Genetic analysis of longevity in sheep

Final Report

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Contents

1. Objectives

The overall aim of the project is to define the best way to include productive lifespan into sheep breeding programmes and to use that new knowledge to be implemented in practise for three different sheep breeds.

Specific objectives of the research are:-

1. To define longevity and the best way to mine existing data recorded in Signet's Sheepbreeder recording programme.

2. To evaluate productive lifespan by including lambing interval as a continuous trait (in days).

3. To determine the best way to combine these as a sub-index to the main Sheepbreeder indexes used by Signet for the three breeds.

Milestones

The milestones of the project are shown in Table 1.1 below.

Table 1.1: Project Milestones

Milestone reference	Milestone	Status
1	Mine BASCO data set for three sheep breeds to extract relevant data. Clean up three data sets to a high standard required for genetic parameter evaluation purposes and generate pedigree. Revise and discuss with Signet.	Completed and revised following discussion with Signet.
2	Construct model and estimate transition probabilities for each age group for each breed.	Complete Several models evaluated. Seven definitions of traits generated from the data. Transition probabilities generated.

3	Estimate parameters and generate EBVs for Lifespan (Objective 1) and Lambing Interval (Objective 2) for dead and live animals. Evaluate results and report.	Parameters completed.
4	Estimate EBVs for lifespan and lambing interval including sensitivity analyses.	Complete for parameter data set. EBVs for current (whole) database in progress.
5	*Construct Mathcad model and evaluate Productive Lifespan sub-index. Predict annual genetic Improvements.*	*Model completed.* *Analyses will be completed by 30 April 2016*
6	Provide recommendations to Signet for including longevity into sheep breeding programmes and write final report.	Completed
7 (Optional)	Implementation of longevity into sheep breeding programmes for Signet	Code written into EGENES extraction and evaluation procedure, QA and regression if EBV and phenotypes completed.

This report builds on the interim reports sent to Signet:-

1st interim report Feb 2015

2nd Interim report May 2015

3rd Updated interim report September 2015

Update notes on EBV implementation Feb 2016

2. Trait definition

Seven new trait definitions were originally investigated (see Interim Reports, February 2015, June 2015, September 2015), however, these were cut down to three of interest:

Longevity (LONG) – Age at last recorded lambing (in years), calculated only for animals born between 1980-2000.

Age at first lambing (AFL) – Age of the ewe at her first recorded lambing event (in years), calculated for ewes born between 1980 – 2011.

Lambing interval (LI) – Number of days between the ewes first and second lambing event, calculated for ewes born between 1980 – 2011.

3. Materials and Methods

3.1. Summary of traits used for parameter estimation

A summary of the data for the three traits for the Dorset, Lleyn and Texel breeds are shown in Tables 3.1, 3.2 and 3.3 respectively. Longevity data for ewes born between 1980 and 2000 were used, so that they could achieve their longevity potential. The Texel longevity analyses also considered data from ewes born between 1995 and 2000 due to the very large number of records (as larger data set was taking several days for the analyses to converge). Additionally, AFL for the Dorsets was split between those lambing as ewe lambs (before 1.8 years old) and those lambing as gimmers or older for the first time (1.8 years old and older) (See Appendix 1).

Table 3.1: Data summary for Dorset traits

Trait	Count	Data Used	Minimum	Maximum	Average	Std. Dev.
LONG	14047	Ewes born 1980-2000	1.2 years	11.0 years	3.7 years	1.6
AFL	20816	Ewes born 1980-2012	1.2 years	3.5 years	2.0 years	0.4
LI	14648	Ewes born 1980-2012	152 days	800 days	365 days	100.1

Table 3.2: Data summary for Lleyn traits

Trait	Count	Data Used	Minimum	Maximum	Average	Std. Dev.
LONG	13652	Ewes born 1980-2000	1.2 years	12.0 years	3.7 years	1.6
AFL	30597	Ewes born 1980-2011	1.2 years	3.4 years	2.1 years	0.3
LI	18391	Ewes born 1980-2011	251 days	797 days	390 days	94.5

Table 3.3: Data summary for Texel traits

Trait	Count	Data Used	Minimum	Maximum	Average	Std. Dev.
LONG[1]	24143	Ewes born 1995 - 2000	1.2 years	12.1 years	4.0 years	1.7
LONG[2]	84782	Ewes born 1980 - 2000	1.2 years	14.0 years	3.9 years	1.7
AFL	68236	Ewes born 1995 - 2005	1.2 years	3.4 years	2.2 years	0.4
LI	47656	Ewes born 1995 - 2005	250 days	800 days	400 days	112.0

3.2. Models used for analyses

The univariate models using ASReml for the heritability estimation, for each breed are listed below.

Longevity = birth year + flock + age at first lambing + total litter size born + number of lambing events.

Dorset = Total litter size born had 12 levels (from 1 to 12+); number of lambing events had 9 levels (1 to 9+).

Lleyn = Total litter size born had 14 levels (from 1 to 14+); number of lambing events had 7 levels (1 to 7+).

Texel = Total litter size born had 14 levels (from 1 to 14+); number of lambing events had 8 levels (1 to 8+).

The number of ewes in each level, for total litter size born and number of lambing events are shown in Tables 3.4 and 3.5 respectively.

Table 3.4: Number of ewes according to their total litter size born (longevity trait analyses).

Total litter size born	Dorset Count	Lleyn Count	Texel Count
1	2210	1774	4777
2	2659	2990	4747
3	1783	1522	3520
4	1754	1674	3104
5	1399	1224	2404
6	1176	1098	1846
7	945	850	1306
8	669	731	935
9	509	528	575
10	362	385	389
11	207	302	238
12 (and above for Dorset)	372	202	147
13		136	79
14 (and above)		234	76

Table 3.5: Number of ewes according to the number of lambing events (longevity trait analyses).

Number of lambing events	Dorset Count	Lleyn Count	Texel Count
1	4048	4707	7595
2	3100	3294	5771
3	2624	2417	4490
4	1999	1569	3213
5	1155	1001	1830
6	653	460	820
7 and above	276	204	294
8 and above	116		130
9 and above	74		

Age at first lambing (years) = lambing year + litter size of the ewe when she was born + (flock x birth year)

Dorset = Lambing year ranged from 1981 – 2014 and also included season of birth, due to the ability of the Dorsets to lamb more than once each year. The litter size of the ewe at birth was between 1 and 4 and above. 461 different contemporary (flock x birth year) groups were fitted.

Lleyn = Lambing year ranged from 1982 – 2013 and the litter size of the ewe at birth was between 1 and 4 and above. 708 different contemporary (flock x birth year) groups were fitted.

Texel = Lambing year ranged from 1996 – 2008 and the litter size of the ewe at birth was between 1 and 4 and above. 1827 different contemporary (flock x birth year) groups were fitted.

Lambing Interval (days) = age at first lamb + lambing year + previous litter size born + (flock x birth year)

Dorset = Where age at first lambing ranged from 1.2 years up to 3.5 years and the lambing-year(plus season) effect had 123 different levels (19821 – 20141) Previous litter size born had 4 levels (1 – 4 and above).

Lleyn = Where age at first lambing ranged from 1.2 years up to 3.2 years, the lambing year ranged 1981 – 2012. Previous litter size born had 4 levels (1 – 4 and above).

Texel = Where age at first lambing ranged from 1.2 years up to 3.4 years, the lambing year ranged from 1996 – 2008. Previous litter size born had 4 levels (1 – 4 and above).

Genetic and phenotypic correlations were estimated using bivariate analyses in ASReml.

4. Results and Discussion

4.1. Summary parameter estimates

The genetic parameters estimated for the Dorsets, Lleyns and Texels are shown in Tables 4.1, 4.2 and 4.3 respectively.

Table 4.1: Genetic parameters estimated for the Dorset longevity traits.

Trait	Direct	Residual	Phenotypic	Heritability
LONG	**0.014**	**0.114**	**0.12 (0.002)**	**0.11 (0.01)**
AFL	**0.007**	**0.028**	**0.03 (0.0004)**	**0.20 (0.02)**
LI	**424.77**	**3016.06**	**3440.80 (42.66)**	**0.12 (0.02)**

Table 4.2: Genetic parameters estimated for the Lleyn longevity traits.

Trait	Direct	Residual	Phenotypic	Heritability
LONG	**0.004**	**0.080**	**0.08 (0.001)**	**0.05 (0.01)**
AFL	**0.0003**	**0.002**	**0.002 (0.00002)**	**0.14 (0.01)**
LI	**10.38**	**175.97**	**186.35 (2.01)**	**0.06 (0.01)**

Table 4.3: Genetic parameters estimated for the Texel longevity traits.

Trait	Direct	Residual	Phenotypic	Heritability
LONG[1]	**0.0004**	**0.144**	**0.144 (0.001)**	**0.003 (0.01)**
LONG[2]	**0.002**	**0.149**	**0.151 (0.001)**	**0.015 (0.003)**
AFL	**0.0004**	**0.004**	**0.004 (0.00002)**	**0.10 (0.01)**
LI	**13.89**	**337.95**	**351.83 (2.37)**	**0.04 (0.01)**

The heritability estimates presented here for Longevity differ slightly (the maximum difference is +/- 2%) from those presented in previous reports. This is due to the different data structure used between the different analyses. Although the model has remained the same, the current data has had all records from contemporary groups (flock x birth year) with less than 10 ewes (less than 20 ewes for the Texels) represented removed. In addition, previously, for the Texel analyses, data from flocks with less than 100 ewes represented in the data were removed. This was changed in the current analyses with those in a contemporary group of less than 20 removed.

The heritability estimates for Age at first lambing have fallen from 0.31 for both the Dorsets and Lleyns to 0.20 and 0.14 respectively. The Texel estimate has also fallen from 0.16 to 0.10. The variance components observed have also reduced. This is again primarily down to the different data structure. In addition to removing records from smaller contemporary groups, data from all ewes born before 1980 was also removed for this trait. The initial model has also been slightly altered by

including the interaction between the birth year and flock of birth of the ewe and the inclusion of year-season of lambing for the Dorset ewes.

The Lambing interval heritability estimates have also changed slightly from those reported previously. In addition to the data structure changes mentioned previously, the model for this trait has been altered by replacing age at lambing (as in the original model) with age at first lambing. The interaction between birth year and flock of birth of the ewe has now been included as well as the year-season of lambing for the Dorset ewes

4.2. Correlations among the traits.

Genetic and phenotypic correlations between the three traits were estimated using bivariate analyses in ASReml (Table 4.4 and Table 4.5). Bivariate analyses were attempted using data from Texel ewes born between 1995 – 2005, unfortunately however, problems arose with convergence, due to the particularly low heritability estimated for longevity and so the correlations are not reported here. Across both the Dorset and Lleyn analyses, positive genetic correlations were observed between longevity and both age at first lambing and lambing interval. The correlations observed between age at first lambing and lambing interval were both negative in terms of the phenotypic correlations observed. However, differences in the genetic relationship between these two traits were observed with the genetic correlations for the Dorsets being positive (0.25), but the genetic correlation estimated for the Lleyns being negative (-0.19).

Table 4.4: Genetic (above diagonal) and phenotypic (below diagonal) correlations between the longevity traits – Dorsets.

Trait	LONG	AFL	LI
LONG		**0.74 (0.05)**	**0.55 (0.06)**
AFL	0.54 (0.01)		**0.27 (0.07)**
LI	0.45 (0.01)	-0.19 (0.01)	

Table 4.5: Genetic (above diagonal) and phenotypic (below diagonal) correlations between the three longevity traits – Lleyns.

Trait	LONG	AFL	LI
LONG		**0.31 (0.08)**	**0.25 (0.09)**
AFL	0.16 (0.01)		**-0.14 (0.05)**
LI	0.10 (0.01)	-0.12 (0.01)	

The genetic correlations observed between Age at first lambing and Longevity for the Dorsets remains relatively high (the previous estimate was 0.87), which will again be influenced by the changes already discussed in terms of data structure and model used. Despite similar changes in the data and model structure, the Lleyn estimate remains very similar to the estimate presented in the earlier reports (0.30). Both these results suggest that the longer it takes a ewe to have her first lamb, the longer she will remain in the flock. It should be noted that the vast majority of ewes in the Lleyn

dataset (and the Texel dataset) lambed for the first time at 1.8 years old or older, however the Dorsets had a wider distribution for age at 1st lambing with 25% of the ewes represented in the data lambing before 1.8 years old. As a result of this, additional analyses were carried out separating those lambing early (before 1.8 years old) and those lambing from 1.8 years old and onwards. The results are presented in Appendix 1.

The genetic correlations estimated between Longevity and Lambing Interval were previously very high for both Dorsets and Lleyns (>0.81). The correlations observed in the present analyses were 0.55 and 0.25 for the Dorsets and Lleyns respectively. Although the strength of the correlations have reduced, the relationship between the traits is still significant indicating that ewes that have longer intervals between lambing events live longer. Biologically this sounds sensible as the longer the intervals between lambing could reduce the number of times the ewe goes through the high risk period, to her health, of the lambing process and subsequent rearing. Also, if ewes miss a lambing it means that she has had to work less than those that have a lamb every year.

The correlations observed between Age at first lambing and Lambing Interval have increased when compared with those estimated previously, but the direction of the relationships remain similar. The genetic and phenotypic correlations estimated for the Lleyns were negative (-0.14 and -0.12 respectively) suggesting that ewes that lamb for the first time at an older age will have a lower lambing interval for her second lambing, perhaps due to the fact she is more mature or in a fitter condition when she does lamb for the time, and is therefore able to recover quicker. However, the results for the Dorsets are somewhat different due to a moderately positive genetic correlation (0.27) but a negative phenotypic correlation (-0.19). This difference could be accounted for by the management on farm. For example is ewes lamb for the first time at a young age, the farmer may wait a bit longer to put them back in lamb. The positive genetic correlation however indicates that they may in fact have the genetic potential to cope with a shorter interval between the first and second lambing. For a breed such as the Dorset this would seem plausible as we know they can lamb at shorter intervals than other breeds, but the management on certain farms may mean that they don't necessarily get to display this.

5. Data editing and extraction

Data extracted from the Signet database, for the three breeds, were edited using the following criteria for the parameter estimation:-.

- All animals born on the 15th of March, with unknown sires, were removed.

- Outliers for age at first lambing were removed, with only those between 1.2 and 3.5 years old retained.

- Outliers for lambing interval were also removed, with only those between 125 and 800 days between consecutive lambings retained.

- Records with missing values for lambing interval removed.

- All embryo transfer ewes were removed as were all animals with no sire and dam information or flock information.

- All animals born before 1980 removed.

- All contemporary groups (birth year x flock) less than 10 (20 for Texels) were removed.

In addition, the extraction rules for the EBVs are embedded in the EGENES data extraction procedure as follows:-

- All ewes with any ET progeny are discarded

- Lambs must have Genetic Dam Id $\neq$ 0 and valid date of birth

- Lambing Interval as the difference between 1st and 2nd lambing (days): kept between 125-1000 days (otherwise missing -1)

- Lambing interval penalty: if between 730-1000, become 764 (2 years and 2 cycles)

- Age at first lambing (years): kept between 0.9-5 (otherwise missing -1)

- age at last lambing (years): kept between 0.9-5 (otherwise missing -1)

- cumulative LSB: max 25 (over 25 changed to be 25)

- number of lambing events: max 12 (over 12 changed to be 12)

6. Overall Conclusions

The parameters give new insight into the biology of the maternal ewe, in general they are under low genetic control and are within the anticipated range for fertility traits in livestock. The three traits described in this final report are recommended to be suitable new maternal traits for the breeds investigated.

The estimate of heritability for Texels was very low. Two interpretations can be concluded from this. First, that longevity in Texels is negligible and therefore is not a heritable trait. Second, that 'true' longevity is being masked by management (e.g. by keeping ewes for longer than they otherwise should possibly because of their high monetary value). Again, there are two recommendations that can be drawn from this, 1) Longevity should not be included in Texel sheep breeding programmes, or 2) include it because the biological interpretation is, that there is an underlying genetic basis to longevity (however small) and there is no rationale for Texels to be any different to other sheep (indeed the phenotypic variances for Longevity are similar to the Dorsets). If (2) is accepted, and using the evidence from Figures A5 and A6 , then including longevity as a breeding goal for Texels can indeed be justified.

The alternative for Texels is to use proxy traits for longevity such as disease and functional fitness traits which may be better predictors of longevity compared to the age at which a ewe is recorded for the last time in the recorded flock.

As these traits ordinarily have a low genetic basis, the parameters were very sensitive to the models and data cohorts used for analyses, which, over the course of the project, have been exhaustively researched. They also differ according to the breed, which leads us to conclude that separate parameters should be implemented according to the breed.

Even though Age at first lambing trait consistently has the highest heritability, it has very low genetic variance in all breeds. Despite this, the EBVs and regression of EBV on daughter phenotype graphs indicate that selection for this trait will result in a genetic change in the expected direction.

According to the results, in the Dorset and Lleyn breeds, the information shows both at a genetic and phenotypic level:-

1. The age of the ewe at her first lambing will influence the length of time she will remain in the flock, with older ewes at first lambing having higher longevity.
2. Ewes with longer lambing interval between 1st and 2nd lambing also have higher longevity.

For Dorsets (all ewes data set and gimmers and older only dataset)

1. At a genetic level for all ewes, those that are younger at their first lambing have the potential to be more fertile as they have subsequently shorter lambing interval between 1st and 2nd lambing. At a phenotypic level this ability may be masked by management decision to delay quick re-breeding younger ewes.

For Lleyn and Dorset ewe lambs

1. Both phenotypically and genetically younger ewes lambing for the first time have longer lambing intervals.

It is possible that ewes lambing for the first time at a young age, take longer to recuperate leading to a higher proportion of these not conceiving for their 2nd lambing.

All of the QA data analyses in Appendix 2 show positive correlations between sire genotype and offspring phenotype, indicating that despite low genetic parameters, it is possible to differentiate animals with high and low EBVs for all traits.

Appendix 1: Age at first lambing – Additional Analyses

Additional analyses were done to disentangle the impact of ewe age on parameter estimations for the Dorset breed.

When only Dorset ewe lambs (AFL^{EL}) were considered (those lambing before 1.8 years old), there were 119 different lambing year season effects (ranging from 19811 – 20141) and 256 different contemporary groups (flock x birth year). Similarly, for those lambing for the first time later (1.8 years old and older), or in other words from gimmers onwards (AFL^{GO}), there were 123 different lambing year season effects (ranging from 19811 – 20134) and 452 different contemporary groups (flock x birth year). The data summaries are shown in Table A1.

Table A1. Data summary for Age at 1st lambing

Trait	Count	Data Used	Minimum	Maximum	Average	Std. Dev.
AFL^{EL}	5133	Ewes born 1980-2012	1.2 years	1.7 years	1.4 years	0.2
AFL^{GO}	15683	Ewes born 1980-2012	1.8 years	3.5 years	2.1 years	0.3

AFL^{EL} – Ewe lamb analyses
AFL^{GO} – Gimmer and older analyses

The variance components estimated from the two analyses are shown in Table A2.

Table A2. Genetic parameters estimated for Age at 1st lambing.

Trait	Direct	Residual	Phenotypic	Heritability
AFL^{EL}	0.003	0.004	0.007 (0.0001)	0.39 (0.04)
AFL^{GO}	0.006	0.022	0.03 (0.0003)	0.23 (0.02)

AFL^{EL} – Ewe lamb analyses
AFL^{GO} – Gimmer and older analyses

The heritabilities estimated were moderate for both analyses, with the estimate for the ewes lambing before 1.8 years old (AFL^{EL}) the higher of the two. The correlations estimated with the other traits are shown in Table A3 and A4.

Table A3. Genetic (above diagonal) and phenotypic (below diagonal) correlations between the Age at first lambing (those below 1.8 years old) AFL^{EL}

Trait	LONG	AFL	LI
LONG		**0.08 (0.08)**	
AFL^{EL}	0.19 (0.02)		**-0.13 (0.09)**
LI		-0.13 (0.01)	

Interestingly, the genetic correlations between AFL and LI for the Dorset ewe lambs follows the same direction and order of magnitude as those for Lleyn (Table 4.5). The same correlations for the older Dorset ewes in Table A4 follows the same direction as that for all Dorset ewes in Table 4.4. The interpretation of these is, that ewe lambs lambing are more likely to have longer lambing intervals (i.e. less likely to conceive the following year) whereas it is the gimmers and older ewes that are driving the correlations seen in Table 4.4 and below in Table A4.

Table A4.Genetic (above diagonal) and phenotypic (below diagonal) correlations between the Age at first lambing (those 1.8 years old and older) AFL[GO]

Trait	LONG	AFL	LI
LONG		**0.48 (0.5)**	
AFL	0.57 (0.01)		**0.51 (0.07)**
LI		-0.14 (0.01)	

Appendix 2: Implementation of EBVs

The implementation of the EBVs included several QA steps including analyses of EBV distribution and outliers, and regression of sire EBVs against the residual phenotypic performance of daughters. Only sires with 10 or more offspring were included in the data.

The accuracy of the EBVs for all traits is shown in the following tables for each breed.

Dorset

		Accuracy		
	min	max	avg	sd
LI	0	0.96	0.29	0.16
AFL	0	0.98	0.42	0.21
Longevity	0	0.99	0.48	0.23

Lleyn

		Accuracy		
	min	max	avg	sd
survival	0	0.97	0.22	0.18
LI	0	0.95	0.29	0.15
AFL	0	0.98	0.45	0.20
Longevity	0	0.95	0.35	0.16

Texel

		Accuracy		
20082780	min	max	avg	sd
survival	0	0.97	0.28	0.14
LI	0	0.98	0.27	0.11
AFL	0	0.97	0.36	0.14
Longevity	0	0.99	0.28	0.11

<u>Longevity</u>

Dorset Longevity EBVs

The distribution of sire breeding values (for 389 sires with over 10 offspring represented in the data) is shown in Figure A1. The minimum breeding value was -0.066, the maximum was 0.089. The

average breeding value was 0.The regression of sire EBVs against the residual phenotypic performance of daughters is shown in Figure A2 and the extreme animals are in Tables A5 and A6.
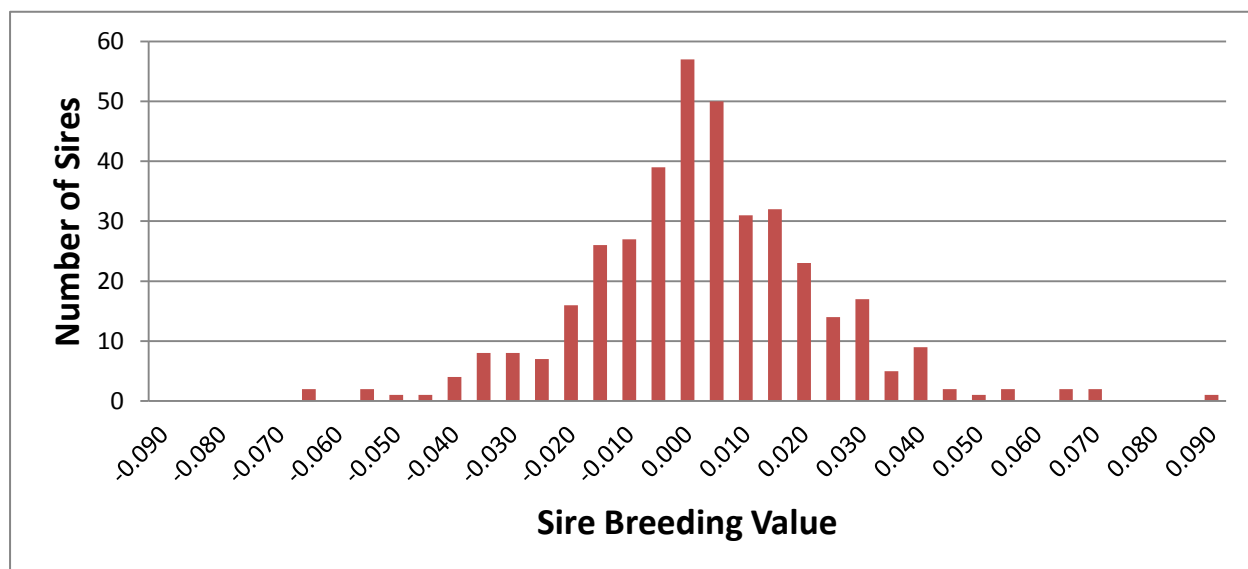

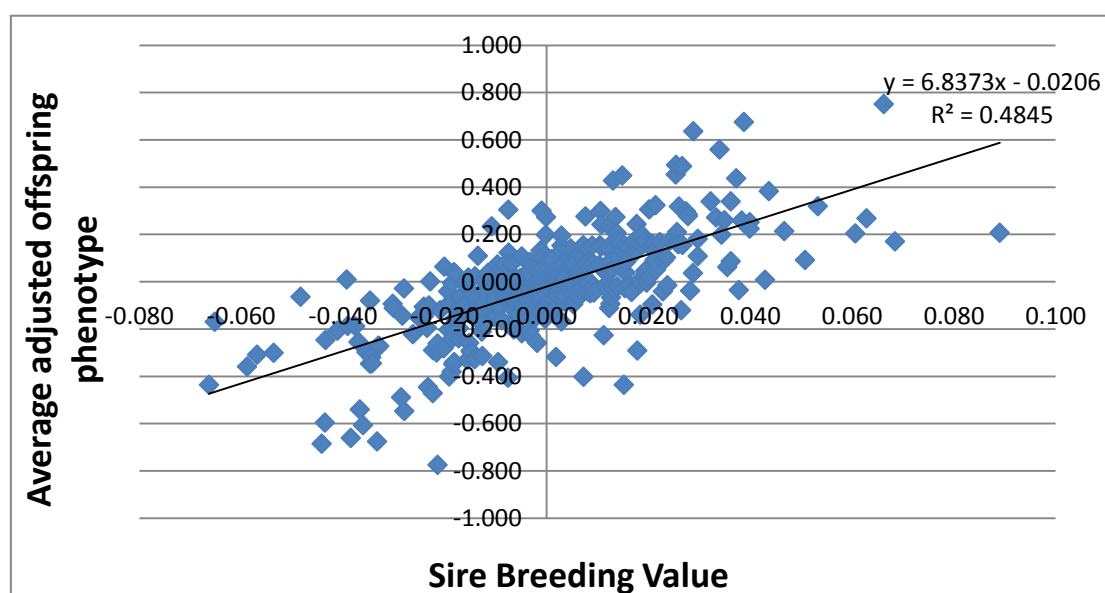**Figure A1: DORSET Distribution of sire breeding values for Longevity**

Figure A2: DORSETS Regression of sire EBV vs daughter longevity

Dorset Longevity – Extreme Animals

In general, the distribution of the sire breeding values followed a normal pattern, with the majority of values falling between -0.070 and 0.070. However, sire number 5726273 did have a 'high' breeding value of 0.089. The sire with the lowest breeding value, although still within the range of -0.070 and 0.070 was sire number 6268364 (-0.066).

Looking at these sires in more detail:

Sire 5726273 (breeding value of 0.089)
     119 animals represented in the dataset (has 482 progeny according to BASCO)
     Interval range for these 119 animals: 1.4 years – 9.1 years, with an overall average of 4.5 years.
     No parent information (born in 1991)
     By contemporary group (Table A5):

Table A5. Contemporary group information for Sire 5726273 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3206619981	13	2.0	3.0	2.8
3206619991	3	2.1	2.1	2.0
3211019981	9	3.0	7.1	6.0
3221419981	7	5.0	9.1	7.2
3223119981	5	2.3	5.0	3.2
3225519981	8	2.0	8.0	5.3
3230819981	2	3.0	7.0	5.0
3239319981	27	1.4	8.1	4.8
3239319991	24	2.1	8.0	4.8
3239320001	9	2.1	5.3	3.8
3263019981	10	2.1	3.5	2.9
3292419981	2	5.9	9.0	7.5

Sire 6268364 (breeding value of -0.066)
     40 animals represented in the dataset (has 490 progeny according to Basco webpage)
     Interval range for these 40 animals: 1.4 years – 5.3 years, with an overall average of 3.4 years.
     No parent information (born in 1984)
   By contemporary group (Table A6):

Table A6. Contemporary group information for Sire 6268364 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
32077198612	9	2.8	5.3	4.2

32077198613	1	4.9	4.9	4.9
32077198715	11	1.4	4.4	3.2
32077198716	8	2.6	3.9	3.4
32077198717	4	2.4	3.5	3.0
32077198817	5	2.8	3.4	3.1
32077198819	8	1.8	3.3	2.9

Lleyn Longevity EBVs

The distribution of sire breeding values (for 453 sires with over 10 offspring represented in the data) is shown in Figure A3. The minimum breeding value was -0.035, the maximum was 0.048. The overall average breeding value was 0.00. The regression of sire EBVs against the residual phenotypic performance of daughters is shown in Figure A4 and the extreme animals are in Tables A7 and A8.
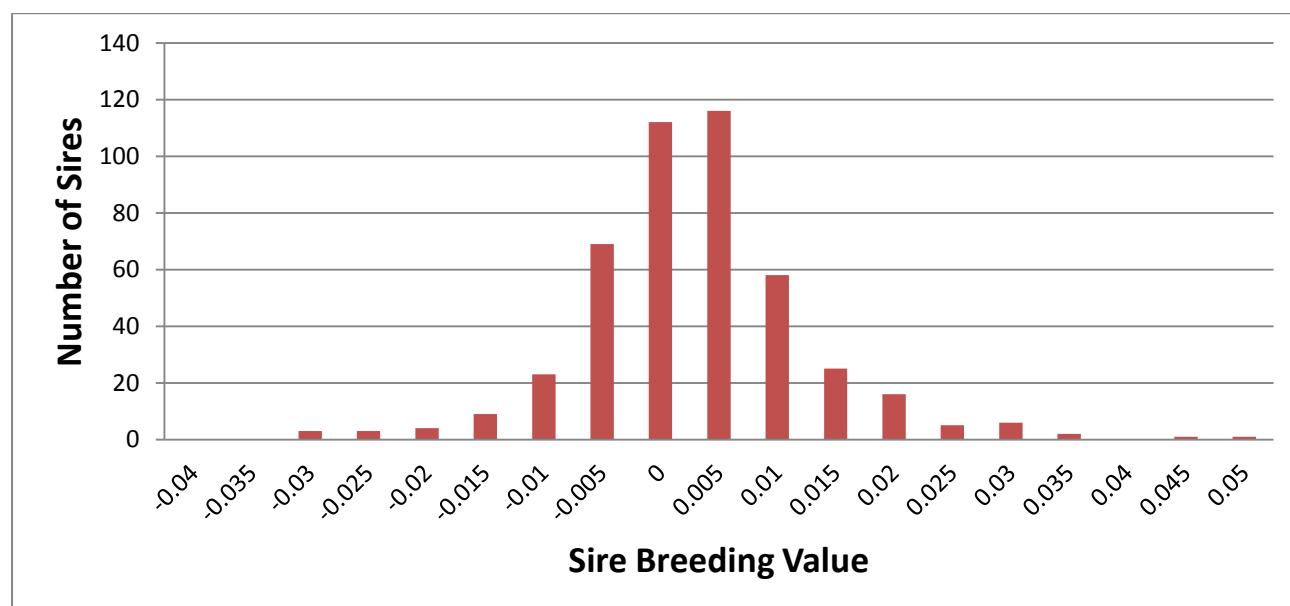
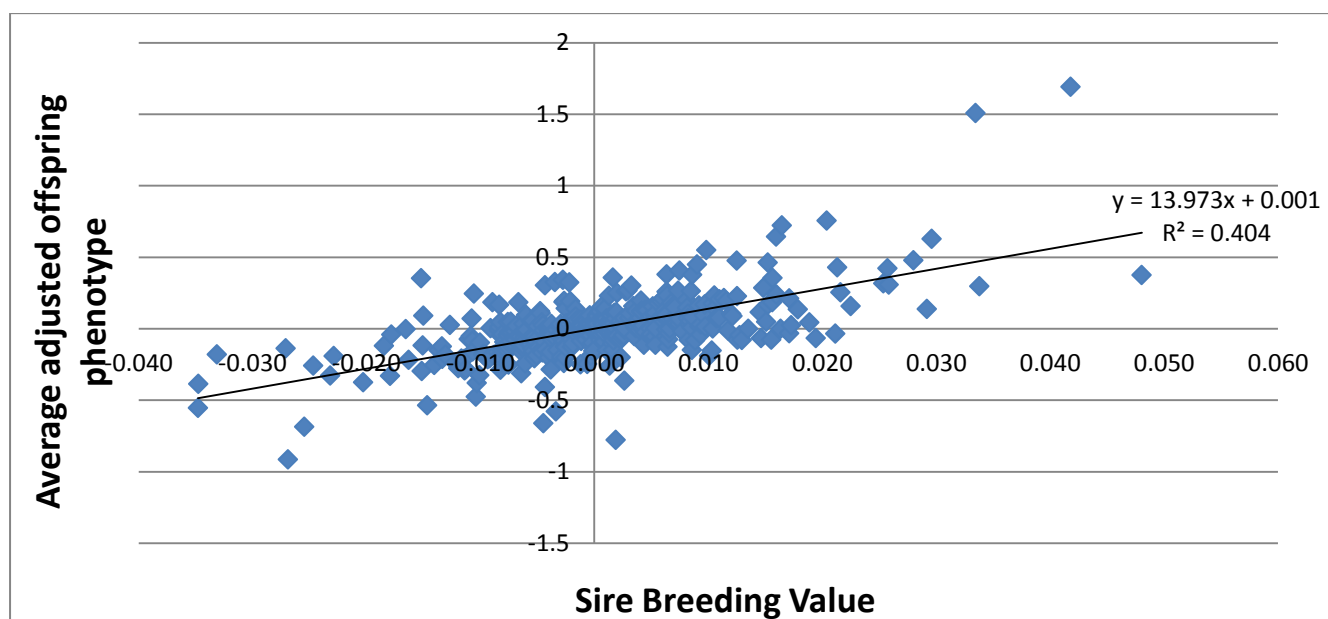**Figure A3: LLEYN – Distribution of sire breeding values for Longevity**

Figure A4: LLEYN Regression of sire EBV vs daughter longevity

Lleyn Longevity – Extreme Animals

In general, the distribution of the sire breeding values followed a normal pattern, with the majority of values falling between -0.035 and 0.035. However, sires number 5779950 and 6754927 did have high breeding values (0.042 and 0.048 respectively).

Looking at these sires in more detail:

Sire 5779950 (breeding value of 0.042)
    13 offspring represented in the dataset (has 49 offspring according to Basco webpage)
    Interval range for these 13 animals: 2.0 years – 4.0 years, with an overall average of 3.8
years.
    No parent information (born in 1989)
    All 13 animals were in the same contemporary group (3277319951).

Sire 6754927 (breeding value of 0.048)
    47 offspring represented in the dataset (has 290 offspring according to Basco webpage)
    Interval range for these 47 animals: 1.9 years – 9.0 years, with an overall average of 3.7
years.
    Both parents and grandparents are known (born in 1990)
    By contemporary group (Table A7):

Table A7. Contemporary group information for Sire 6754927 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3205519932	21	1.9	8.9	4.6
3205519951	10	3.0	9.0	4.9
3277319971	16	1.9	2.0	2.0

The sires with the lowest breeding values were 6658497 and 7244778.

Sire 6658497

   38 animals represented in the dataset (has 175 progeny according to Basco webpage)

   Interval range for these 38 animals: 2.0 years – 5.0 years, with an overall average of 4.2 years.

   Both parent known (born in 1998)

   All 38 animals were in the same contemporary group (3205520002).

Sire 7244778

   60 animals represented in the dataset (has 560 progeny according to Basco webpage)

   Interval range for these 60 animals: 2.0 years – 8.0 years, with an overall average of 3.9 years.

   No parent information (born in 1987)

   By contemporary group (Table A8):

Table A8. Contemporary group information for Sire 7244778 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3205519911	11	2.0	6.0	3.9
3205519922	19	2.0	8.0	4.2
3205519932	16	2.0	8.0	3.3
3205519951	14	2.0	7.0	4.4

Texel Longevity EBVs

The distribution of sire breeding values (for 560 sires with > 10 offspring) is shown in Figure A5. The summary statistics of the breeding values estimated are presented in Tables A9 and A10.The regression of sire EBVs against the residual phenotypic performance of daughters is shown in Figure A6.
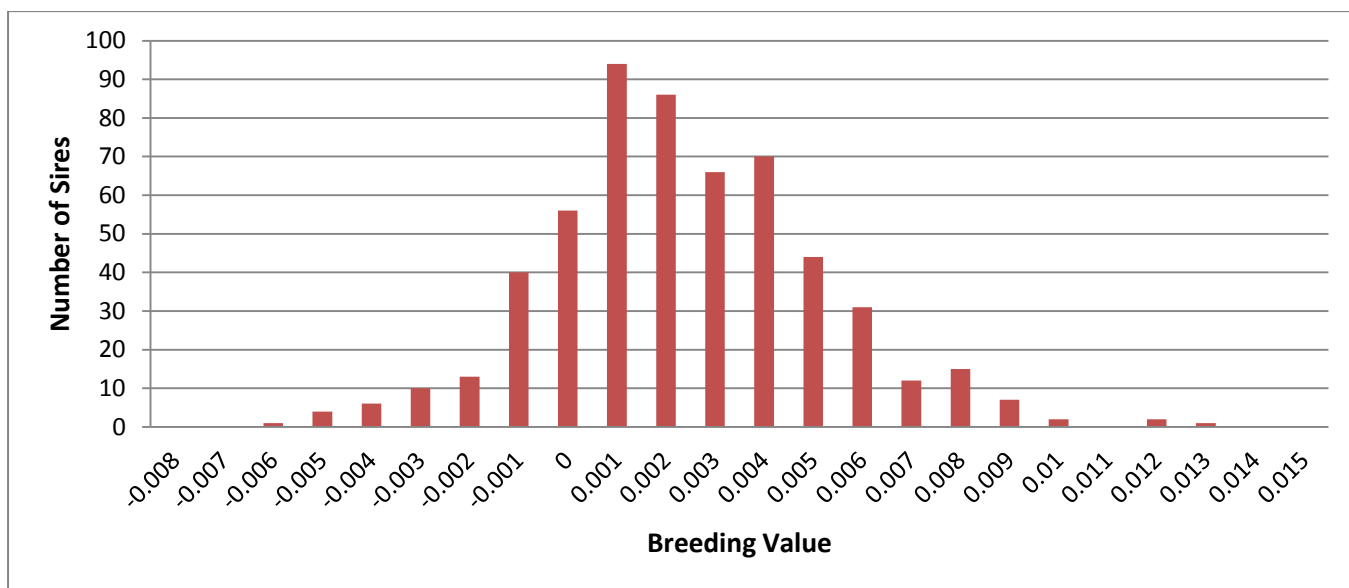
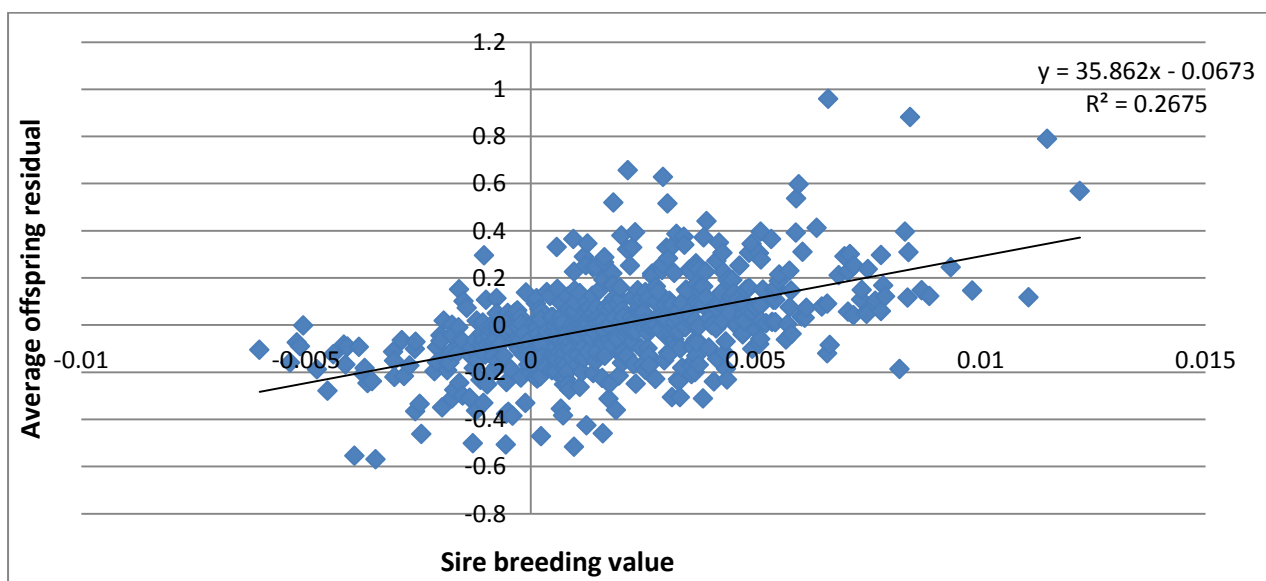**Figure A5. TEXEL - Distribution of sire breeding values for Longevity**

$$y = 35.862x - 0.0673$$
$$R^2 = 0.2675$$

Figure A6. TEXEL - Regression of sire EBV vs daughter longevity

Texel Longevity – Extreme Animals

In general, the distribution of the Sire breeding values followed a normal pattern. The two sires at the higher end of the analyses were sires 570662 and 400197 which had breeding values of 0.012 and 0.011 respectively. The sire at the lower end of the distribution was 427673.

Sire 570662 (breeding value of 0.012)
    15 animals represented in the dataset (has 844 progeny according to Basco webpage)
    Interval range for these 15 animals: 2.0 years – 8.1 years, with an overall average of 5.7 years.
    Both parents known (born in 1993)
    By contemporary group (Table A9):

Table A9. Contemporary group information for Sire 570662 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
594719951	5	4.0	8.1	6.2
594719961	6	3.0	8.1	6.6
594720001	4	2.0	5.0	3.7

Sire 400197 (breeding value of 0.011)
    45 animals represented in the dataset (has 500 progeny according to Basco webpage)
    Interval range for these 45 animals: 2.0 years – 8.1 years, with an overall average of 4.7 years.
    Both parents known (born in 1992)
    By contemporary group (Table A10):

Table A10. Contemporary group information for Sire 400197 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
166619971	5	3.1	7.1	4.5
173619961	1	7.1	7.1	7.1
197819971	6	4.0	8.1	5.4
197819981	3	3.0	6.0	4.4
348819951	12	2.0	8.0	4.3
348819961	7	3.0	7.0	5.0
348819971	5	2.0	6.0	4.2
348819981	2	4.1	7.1	5.6
441419971	4	3.0	5.1	3.8

Sire 427673 (breeding value of -0.006 and -0.016)
   75 animals represented in the dataset (has 379 progeny according to Basco webpage)

Interval range for these 75 animals: 1.9 years – 9.1 years, with an overall average of 5.6 years.

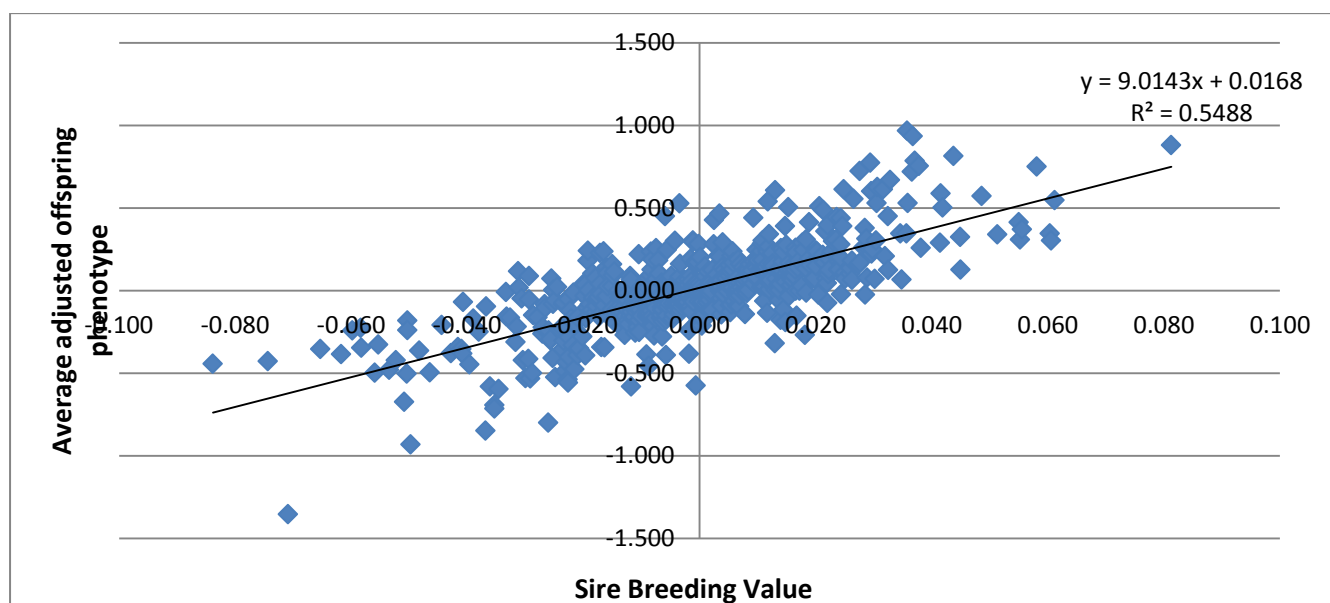Both parents known (born in 1996)

Age at first lambing (AFL)

Dorset Age at first lambing (all ewes)

The distribution of sire breeding values (for 601 sires with over 10 offspring represented in the data) is shown in Figure A7. The minimum breeding value was -0.084, the maximum was 0.081. The average breeding value was -0.001. Figure A8 shows the regression of sire EBV with daughter phenotype, and extreme animal data are in Tables A11 - A13.
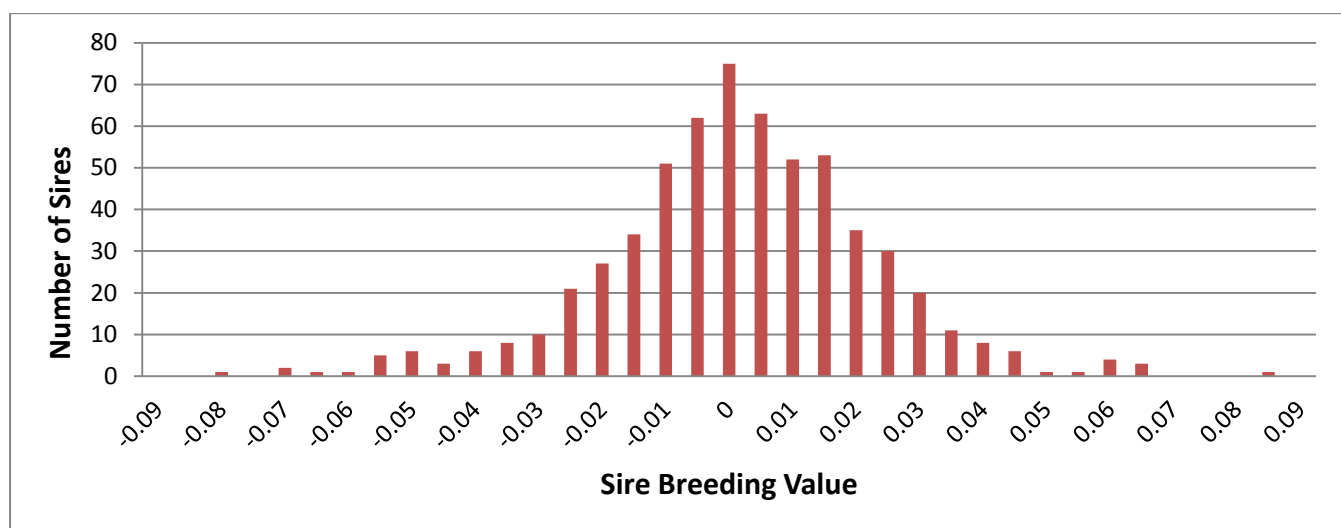
Figure A7. DORSET sire EBVs Age at first lambing (All ewes)

Figure A8. DORSET Regression of sire EBV vs daughter age at first lambing

Dorset Age at first lambing (all ewes) – Extreme Animals

In general, the distribution of the sire breeding values followed a normal pattern, with the majority of values falling between -0.070 and 0.070. However, sires number 5601240, 6213538 and 5951378 did have breeding values below -0.07. Sire 7028291 had the highest breeding value, of 0.081.

Looking at these sires in more detail:

Sire 5601240 (breeding value of -0.084)
>   45 offspring represented in the dataset (has 143 offspring according to Basco webpage)
>   Age range for these 45 animals: 1.2 years – 3.0 years, with an overall average of 1.9 years.
>   Both parents known (born in 1994)
>   By contemporary group (Table A11):

Table A11. Contemporary group information for Sire 5601240 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3211019981	10	1.2	2.1	1.9
3211019991	9	1.2	2.4	1.8
3211019992	1	1.9	1.9	1.9
3263019971	22	1.7	2.7	1.9
3263019972	3	1.7	3.0	2.2

Sire 6213538 (breeding value of -0.074)

39 offspring represented in the dataset (has 502 offspring according to Basco webpage)

Age range for these 39 animals: 1.3 years – 3.5 years, with an overall average of 1.9 years.

Both parents known (born in 1978)

By contemporary group (Table A12):

Table A12 Contemporary group information for Sire 6213538 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3207219842	6	1.3	2.0	1.6
32072198212	10	1.7	3.5	2.3
32072198313	4	1.3	3.2	1.8
32072198314	1	2.9	2.9	2.9
32072198315	3	1.6	2.6	2.3
32513198212	11	1.6	2.3	1.7
32513198313	4	1.3	1.4	1.3

Sire 5951378 (breeding value of -0.071)

14 offspring represented in the dataset (has 21 offspring according to Basco webpage)

Age range for these 14 animals: 1.4 years – 2.0 years, with an overall average of 1.5 years.

Both parents and grandparents known (born in 2005)

All 14 animals were in the same contemporary group (3350120081).

Sire 7028291 (breeding value of 0.081)

27 offspring represented in the dataset (has 176 offspring according to Basco webpage)

Age range for these 27 animals: 2.0 years – 3.3 years, with an overall average of 2.2 years.

Both parents known (born in 2004)

By contemporary group (Table A13):

Table A13. Contemporary group information for Sire 7028291 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3211019981	10	1.2	2.1	1.9
3211019991	9	1.2	2.4	1.8
3211019992	1	1.9	1.9	1.9
3263019971	22	1.7	2.7	1.9
3263019972	3	1.7	3.0	2.2

Dorset age at first lambing (ewe lambs)

The distribution of sire breeding values (for 118 sires with over 10 offspring represented in the data) is shown in Figure A9. The minimum breeding value was -0.037, the maximum was 0.025. The overall average breeding value was -0.001. The regression of sire EBV vs daughter residual phenotype is shown in Figure A10 and extreme animals in A14 and A15.
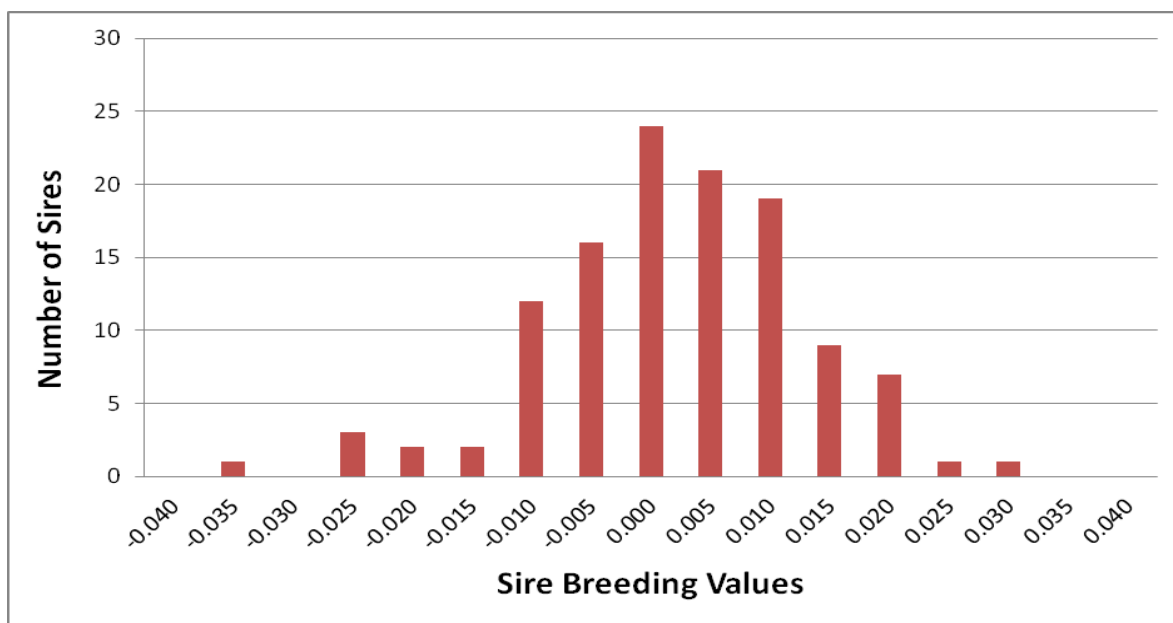
Figure A9: DORSET Distribution of sire EBVs Age at first lambing (Ewe lambs only)
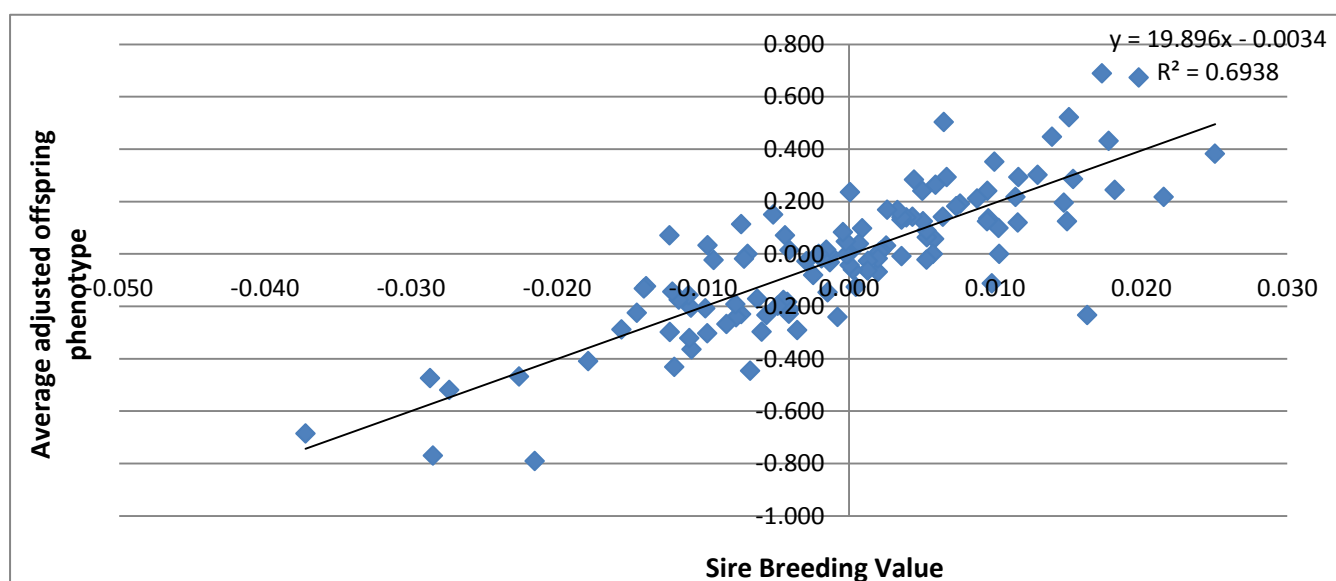

y = 19.896x - 0.0034
R² = 0.6938

Figure A10. DORSET Regression of sire EBV vs daughter phenotype - age at first lambing (ewe lambs only)

Dorset age at first lambing (ewe lambs) – Extreme Animals

In general, the distribution of the sire breeding values followed a normal pattern, with the majority of values falling between -0.030 and 0.030. The only sire to fall below -0.030 was sire 6213538 who had a breeding value of -0.037. Sire 5642867 had the highest breeding value, of 0.025.

Looking at these sires in more detail:

Sire 6213538 (breeding value of- 0.037)

      43 offspring represented in the dataset (has 502 offspring according to Basco webpage)

      Age range for these 43 animals: 1.3 years – 1.7 years, with an overall average of 1.5 years.

      Both parents known (born in 1978)

      By contemporary group (Table A14):

Table A14 Contemporary group information for Sire 6213538 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3207219842	3	1.3	1.3	1.3
32072198212	1	1.7	1.7	1.7
32072198313	3	1.3	1.4	1.3
32072198315	1	1.6	1.6	1.6
32513198212	9	1.6	1.7	1.6
32513198313	4	1.3	1.4	1.3

Sire 5642867 (breeding value of 0.025)

      43 offspring represented in the dataset (has 731 offspring according to Basco webpage)

      Age range for these 43 animals: 1.2 years – 1.7 years, with an overall average of 1.5 years.

      Both parents and grandparents known (born in 1997)

      By contemporary group (Table A15):

Table A15. Contemporary group information for Sire 5642867 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3230820001	1	1.2	1.2	1.2
3230820011	7	1.5	1.6	1.5
3263020001	6	1.2	1.5	1.5
3263020023	5	1.7	1.7	1.7
3263020032	6	1.6	1.7	1.7
3263020041	4	1.2	1.3	1.3
3263020051	8	1.3	1.4	1.4
3263020081	1	1.2	1.2	1.2
3287320001	4	1.3	1.3	1.3

Dorset age at first lambing (gimmers and older)

The distribution of sire breeding values (for 499 sires with over 10 offspring represented in the data) is shown in Figure A11. The minimum breeding value was -0.074, the maximum was 0.061. The overall average breeding value was -0.002. The regression of sire EBV vs daughter phenotype is shown in Figure A12 and extreme animals in Tables A16-A19.
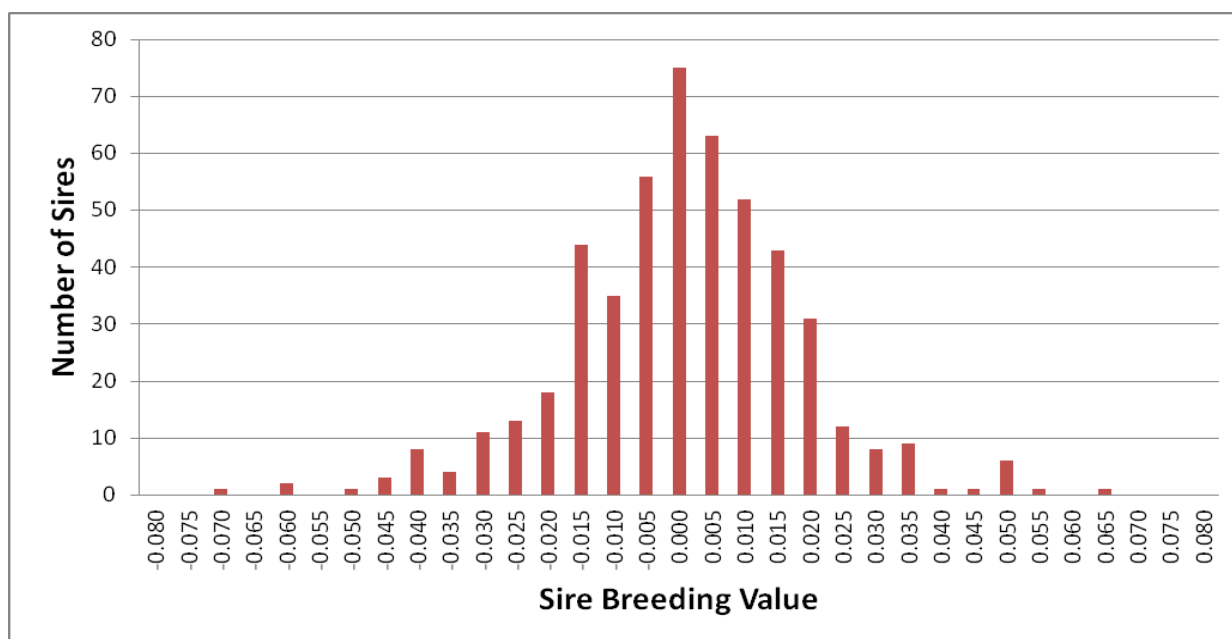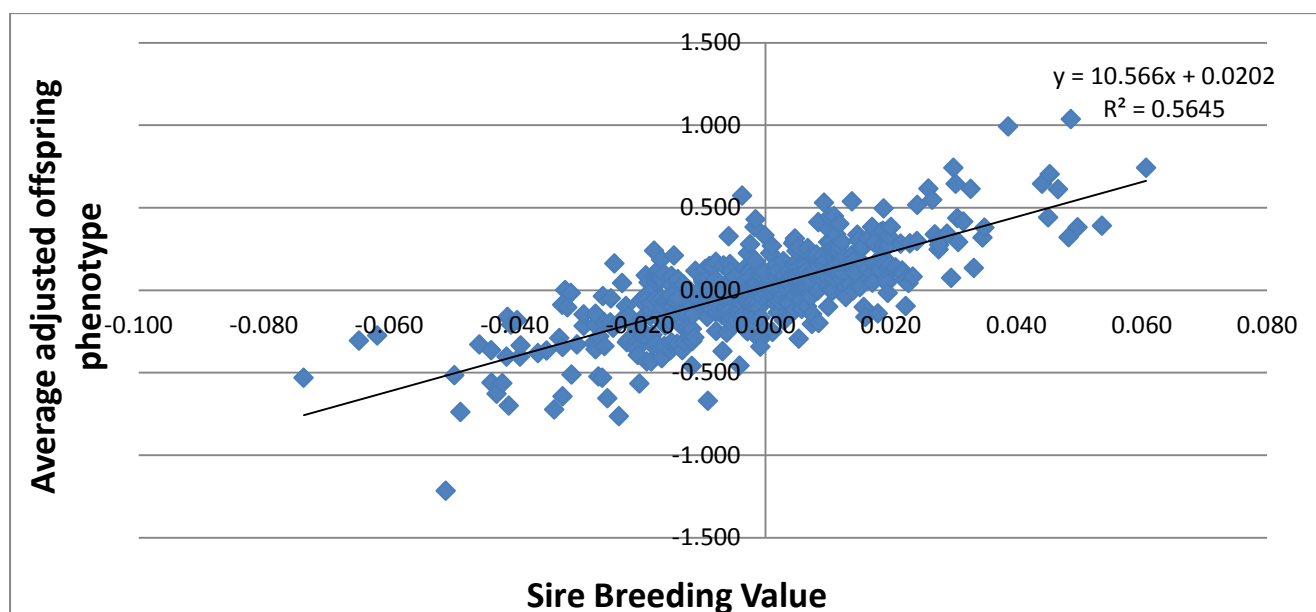

Figure A11: DORSET Distribution of sire EBVs for Age at first lambing (gimmers and older only)

Figure showing scatter plot with trendline: $y = 10.566x + 0.0202$, $R^2 = 0.5645$. X-axis: Sire Breeding Value; Y-axis: Average adjusted offspring phenotype.

Figure A12: DORSET Regression of sire EBV for Age at first lambing vs daughter phenotype (gimmers and older only)

Dorset Age at first lambing (gimmers and older) – Extreme Animals

In general, the distribution of the sire breeding values followed a normal pattern, with the majority of values falling between -0.060 and 0.060. Three sires fell below -0.060, sire 5601240, 7245197 and 5877190 who had a breeding value of -0.074, -0.065 and -0.062 respectively. Sire 7028291 had the highest breeding value, of 0.061.

Looking at these sires in more detail:

Sire 5601240 (breeding value of -0.074)

> 30 offspring represented in the dataset (has 143 offspring according to Basco webpage)
> Age range for these 30 animals: 1.8 years – 3.0 years, with an overall average of 2.1 years.
> Both parents known (born in 1994)
> By contemporary group (Table A16)

Table A16. Contemporary group information for Sire 5601240 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3211019981	9	2.0	2.1	2.0
3211019991	5	2.0	2.4	2.1
3211019992	1	1.9	1.9	1.9
3263019971	13	1.8	2.7	2.1

Sire 7245197 (breeding value of -0.065)

> 46 offspring represented in the dataset (has 550 offspring according to Basco webpage)
> Age range for these 46 animals: 1.9 years – 3.2 years, with an overall average of 2.1 years.

Parents unknown (born in 1986)

By contemporary group (Table A17):

Table A17. Contemporary group information for Sire 7245197 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3239319891	8	2.3	2.3	2.3
3239319901	21	1.9	3.2	2.2
3239319911	17	2.0	2.2	2.1
3239319931	6	1.9	2.0	2.0
3239319942	11	1.9	2.3	2.1
3239319971	2	2.1	2.1	2.1
3239320001	1	2.3	2.3	2.3
3263019981	1	2.2	2.2	2.2

Sire 5877190 (breeding value of -0.062)

31 offspring represented in the dataset (has 102 offspring according to Basco webpage)

Age range for these 31 animals: 1.9 years – 2.9 years, with an overall average of 2.1 years.

Both parents known (born in 1991)

By contemporary group (Table A18):

Table A18. Contemporary group information for Sire 5877190 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3211019941	13	2.0	2.3	2.0
3211019951	12	1.9	2.9	2.1
3211019951	12	1.9	2.9	2.1
3211019961	6	2.0	2.3	2.1

Sire 7028291 (breeding value of 0.061)

27 offspring represented in the dataset (has 176 offspring according to Basco webpage)

Age range for these 27 animals: 2.0 years – 3.3 years, with an overall average of 2.2 years.

Both parents known (born in 2004)

By contemporary group (Table A19):

Table A19. Contemporary group information for Sire 7028291 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3211020071	7	2.0	3.2	2.3
3211020081	14	2.0	2.3	2.1
3211020091	6	2.0	3.3	2.3

Lleyn Age at first lambing

The distribution of sire breeding values (for 906 sires with over 10 offspring represented in the data) is shown in Figure A13. The minimum breeding value was -0.059, the maximum was 0.067. The overall average breeding value was -0.001. Figure A14 shows the regression of sire EBVs vs daughter phenotype for this trait and extreme animals are listed in Tables 20-24.
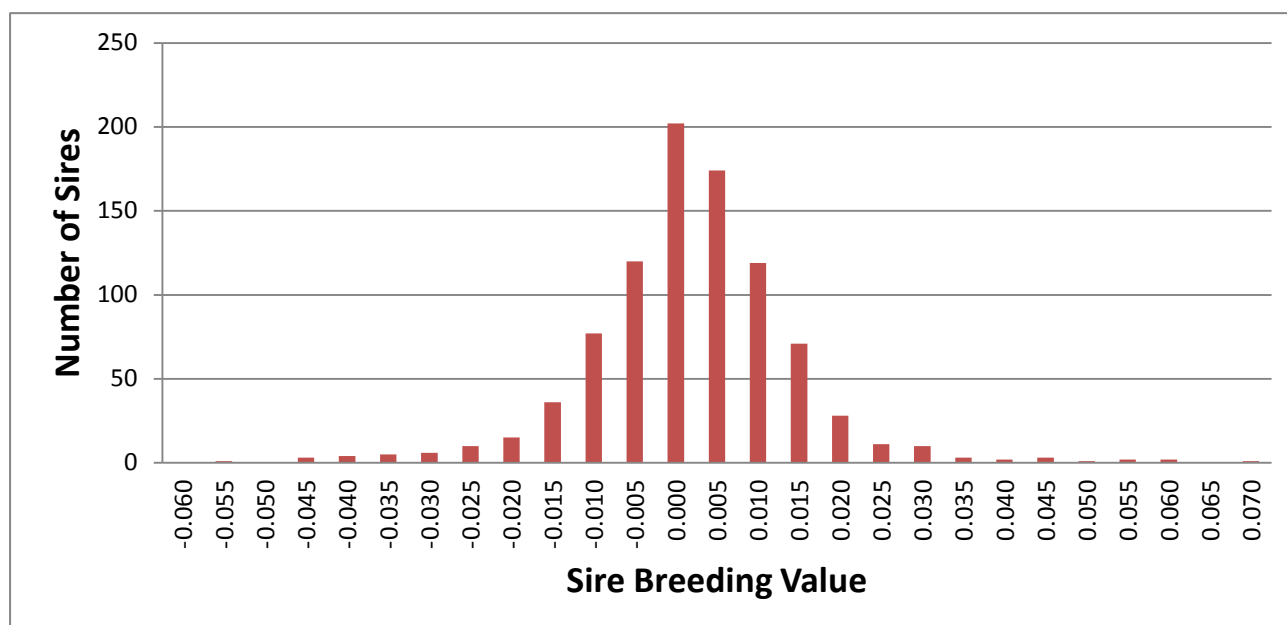

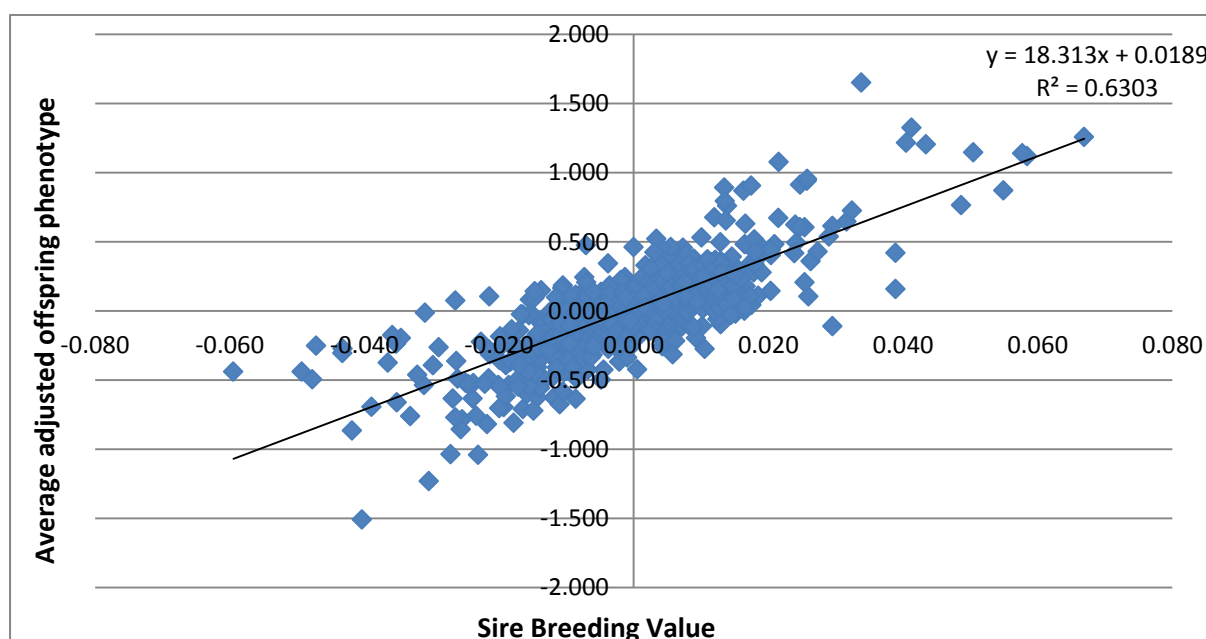**Figure A13. LLEYN – Distribution of sire EBVs for age at first lambing**

$y = 18.313x + 0.0189$
$R^2 = 0.6303$

Figure A14. LLEYN Regression of sire EBV vs daughter phenotype for age at first lambing

Lleyn Age at first lambing – Extreme Animals

In general, the distribution of the sire breeding values followed a normal pattern, with the majority of values falling between -0.050 and 0.050. However, sires number 6822751, 6042023, 7245352 and 6037971 did have breeding values above 0.050.

Looking at these sires in more detail:

Sire 6822751 (breeding value of 0.055)
 41 offspring represented in the dataset (has 257 offspring according to Basco webpage)
 AFL range for these 41 animals: 1.9 years – 2.1 years, with an overall average of 2.0 years.
 Both parents known (born in 2004)
 By contemporary group (Table A20):

Table A20 ontemporary group information for Sire 6822751 for age at first lambing

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3235720061	12	1.9	2.1	2.0
3339820061	6	1.9	2.1	2.0
3339920061	15	2.0	2.1	2.1
3361820061	2	2.1	2.1	2.1
3370320061	6	2.0	2.1	2.1

Sire 6042023 (breeding value of 0.058)
 49 offspring represented in the dataset (has 349 offspring according to Basco webpage)
 AFL range for these 49 animals: 1.9 years – 3.1 years, with an overall average of 2.1 years.
 No parent information (born in 2000)
 By contemporary group (Table A21):

Table A21. Contemporary group information for Sire 6042023 for age at first lambing

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3235720061	10	1.9	2.1	2.0
3332020051	6	2.1	3.1	2.2
3339820061	13	1.9	2.1	2.0
3339920041	4	1.9	2.0	2.0
3353020071	13	2.0	3.1	2.3
3365120081	3	2.1	2.1	2.1

Sire 7245352 (breeding value of 0.058)
 26 offspring represented in the dataset (has 308 offspring according to Basco webpage)
 AFL range for these 26 animals: 2.0 years – 2.2 years, with an overall average of 2.1 years.
 Both parents known (born in 1999)

By contemporary group (Table A22):

Table A22. Contemporary group information for Sire 7245352 for age at first lambing

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3232419941	1	2.1	2.1	2.1
3232419951	4	2.0	2.0	2.0
3232419961	8	2.0	2.2	2.1
3232419962	3	2.0	2.1	2.0
3232419981	10	2.0	2.2	2.1

Sire 6037971 (breeding value of 0.067)

42 offspring represented in the dataset (has 258 offspring according to Basco webpage)

AFL range for these 42animals: 2.0 years – 3.1 years, with an overall average of 2.2 years.

Both parents known (born in 2002)

By contemporary group (Table A23):

Table A23. Contemporary group information for Sire 6037971 for age at first lambing

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3235720041	11	2.1	2.2	2.1
3339820041	7	2.1	2.2	2.1
3339920041	9	2.0	2.1	2.0
3358320041	13	2.0	3.1	2.5
3358320061	2	2.0	2.0	2.0

The sire with the lowest breeding value (below -0.050) was 6535420.

Sire 6535420

102 animals represented in the dataset (has 416 progeny according to Basco webpage)

Interval range for these 102 animals: 1.8 years – 3.0 years, with an overall average of 2.1 years.

Both parents known (born in 2005)

By contemporary group (Table A24):

Table A24. Contemporary group information for Sire 6535420 for longevity

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3229720061	55	1.8	3	2.0
3229720071	47	1.8	3	2.2

Lambing interval

Dorset Lambing Interval

The distribution of sire breeding values (for 436 sires with over 10 offspring represented in the data) is shown in Figure A15. The minimum breeding value was -8.18, the maximum was 8.57. The overall average breeding value was -0.45. The regression of sire EBV vs daughter residual phenotype is shown in Figure A16 and extreme animals are in Tables A26-A29.
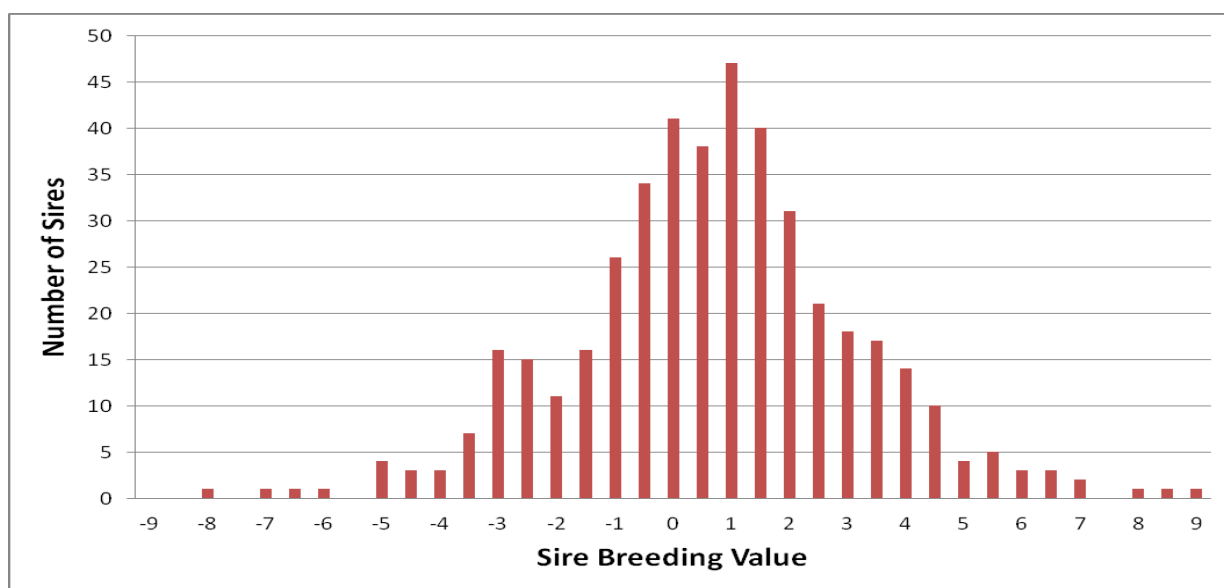

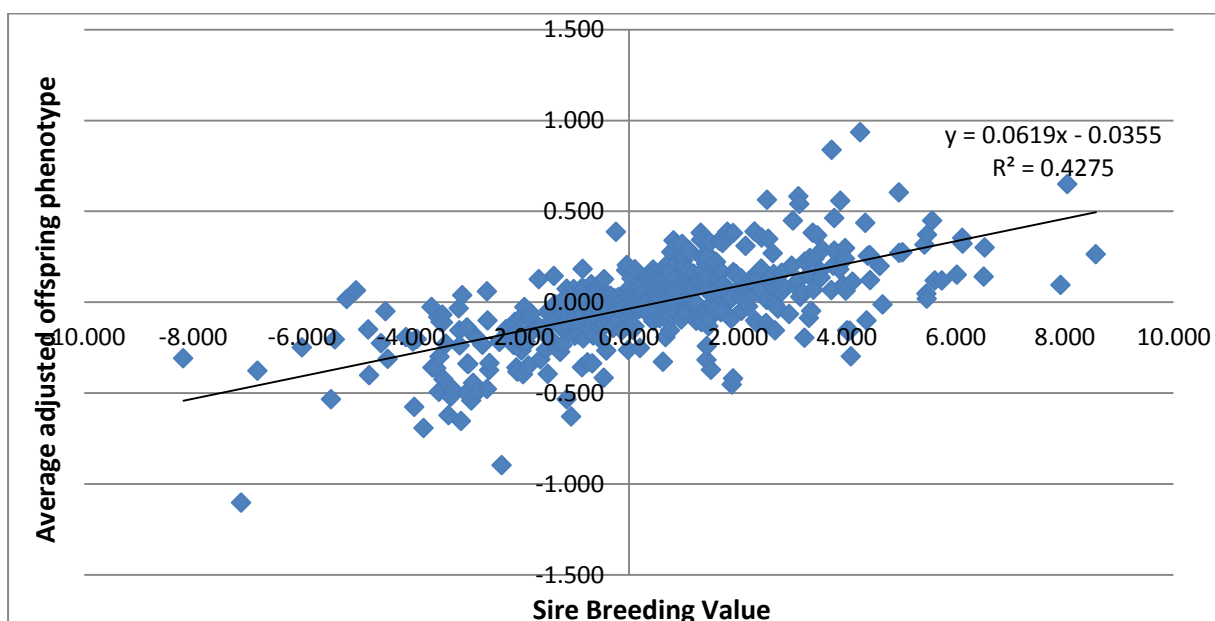**Figure A15: DORSET Regression of sire EBVs for Lambing interval**

$y = 0.0619x - 0.0355$
$R^2 = 0.4275$

Figure A16: DORSET regression of sire breeding values for Lambing interval

Dorset Lambing Interval – Extreme Animals

In general, the distribution of the sire breeding values followed a normal pattern. The three sires with the highest breeding values were 6792395, 5726300 and 5672530, whereas sires 6852421 and 5268104 had the two lowest breeding values.

Looking at these sires in more detail:

Sire 6792395 (breeding value of 7.93)

      102 offspring represented in the dataset (has 517 offspring according to Basco webpage)

      Interval range for these 102 animals: 245 days – 764 days, with an overall average of 404

days.

      Both parents known (born in 2001)

      By contemporary group (Table A25):

Table A25. Contemporary group information for Sire 6792395 for lambing interval

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3211020041	3	297	359	335
3211020051	11	284	387	336
3225520041	4	245	720	400
3230820051	2	301	415	358
3239320031	4	282	363	322
3239320041	16	286	678	352
3239320051	11	337	697	396
3239320061	6	355	711	477
3239320071	7	351	764	428
3239320081	7	361	751	536
3239320091	1	347	347	347
3239320101	6	332	505	408
3263020041	6	342	537	420
3287320041	2	317	338	328
3350120041	7	369	742	549
3350120051	7	293	722	403
3363120051	2	346	364	355

Sire 5726300 (breeding value of 8.05)

      30 offspring represented in the dataset (has 462 offspring according to Basco webpage)

      Interval range for these 30 animals: 241 days – 729 days, with an overall average of 387

days.

      Both parents known (born in 2004)

      By contemporary group (Table A26):

Table A26. Contemporary group information for Sire 5726300 for lambing interval

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3230820011	10	287	729	466
3230820021	2	262	301	282
3230820022	9	241	417	323
3230820031	9	302	463	386

Sire 5672530 (breeding value of 8.57)

   81 offspring represented in the dataset (has *** offspring according to Basco webpage)

   Interval range for these 81 animals: 241 days – 729 days, with an overall average of 387 days.

   Both parents known (born in ***)

   By contemporary group (Table A27):

Table A27. Contemporary group information for Sire 5672530 for lambing interval

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3211020061	6	274	448	341
3211020071	10	270	738	406
3211020081	11	344	450	399
3211020091	8	281	385	360
3211020101	2	301	373	337
3225520071	4	277	457	348
3225520081	4	278	454	347
3239320071	11	358	739	402
3263020076	2	275	327	301
3287320071	3	335	588	429
3292420071	3	246	320	294
3350120071	5	342	441	394
3350120081	10	277	455	393
4020420092	2	309	387	348

Sire 6852421 (breeding value of -8.18)

   53 offspring represented in the dataset (has 257 offspring according to Basco webpage)

   Interval range for these 53 animals: 277 days – 654 days, with an overall average of 375 days.

   Both parents known (born in 1995)

   By contemporary group (Table A28):

Table A28. Contemporary group information for Sire 6852421 for lambing interval

Contemporary Group	Count of offspring	Minimum	Maximum	Average

3211019971	4	277	654	420
3211019972	2	308	337	323
3263019971	21	282	572	395
3263019972	14	278	443	359
3263019981	5	311	442	369
3263019982	4	282	428	336
3263019983	2	323	348	336
3263019991	1	354	354	354

Sire 5268104 (breeding value of -7.12)

    11 offspring represented in the dataset (has 108 offspring according to Basco webpage)

    Interval range for these 11 animals: 275 days – 377 days, with an overall average of 334

days.

    Both parents known (born in 1996)

    By contemporary group (Table A29):

Table A29. Contemporary group information for Sire 5268104 for lambing interval

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3211019991	9	287	377	339
3211020001	2	275	355	315

Lleyn Lambing Interval

The distribution of sire breeding values (for 906 sires with over 10 offspring represented in the data) is shown in Figure A17. The minimum breeding value was -8.23, the maximum was 7.51. The overall average breeding value was -0.04. The regression of sire EBV vs daughter residual phenotype is in Figure A18 and extreme animals are in Tables A30-A33.
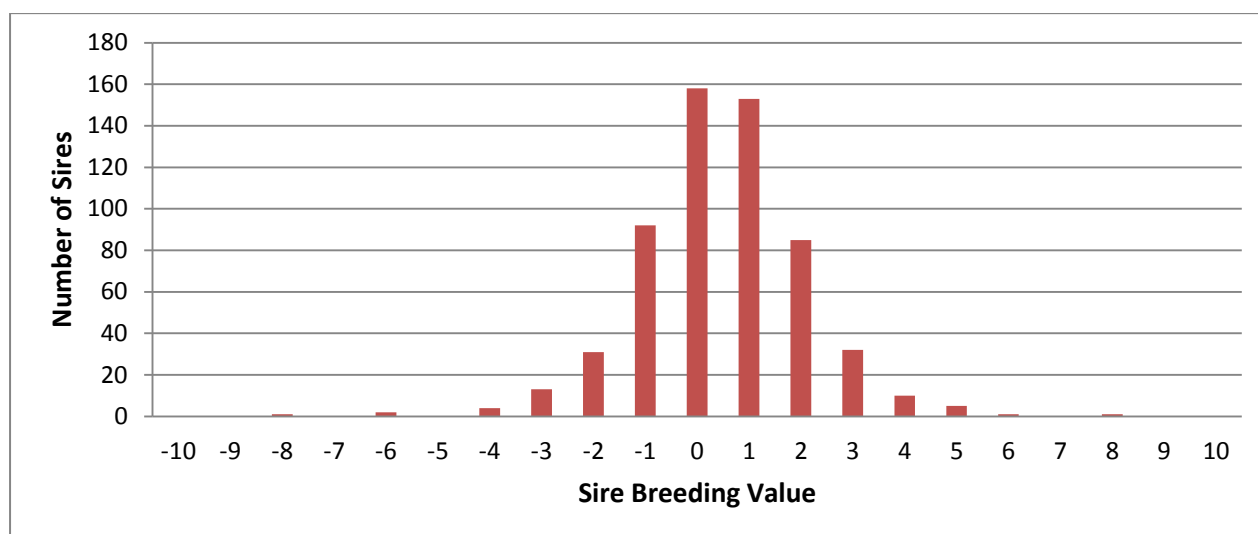
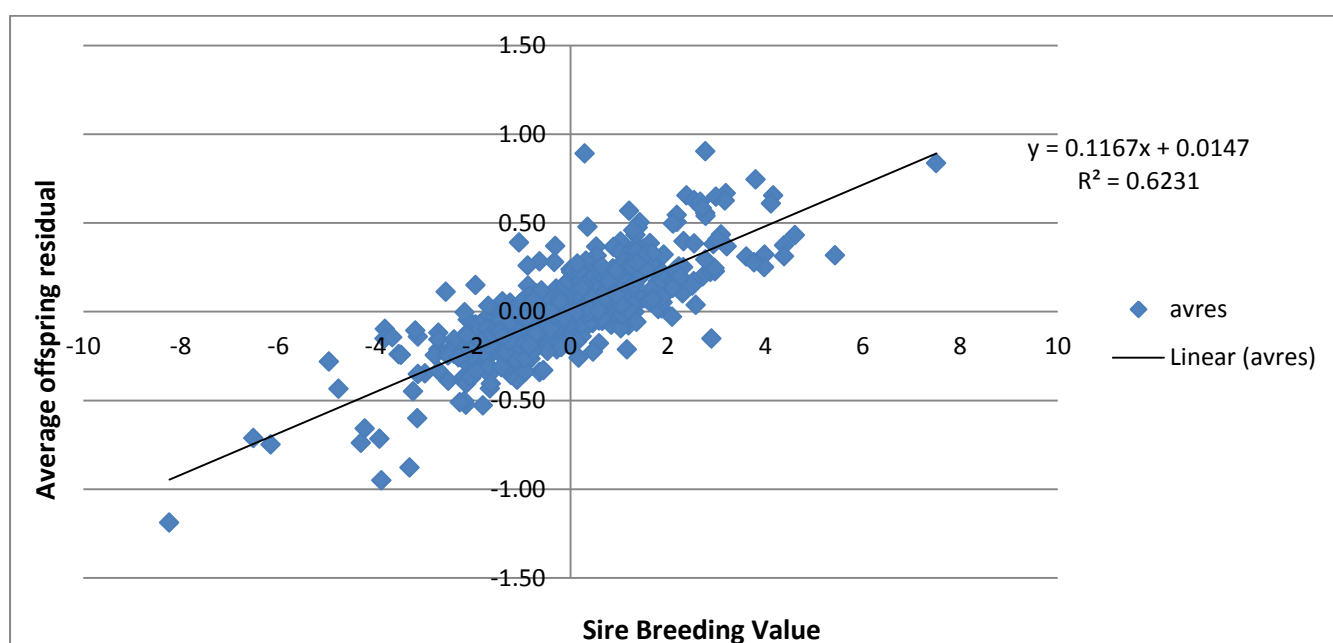**Figure A17. LLEYN Distribution of sire EBVs for Lambing interval**

$y = 0.1167x + 0.0147$
$R^2 = 0.6231$

Figure A18: LLEYN Regression of sire EBV vs daughter phenotype for Lambing interval

Lleyn Lambing Interval – Extreme Animals

In general, the distribution of the sire breeding values followed a normal pattern, with the majority of values falling between -6.00 and 6.00. However, sire numbers 6852536, 7021544 and 6826431 did have breeding values below -6.00 and sire 6037971 above 6.00.

Looking at these sires in more detail:

Sire 6852536 (breeding value of -8.23, average residual of -1.19)

    22 offspring represented in the dataset (has 219 offspring according to Basco webpage)

    LI range for these 22 animals: 293 days – 444 days, with an overall average of 358 days.

    Both parents unknown (born in 1996)

    By contemporary group (Table A30):

Table A30. Contemporary group information for Sire 6852536 for lambing interval

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3297619981	9	293	374	354
3297619991	7	357	444	379
3297620001	9	298	357	338

Sire 7021544 (breeding value of -6.51, average residual of -0.71)

    32 offspring represented in the dataset (has 421 offspring according to Basco webpage)

    LI range for these 32 animals: 312 days – 726 days, with an overall average of 550 days.

    Both parents unknown (born in 2002)

    By contemporary group (Table A31):

Table A31. Contemporary group information for Sire 7021544 for lambing interval

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3235720041	15	670	707	688
3235720061	5	341	726	571
3339820041	6	370	416	384
3339820051	6	312	379	355

Sire 6826431 (breeding value of -6.15, average residual of -0.75)

    24 offspring represented in the dataset (has 261 offspring according to Basco webpage)

    LI range for these 24 animals: 369 days – 732 days, with an overall average of 644 days.

    Both parents and grandparents known (born in 2001)

    By contemporary group (Table A32):

Table A32. Contemporary group information for Sire 6826431 for lambing interval

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3235720041	20	678	732	697
3370320051	4	369	387	378

Sire 6037971 (breeding value of 7.51, average residual of 0.84)

    28 offspring represented in the dataset (has 258 offspring according to Basco webpage)

    LI range for these 28 animals: 333 days – 781 days, with an overall average of 438 days.

    Both parents known (born in 2002)

    By contemporary group (Table A33):

Table A33. Contemporary group information for Sire 6037971 for lambing interval

Contemporary Group	Count of offspring	Minimum	Maximum	Average
3235720041	5	718	781	752
3339820041	7	366	416	388
3339920041	9	356	393	370
3358320041	7	333	379	354

Note - Three of these extreme sires have offspring in contemporary group 325720041, which are all associated with high LI values.