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BRIEF COMMUNICATION: Impact of date of birth recording practises in genetic evaluation in New Zealand sheep

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Introduction

Accuracy of selection is an important feature for all breeding programs and genetic evaluation systems, with genetic gain influenced by the accuracy of the breeding values and by the selection decisions taken by the breeder. Accuracy of estimated breeding values (eBVs) are affected by the amount and quality of the pedigree and performance data recorded. With increasing use of breeding values based on across–flock analyses, the impact of various data recording practises used in sheep flocks needs investigation to ensure practises by any particular breeder do not adversely affect the whole analysis.

Date of birth is used in the genetic evaluation process to correct performance traits, especially live weights, for non-genetic differences resulting from being born earlier or later in the season. However, recording of actual date of birth is not feasible in some farming systems due to the extensive farming environment, species or breed management difficulties or management practises such as DNA parentage. Amer et al. (1999) and Johnson and Blair (2003) concluded that while genetic progress in sheep or deer would be compromised by lack of date of birth records, selection for growth traits could still be effective.

The objective of this study was to determine the impact on estimated breeding values of different date-of-birth recording practises currently used by New Zealand sheep breeders.

Materials and methods

Pedigree and performance data (1995-2015) were obtained from the SIL (Sheep Improvement Limited) database, for two fully recorded flocks. Complete information was collected at birth, including pedigree, sex, date of birth (DOB), birth and rearing rank. Data were recorded for weaning weight (WWT), live weight at eight months (LW8), live weight at 12 months (LW12) and ewe weight (EWT). Standard SIL analyses, which include transforming observed data to a proportion of the contemporary group mean (Brown et al. 2003) and fitting birth date as a birthday deviation (bdev) from the mean of contemporary group (flock.birth year.sex.weaning weight mob) birth date (Pickering et al. 2012), were used to estimate breeding values (eBVs) and calculate the sub index for growth traits. Analyses included 1. full date of birth records, 2. no date of birth in the analysis (X), 3. no date of birth for the last three years of progeny (X3), and 4. date of birth in 10 day intervals (FA), as would be calculated from foetal age estimated at pregnancy scanning.

The impact on progeny born in 2014 and their sires is reported. Flock A is a large flock, with 6621 lambs from 48 sires, with an average lambing date of 30/08/2014 and a spread of 47 days. Five sires had fewer than 100 progeny; the rest averaged 133 progeny per sire. Flock B had 595 lambs from 24 sires, of which eight had restricted birth periods of 4-7 days and the remainder had birth-date spreads of 13 - 24 days, with a total spread of 26 days.

Results

Removing all date of births (X) and date of births for the last three years (X3) resulted in slightly higher mean and standard deviation values for WWTeBV, LW8eBV and DPG (SIL lamb-growth sub-index) compared to when birth date was fitted (table 1). The effect of date of birth was smaller in Flock B with the shorter spread of birth dates.

Correlations between values with DOB fitted and X or X3 for later live weights were high compared to earlier live weights. As weaning weight is included in most SIL goal trait groups (reproduction, wool, meat yield, etc) under or overestimation in weaning weight breeding values will have a wide-spread impact. Simulating foetal age by

Table 1 Breeding value mean and standard deviation (SD) with date of birth fitted, no date of birth (X), no date of birth for last 3 years (X3) and date of birth assigned into 10-day birth periods (FA) in two recorded New Zealand sheep flocks.

	Flock A			Flock B		
Trait (kg)	Mean	SD	Correl	Mean	SD	Correl
WWTeBV	2.468	0.797		0.414	1.177	
WWTeBV (X)	2.507	1.017	0.876	0.673	1.384	0.947
WWTeBV (X3)	2.743	1.043	0.866	0.021	1.418	0.930
WWTeBV (FA)	2.605	0.829	0.984	0.766	1.215	0.992
LW8eBV	4.052	1.485		1.012	2.362	
LW8eBV (X)	4.022	1.645	0.945	1.991	2.520	0.989
LW8eBV (X3)	4.204	1.686	0.939	0.998	2.557	0.984
LW8eBV (FA)	4.136	1.507	0.994	1.688	2.400	0.998
DPG	967	297		219	456	
DPG (X)	933	347	0.906	418	499	0.979
DPG (X3)	979	358	0.899	1998	507	0.968
DPG (FA)	989	303	0.989	363	466	0.996

assigning actual birth date to a 10-day birth period (FA) improved the correlation to 98.4% for WWT, 98.9% for DPG and 99.2% for WWT and 99.6% for DPG for Flock A and B respectively. Assigning foetal age on actual birth date is likely to be more accurate than assigning birth period on pregnancy scan measurement as is normal practise. The lower correlations when there is no correction for DOB means individuals may re-rank considerably for these traits.

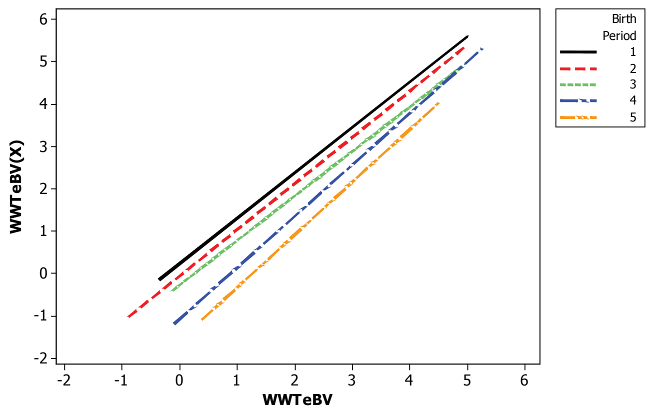
To explore the impact of birth date for lambs born within different periods, movements in eBVs and the sub-index were tracked for animals in each 10-day birth period relative to the same group of animals with DOB fitted. Birth period one was the first 10-day period, period two the second 10-day period, and so forth (table 2). Flock A results are presented as it had a wider spread of birth dates.

When no date of birth was fitted (X), lambs born in the first 10 days (birth period 1) on average had 0.426 kg higher WWTeBVs than when date of birth was fitted (table 2), with the maximum increase 1.7 kg. The later born (birth period 5) lambs WWTeBVs were underestimated by an average of 0.988 kg, with a maximum reduction of 1.65 kg. The average change for individuals in the mid period was less and the standard deviation was lower (figure 2). The same pattern is shown in the lamb growth sub-index (DPG), with index values for early born individuals gaining on average 114 cents (per ewe lambing) and the later born a reduction of 359 cents. The variation arising between individuals was also large, with movements in the order of +/- 500 cents for some individuals.

Discussion

There would be increased variation/reduced accuracy when a scanner assigns birth-date groupings for animals around the category boundaries, compared to cut offs based on actual birth date as used in this study. However, an analysis by Johnson and Blair (2003) in which birth-date group was randomly assigned to lambs that were born around the cut off dates, only resulted in a small loss (approximately 1%) in variation explained.

Figure 1 Relationship between weaning weight breeding values (kg) estimated including or excluding (X) date of birth for 10-day birth periods in a recorded New Zealand sheep flock.



Changes in breeding values and indexes tend to be amplified when breeders make selections based on rankings. The top 200 ram lambs based on DPG (X), consisted of individuals ranging from 1st to 1499th in rank for DPG when DOB was fitted. For weaning weight in deer, failure to record date of birth resulted in reductions of 29% and 19% in selection accuracy, with selection on the records from the individual or from 20 progeny respectively (Amer et al. 1999). Corresponding reductions in yearling weights were 11% and 5% respectively.

Provided sire progeny are born throughout the lambing period, then lack of date of birth will have little impact on sire eBVs. However, the impact is greater if sire progeny are born earlier or much later than average, as often occurs for artificial insemination (AI) sires and follow-up sires, and for individual animals who will be selected as future sires and have no current progeny. SIL breeder queries frequently refer to the "Hero to Zero" syndrome where a highly rated animal's breeding values drop dramatically

Table 2 Magnitude of change in weaning weight breeding values (WWTeBV) and growth sub-index (DPG) with date of birth (DOB) fitted, no date of birth (X), no date of birth for last 3 years (X3) and date of birth assigned into 10-day birth periods (FA) for 10-day birth periods in a recorded New Zealand sheep flock.

			Average change in mean and SD by birth period					
Variable	Birth Period	Mean (DOB)	DOB (X)	SD	DOB (X3)	SD	DOB (FA)	SD
WWTeBV	1	2.588	0.426	0.414	0.808	0.383	0.176	0.133
	2	2.492	0.174	0.408	0.416	0.401	0.156	0.143
	3	2.414	-0.144	0.378	0.037	0.405	0.122	0.140
	4	2.319	-0.575	0.472	-0.445	0.409	0.050	0.143
	5	2.392	-0.988	0.428	-0.736	0.358	-0.109	0.196
DPG	1	1017	114	105	199	103	41	39
	2	976	14	106	62	103	29	42
	3	944	-106	98	-75	102	14	44
	4	909	-248	117	-231	100	-9	40
	5	938	-359	111	-311	94	-56	53

when used as a sire (M Young, Personal communication). Without date of birth correction, growth breeding values and indices for early born animals will be overestimated and will subsequently decline when used as a sire with progeny either recorded or born over a range of birth dates.

Birth-date groupings estimated from foetal age at pregnancy scanning are sufficient to ensure accurate breeding value estimates. Amer et al. (1999) and Johnson and Blair (2003) also concluded that use of lambing date group does not explain any less variation than knowledge of exact birth date. It is important that breeders who do not record date of birth at lambing, record foetal age at pregnancy scanning. Failure to correct for date of birth will reduce the accuracy of estimated breeding values and, hence, genetic progress for early growth traits.

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