# Generating estimated breeding values for postnatal lamb survival

Report prepared for EBLEX

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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-$\geq$4), sex (3 levels: Male, Female, Castrate), flock, lamb birth year, dam age (10 levels: 1-$\geq$11 years for the Lleyns and 1-$\geq$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 $\geq$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 $h^2 = [h^2p(1-p)]/z^2$, 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 Lleyns 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.**

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