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

A dissertation presented
in partial fulfilment of the requirements
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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 (Δ LW) 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 Δ LW 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.

Δ LW was assessed as a means for enhancing the sensitivity and specificity of oestrus detection. The sensitivity and specificity of detecting true oestrus events using Δ LW combined with tail paint and visual observation was 0.86 and 0.94, respectively. The effect of Δ LW in the first four weeks after calving (Δ LW_{long}) and LW change around the time of the Planned Start of Mating (Δ LW_{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 Δ LW_{short} had a greater effect compared with Δ LW_{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
Δ BCS.LW	Change in body condition score and/or liveweight
Δ LW	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	Lameness 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.

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