



Generating estimated breeding values for postnatal lamb survival

Report prepared for EBLEX
July 2015

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1 .Objectives

The overall aim of the project is to estimate genetic parameters for lamb survival using data obtained from the industry for Dorsets, Lleyns and Texels.

Deliverables specified in the tender document

1. New knowledge relating to genetics of lamb survival in the Dorset, Lleyn and Texel breeds e.g. genetic and phenotypic parameters, and influence of key environmental factors (or 'fixed' effects, e.g. sex of lamb, age of ewe) on lamb survival.
2. EBVs generated for lamb survival, for animals in the three cleaned data sets.
3. Data extraction rules documented and put in place for routine evaluations for lamb survival in the future.
4. Meeting with Signet and presentation materials.
5. Final report for Signet.

2. Methods

Data extraction and editing

Data extracted from the Signet database, for Lleyn, Dorset and Texel ewes were edited using the following criteria:

- All non-purebred lambs were removed.
- All records which did not have a date of birth and/or a genetic dam assigned were removed.
- All records with no sire were removed.
- All records with no birth weight recorded were removed.
- All embryo transfer and foster lambs were removed.
- All those assigned to flock number "1" were removed.
- All records with negative weight values were removed.
- All flocks with less than 20 lamb records were removed.

It was observed that a number of flocks, during certain years, had 100% of animals assigned to 0 (ie. Dead). These could be breeding animals coming into the flock, but that did not have any weights recorded when they were a lamb, and lambs from flocks where weights had not been recorded. As a result, the data was cleaned further by:-

- Removing data from individual flocks/years where 100% of the records were 0.
- Removing data from flocks where 100% of the records were 1. (Note that where individual years had 100% records assigned 1, these were retained as it was difficult to disprove).
- All data from flocks with less than 5% assigned 0.

Trait definition

Lamb survival was considered as a binary trait, and coded 0 for dead lambs and 1 for live lambs. Lambs were coded 0 if they were either born dead or did not have an 8- or 20-week weight recorded. Lamb records from those born between 2003 and 2013 were used in the analyses (Additional data from 2002 was included for the Dorsets as there were few records available for 2013).

Parameter estimation

The genetic parameter estimates were undertaken using the ASREML statistical package using a univariate animal model. Each breed was analysed separately and using fixed effects that were consistent across the three breeds.

The model included fixed effects (significant $p < 0.001$) of litter size born (4 levels: 1- ≥ 4), sex (3 levels: Male, Female, Castrate), flock, lamb birth year, dam age (10 levels: 1- ≥ 11 years for the Lleyms and 1- ≥ 10 for the Texels), lamb birth weight (treated as a covariate), month of birth and (month x year) interaction. Dam age for the Dorset animals was 1.1 years up to ≥ 10 .

Due to the binary nature of the trait, the heritabilities estimated were transformed to an assumed underlying continuous normally distributed scale, using the following equation: transformed $h^2 = [h^2 p(1-p)]/z^2$, where p is the proportion of animals in one of the binary categories and z is the ordinate of the standard normal density function corresponding to p , as described by Dempster and Lerner, 1950.

3. Results

A summary of the data used in the analyses are presented in Tables 1-3. All three breeds had a similar proportion of dead animals observed (between 10-13%) with the Lleyns having the lowest (10.55%) and the Texels having the highest (13.40%). The proportion of lambs not surviving, overall and according to sex category (male, female, castrate) are given in Table 3. The overall heritability estimates observed, once transformed, were low for all three breeds ranging from 0.053-0.089 (Table 4). When the genetic dam and permanent environment (PE) effects were included in the model, the direct heritabilities estimates ranged from 0.040-0.074. All maternal and PE effects were between 0.004-0.022.

Table 1: Summary of lamb survival data

Breed	Count	Minimum	Maximum	Average	Std. Dev.
Dorset	15433	0	1	0.870	0.336
Lleyn	51174	0	1	0.896	0.307
Texel	48995	0	1	0.866	0.341

Table2: Number of dead and alive lambs each year, for each breed.

	Dorset			Lleyn			Texel		
Year	Dead	Alive	Total	Dead	Alive	Total	Dead	Alive	Total
2002	67	580	647	-	-	-	-	-	-
2003	52	737	789	209	3062	3271	359	2052	2411
2004	115	1378	1493	331	3225	3556	393	2590	2983
2005	135	1765	1900	524	4018	4542	520	3387	3907
2006	163	1473	1636	459	3687	4146	788	4066	4854
2007	69	1022	1091	612	5028	5640	523	4987	5510
2008	197	1063	1260	475	3749	4224	545	4706	5251
2009	182	1261	1443	373	3441	3814	647	4372	5019
2010	284	1428	1712	522	4082	4604	629	4493	5122
2011	400	1341	1741	352	3901	4253	849	4485	5334
2012	158	1191	1349	810	6077	6887	751	4624	5375
2013	185	187	372	730	5507	6237	563	2666	3229

Table 3: Proportion of breed totals assigned to survival code 0, according to sex category.

Sex Category	Dorset	Lleyn	Texel
Male	6.58%	5.24%	7.02%
Female	5.94%	4.61%	6.12%
Castrate	0.49%	0.69%	0.27%
TOTAL	13.00%	10.55%	13.40%

Table 4: Variance components estimated for Dorset, Lleyn and Texel lamb survival

Random effects fitted	Direct	Maternal	PE	Residual*	Phen. Var	h2 direct	Trans. h2 direct	h2 maternal	Trans. h2 maternal	h2 pe	Trans. h2 pe	Total Trans h2
Dorset												
Animal	0.852			3.29	4.142 (0.11)	0.21 (0.02)	0.078					0.078
Animal + Maternal Genetic	0.829	0.030		3.29	4.148 (0.11)	0.20 (0.03)	0.074	0.01 (0.02)	0.004			0.078
Animal + PE	0.747		0.145	3.29	4.182 (0.11)	0.18 (0.03)	0.067			0.03 (0.02)	0.011	0.078
Lleyn												
Animal	0.639			3.29	3.929 (0.05)	0.16 (0.01)	0.053					0.053
Animal + Maternal Genetic	0.497	0.192		3.29	3.979 (0.05)	0.12 (0.01)	0.040	0.05 (0.01)	0.017			0.057
Animal + PE	0.461		0.257	3.29	4.007 (0.05)	0.12 (0.01)	0.040			0.06 (0.01)	0.020	0.060
Texel												
Animal	0.856			3.29	4.146 (0.05)	0.21 (0.01)	0.078					0.078
Animal + Maternal Genetic	0.763	0.236		3.29	4.289 (0.04)	0.18 (0.01)	0.067	0.06 (0.01)	0.022			0.089
Animal + PE	0.712		0.186	3.29	4.188 (0.05)	0.17 (0.01)	0.063			0.04 (0.01)	0.015	0.078
Trans. = Transformed heritabilities												
*Residual variance fixed												
PE = Permanent environment												

5. Discussion

The overall proportions of dead/live animals observed in the three datasets (11%-13%) were similar to those observed previously in the Scottish Blackface study carried out in 2012, in which 12% of records were classed as 0.

The heritability estimates observed in this study (total h^2 of 0.053-0.089) were all low, but significantly different from zero, indicating that genetic progress could be made following selection for this trait. The values observed, when compared with the heritability estimates observed in the 2012 Scottish Blackface study (h^2 of 0.05-0.09; Conington et al., 2013) were very similar, although generally lower than those reported for 2 SRUC Blackface flocks (Sawalha et al., 2007) and that of a former Roslin Institute experimental Blackface flock (Riggio et al., 2008). However, the maternal influence, which was deemed quite high in the Scottish Blackface, was found to be less influential in the three breeds studied in the present work. This could be due to the nature of the different breeds, with the Scottish Blackface perhaps having more of an opportunity to express maternal instinct for survival compared to the Texel or Dorset breeds. However, although also generally classed as a maternal breed, the low maternal value observed for the Lleyens is of interest and would perhaps be worthy of further investigation.

However, if this trait was to be introduced as an EBV, some thought as to how the quality of the data collected would be improved, as there were a significant number of flocks where very few animals were classed as being dead/not surviving. In the present study, we only considered flocks with 5% or more of their lambs recorded as being dead. This was to improve data quality and to remove under-recording the trait by not registering/submitting information of lambs that had died either at birth or before their 8-week weight. Further evidence of this was seen in some flocks, in some individual years, where no deaths were observed and 100% of lambs were recorded as being alive at 8-weeks.

6. Conclusion

Lamb survival estimate of survivability has a low genetic basis for all three breeds estimated. However, the estimates are in line with similar ones for the Scottish Blackface breed reported in 2013 by the same authors for EBLEX. Although heritability estimates are low, it would be important to include lamb survival as a breeding goal trait to improve animal resilience, identify families with poor survival and provide a better balance amongst it and other goals in the breeding programme.

References

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