive performance, providing the opportunity to design feeding programmes in pasture fed dairy herds that have positive effects on fertility.

The studies presented in this thesis contribute knowledge to the role of LW monitoring as a tool to better-manage seasonally calving, pasture fed dairy herds. While 'traditional' usage of walkover scales on dairy farms has involved the recording of LW and LW change as a means for monitoring and adapting changes to the herd feeding program, the studies presented here have shown how LW

records have the potential to provide information that can be used to better manage a range of herd level activities, particularly those related to reproductive management and health.

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Nomenclature

Δ	Change
ΔBCS.LW	Change in body condition score and/or liveweight
ΔLW	Liveweight change
ACF	Autocorrelation function
AI	Artificial insemination
AIC	Akaike's Information Criterion
BCS	Body condition score
BW	Breeding Worth
BMSCC	Bulk milk somatic cell count
CI	Confidence interval
CL	Upgraded Irish Holstein-Friesian
DHF	Dutch Holstein-Friesian
DIM	Days in milk
EB	Energy balance
F1	Jersey $\times$ Holstein-Friesian cross
GH	Growth hormone
H	Holstein
HF	Holstein-Friesian
IGF-I	Insulin-like growth factor-I
JE	Jersey
JH	Jersey Holstein cross
LAMIDX	Lameness index
LIR	Lmeness incidence risk
LW	Liveweight
MB	French Montbeliarde
MJ	Megajoule
MS	Milksolids

NEB	Negative energy balance
NR	French Normande
NZHF	New Zealand Holstein-Friesian
NZHF70	High genetic merit Holstein-Friesian of New Zealand origin, 1975
NZHF90	High genetic merit Holstein-Friesian of New Zealand origin, 1998
OESTIDX	Oestrus index
OR	Odd ratio
PSC	Planned Start of Calving
PSM	Planned Start of Mating
REML	Restricted maximum likelihood
RR	Risk ratio
TPVO	Tail paint and visual observation
SE	Standard error
TR	Time ratio
USHD	North American High Durable Holstein-Friesian
USHP	North American High Producing Holstein-Friesian
USHP90	North American with high Breeding Worth, 1998
VFI	Voluntary feed intake
WLD	White line disease
WoW	Walk over weighing

List of Publications

Alawneh JI, Stevenson MA, Williamson NB, Lopez-Villalobos N, Otley T (2011) 'Automatic recording of daily walkover liveweight of dairy cattle at pasture in the first one hundred days in milk'. *Journal of Dairy Science* 94 (9), 4431 – 4440.

Stevenson MA, Alawneh JI, Williamson NB, Lopez-Villalobos N, Otley T (2011) 'The effects of liveweight loss and milk production on the risk of lameness in a seasonally calving, pasture fed dairy herd'. Submitted to *Preventive Veterinary Medicine* 25 November 2011.

Alawneh JI, Stevenson MA, Williamson NB, Lopez-Villalobos N, Otley T (2011) 'The use of liveweight change as an indicator of oestrus in a seasonally calving, pasture fed dairy herd'. Under review *Theriogenology* 15 March 2011.

Alawneh JI, Stevenson MA, Williamson NB, Lopez-Villalobos N, Otley T (2011) 'Long and short term effects of liveweight change on reproductive performance in a seasonal calving, pasture fed dairy herd'. Accepted in *Livestock Production Science, in Press* 2011.

Alawneh JI, Laven RA, Stevenson MA (2011) 'The effect of lameness on the fertility of dairy cattle in a seasonally breeding pasture-based system.'. *Journal of Dairy Science* 94 (11), 5487 – 5493.

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Alawneh JI, Stevenson MA, Williamson NB, Lopez-Villalobos N, Otley T (2011) 'The effects of liveweight loss and high milk production on the risk of lameness in a seasonally calving, pasture fed dairy herd'. 16th Symposium and 8th Conference Lameness in Ruminants, Millennium Hotel Rotorua, New Zealand, 28 February – 3 March 2011.

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Alawneh JI, Stevenson MA, Lopez-Villalobos N, Otley T (2009) 'Automated daily body-weight measurements in dairy cattle at pasture and its association with lameness in early lactation'. Proceedings of the 12th Symposium of the International Society for Veterinary Epidemiology and Economics, Durban, South Africa, 10 – 14 August 2009.

Alawneh JI, Stevenson MA, Lopez-Villalobos N, Otley T (2010) 'Automated daily body-weight measurements in dairy cattle at pasture and its association with lameness in early lactation'. Annual meeting of the Epidemiology Chapter of the Australian College of Veterinary Scientists, Surfers' Paradise, Queensland, Australia, 1 – 3 July 2010.

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