



# Performance Recorded Lleyn Breeders

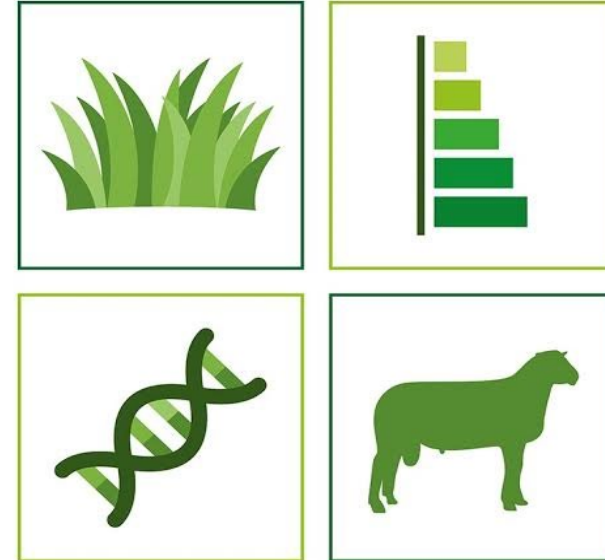
## Five years of breeding for worm resistance



Kate Phillips and George Cullimore

# Who are the PRLB?

- A group of 25 like minded Lleyn breeders recording with Signet
- Mainly large flocks with a total of around 10,000 recorded ewes
- Fully committed to performance recording in commercial conditions
- Breeding for worm resistance a priority



**PERFORMANCE  
RECORDED  
LLEYN BREEDERS**

# Why worm resistance?

- Wormer resistance cost the UK sheep industry £84m in 2005
- 94% of farms thought to have resistance to white wormers (1BZ) 68% to yellow wormers (2 LV) and 51% to clear wormers (3 ML) (HCC, 2014)
- Resistance already found to newer monepantel drench (Zolvix)
- Important to follow SCOPS principles but this will probably only slow down resistance
- Breeders could have a key role to play by producing sheep that are genetically more resistant to worms

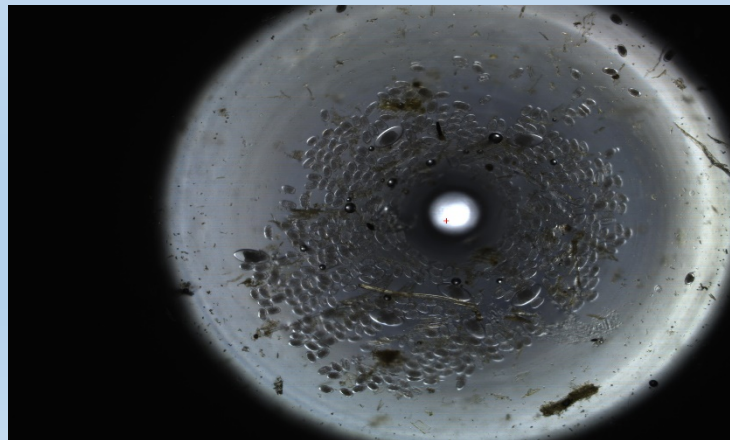
# Why is it a difficult trait for breeders?

- We know that some sheep are genetically more resistant to worms – the difficult bit is identifying them
- It is a hard to measure trait, no direct measurement
- The traditional ‘Gold Standard’ method is by the collection of individual Faecal Egg Counts
- We have also been looking at using Immunoglobulin A (IgA) as an alternative phenotype
- Both methods are expensive and require a big commitment from breeders



# Faecal Egg Counts

- Collection of individual Faecal Egg Counts give us EBVs for Strongyles (FEC S) and Nematodirus (FEC N)
- To get meaningful FEC results lambs have to be under a significant worm challenge – may have to accept a check in production
- Can sometimes be difficult to achieve high enough mob counts to sample

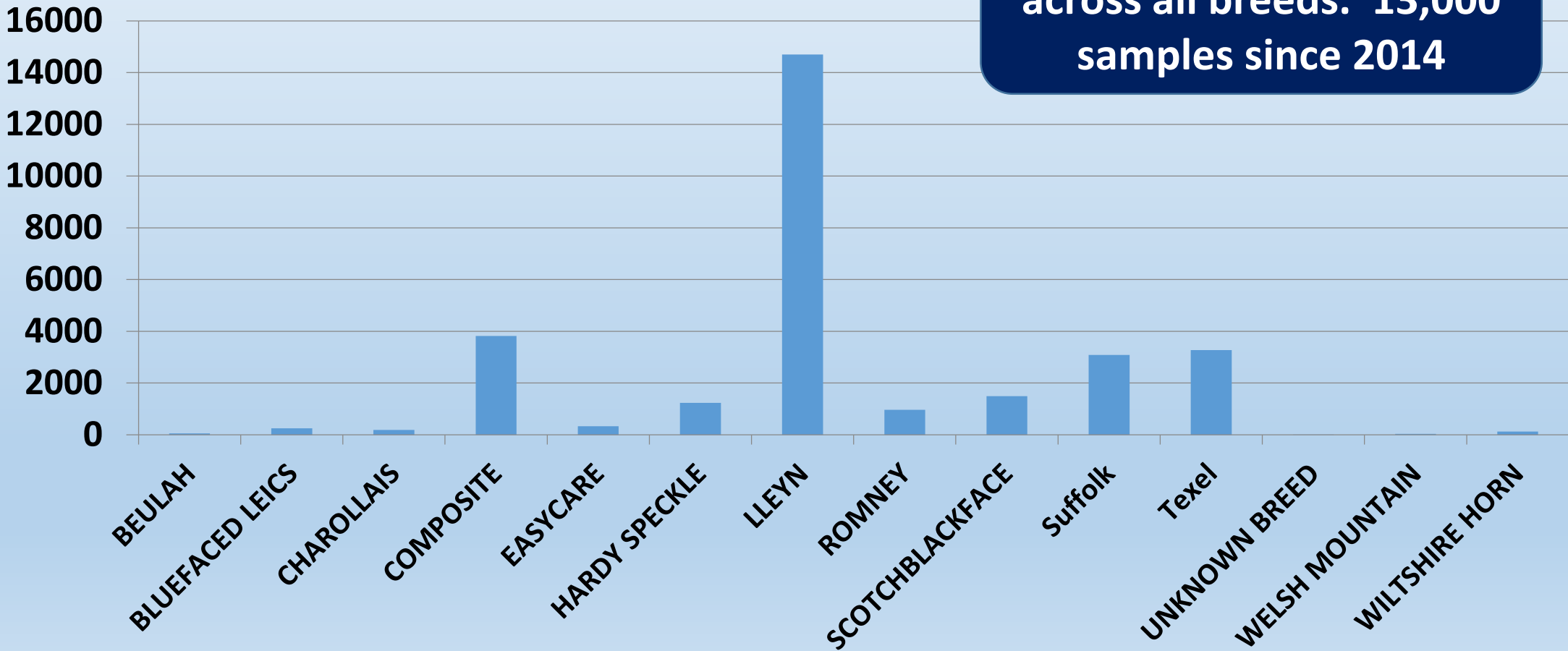


# Immunoglobulin A

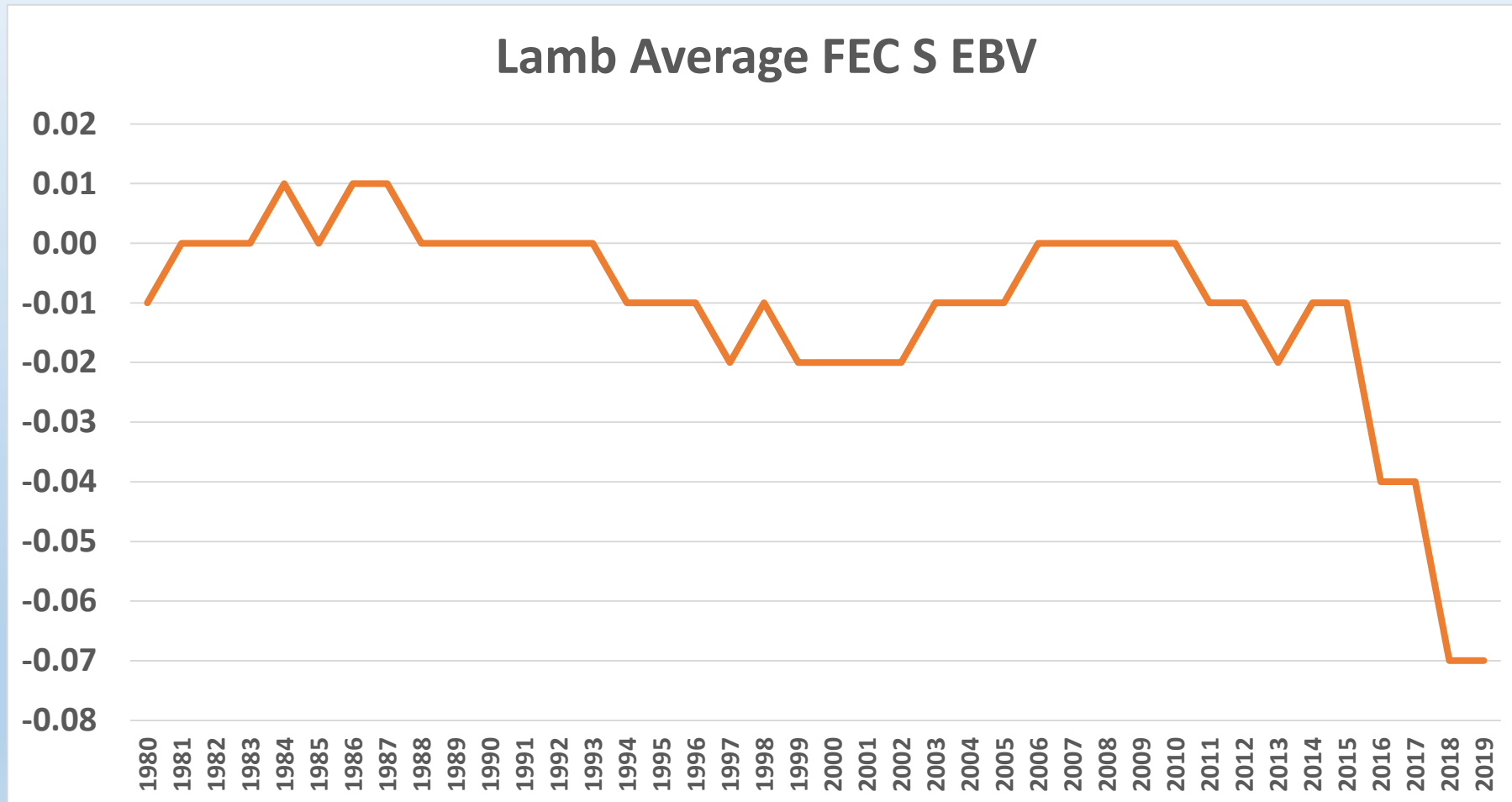
## Resistance to nematode infection – two major mechanisms

- IgE decreased worm **number**, decreased lamb growth, black scour
- IgA decreased worm **size**
  - Target immune cells to worm
  - Prevent worm feeding
  - Shorter worms produce fewer eggs
  - Eggs from immune sheep less fertile
  - The test looks for the IgA specific to the worm species *Teladorsagia circumcincta* – the most important of the trichostrongyles
  - Research suggests higher heritability than FEC and faster reduction in worm counts
  - We can't directly measure the amount of IgA in the intestine mucosa but it can be detected in saliva and serum

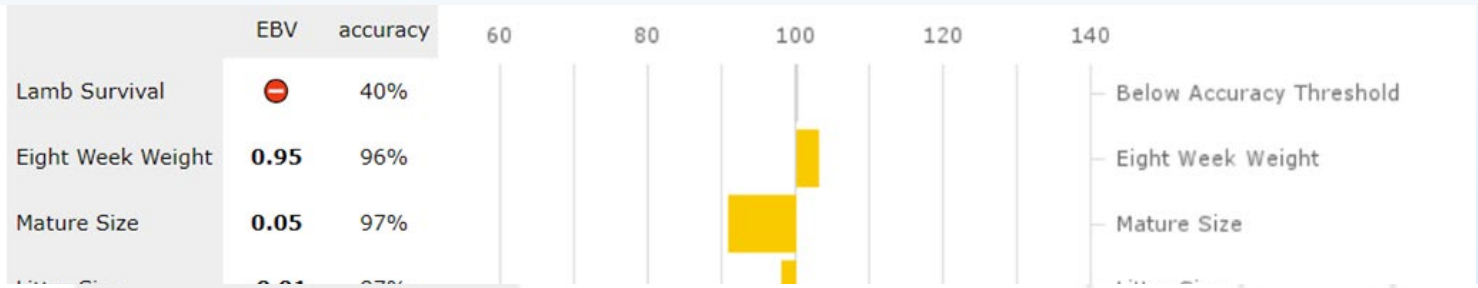
# FEC samples 2000 to 2018 by breed



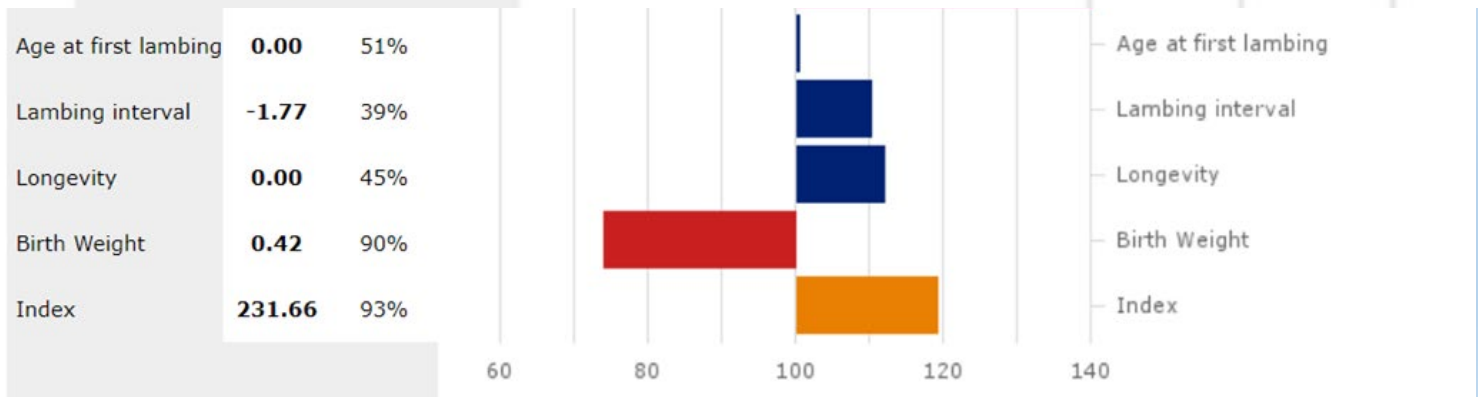
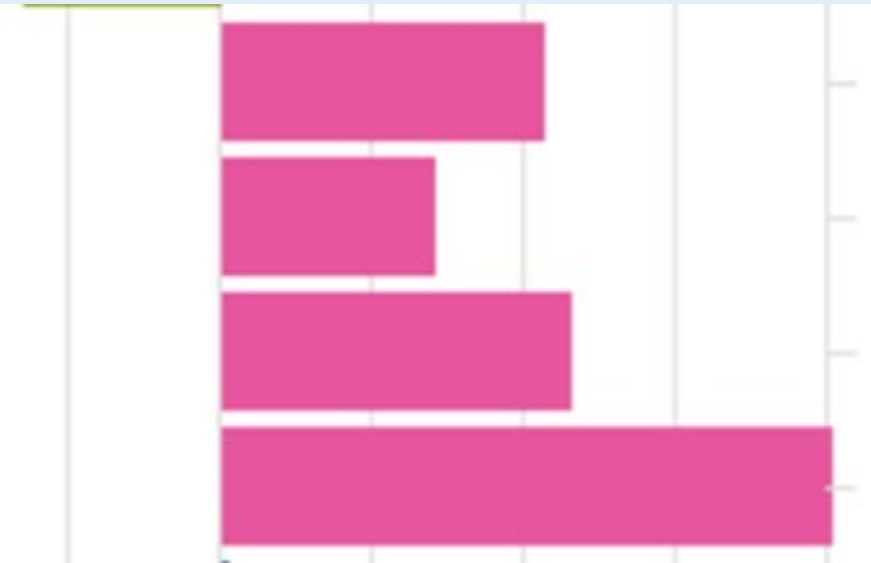
# Genetic progress in FEC S EBV







<b>FEC (Combined)</b>	<b>-0.72</b>	<b>87%</b>
<b>FEC (Strongyles)</b>	<b>-0.29</b>	<b>88%</b>
<b>FEC (Nematodirus)</b>	<b>-0.43</b>	<b>87%</b>
<b>Saliva IgA</b>	<b>0.12</b>	<b>75%</b>



# Updated genetic correlations

- Positive correlation between FEC S and FEC N (0.49)
- Negative correlation between IgA and FEC S (-0.34)
- No significant correlation between IgA and FEC N
- Very low correlations to performance traits



# New heritability estimates

	FEC S	FEC N	Saliva IgA
	0.19	0.13	
2016 Update	0.08	0.14	0.16
2018 Update	0.07	0.21	0.11



The updated heritabilities are lower than previous estimates for IgA and FEC S. The FEC N heritability has increased.

# The Harper Adams project

We have learnt a lot from the work so far but it has also thrown up a lot of questions.

Three year project partly funded by European Innovation Partnership

- Repeatability
- 'Robustness' of EBVs
- What is the most effective testing programme?
- What protocols should we be using?
- Can we switch to just using one of the tests?



# Saliva IgA as an indicator of worm resistance in sheep – HAU project

- 4 years of sampling by PRLB - - about 3000 samples per year
- First year work at HAU testing 200 ewe lambs on two consecutive days showed relatively poor agreement between days for FEC and saliva IgA.

# Saliva IgA

- Supplementary trial at Harper Adams to compare reliability of the methods and to test lambs from planned matings in 2018 – high and low FEC and saliva IgA EBV rams
- 10 ewe lambs and 4 wether lambs selected from each of 6 sires (84 lambs in total at an average of 7 months of age)
- Lambs sampled over 38 days for FEC, saliva IgA and serum IgA
- Aiming to see how IgA changed over time and consider which method might be the most robust for genetic evaluations.

# Spearman's Rank Correlation (year 1)

	Spearman's rank correlation	P
FEC day 1 to day 2	0.625	<0.001
Saliva IgA day 1 to day 2	0.482	<0.001

In terms of ranking, the FEC S data showed that the majority of the animals stayed in the same rank order but the relationship was not as strong for saliva IgA.

# Progeny test

- 3 rams with high FEC and high saliva EBVs
- 3 rams with low FEC and saliva IgA EBVs
- Single sire mated to 50 ewes – pre-selected by Signet (SB)
- In October 2018, duplicate FEC and saliva taken on day 1, single serum sample
- 12 wether lambs slaughtered on day 2 for worm count and speciation
- Sampling repeated over next 36 days – 3 FEC, 5 saliva and 3 serum



# Results

Paired t-test analysis of duplicate FEC and saliva IgA samples taken on day 1

Treatment	FEC (EPG)(log10)	Saliva IgA (OD)
Day 1 sample 1 (A)	187 (2.065)	0.50
Day 1 sample 2 (B)	160 (1.959)	0.45
S.E.D.	0.0734	0.049
P value	0.150	0.265

No significant difference between means of duplicate samples

# FEC, saliva IgA and serum IgA samples taken on day one and day three

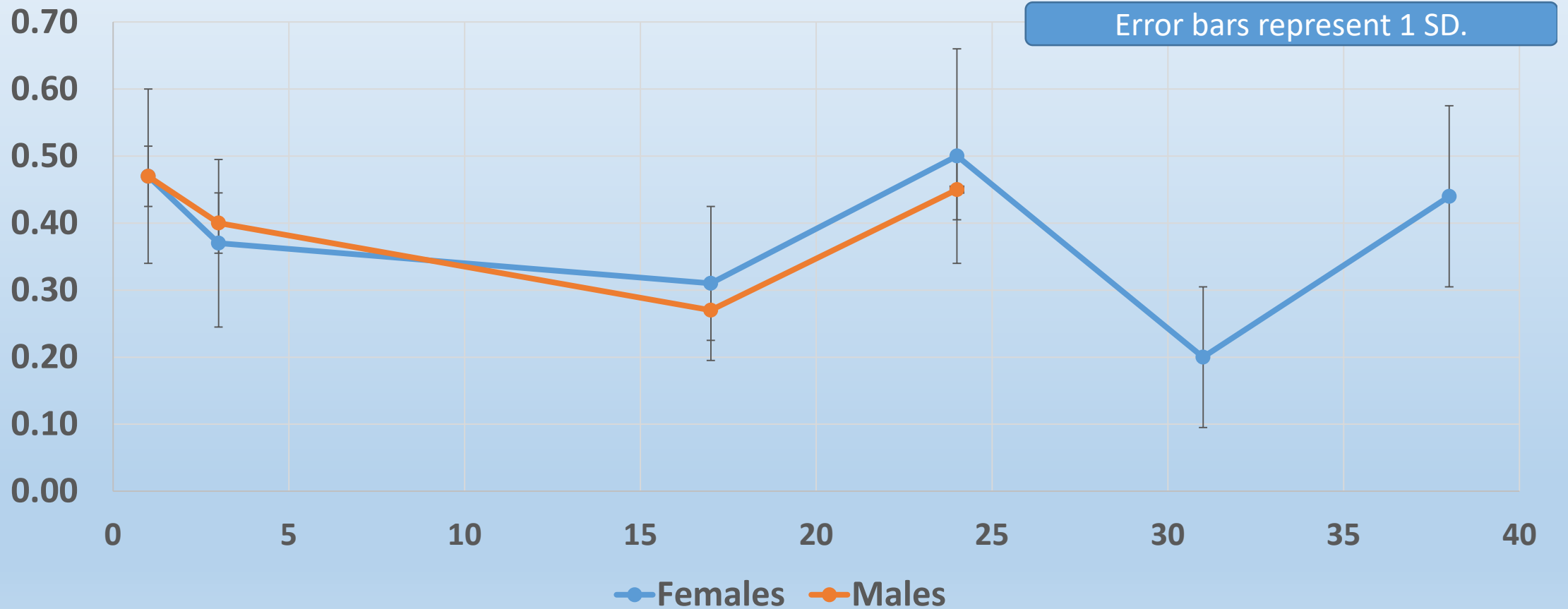
	FEC (EPG)(log10)	Saliva IgA (OD)	Serum IgA (OD)
Mean day one	173 (2.012)	0.47	0.61
Day three	167 (2.009)	0.37	0.62
S.E.M.	17.56	0.032	0.020
P value	0.446	<0.001	0.294

No significant difference between mean of duplicate FEC and serum IgA samples on day 1 and day 3, but significant difference between saliva results

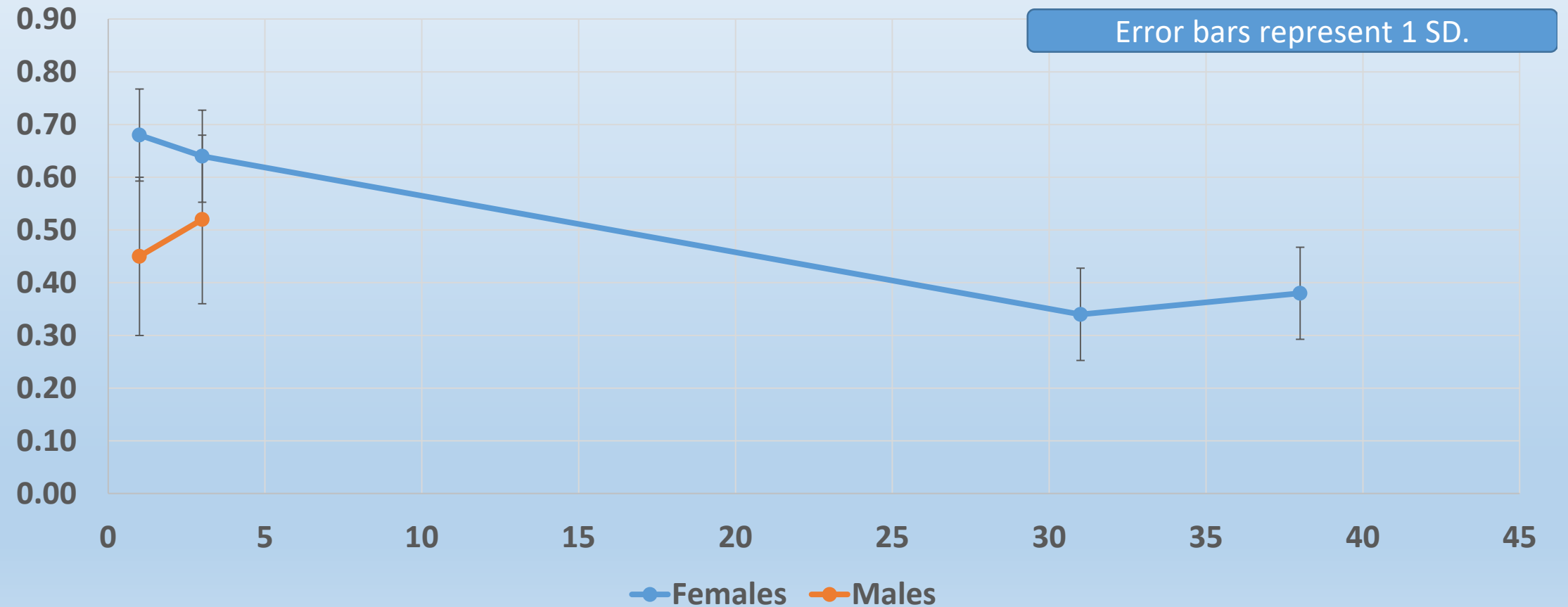
# FEC results

- Variation in FEC results – very wide compared to initial mob count (as expected)
- A possible reason for some very low counts - some of the faeces samples were liquid (15% estimate). Worm eggs are diluted in liquid samples, resulting in lower counts if no allowance is made for sample consistency.
- The lab used considered a difference of 180 epg between duplicate samples as acceptable given that worm eggs are not uniformly distributed in faeces. Greater variation may result from inconsistencies in sampling technique, counting or recording.
- The results found here showed 75% of results from duplicate samples to be within the accepted limit of 180 epg

# Mean saliva IgA over time



# Mean serum IgA



# Ranking correlation coefficients for FEC S, saliva IgA and serum IgA

	Spearman's Rank Correlation Coefficient	P value
FEC - day 1 duplicates (all)	0.415	<0.001
Saliva IgA - day 1 duplicates (all)	0.530	<0.001
<b>Females only</b>		
FEC (EPG) - day 1 vs day 3	0.415	<0.001
Saliva IgA (OD) - day 1 vs day 3	0.481	<0.001
Serum IgA (OD) - day 1 vs day 3	0.878	<0.001
Serum IgA (OD) – day 1 vs day 31	0.673	<0.001
Serum IgA (OD) day 1 vs day 38	0.642	<0.001
Serum IgA (OD) day 3 vs day 31	0.722	<0.001
Serum IgA day 31 vs day 38	0.793	<0.001

## Worm counts and speciation - lambs slaughtered on day 2

Lamb ID	Abo – <i>Teladorsagia</i>	Abo - Immature/L4	Mean FEC (day 1)
5934	13900	11200	315
6008	700	2600	42.5
6036	100	400	70
6039	2200	600	0
6040	5000	8900	70
6063	2200	2400	33.5
6081	4400	5200	175
6169	1000	400	210
6280	15400	5700	280
6300	1000	700	157.5
6305	1000	1200	60
6320	14400	4000	192.5

# Results

- Clear that there was a heavy infestation with adult and immature/L4 *T. Circumcincta* in some lambs
- Possible reasons for the egg counts being lower than would be expected in these animals are:
  - In some lambs the faeces were liquid, so counts were artificially low
  - The worms were not laying eggs yet



# Overall mean saliva IgA and serum IgA by sire



# Lamb EBVs by sire

Ram	Ram FEC EBV (2017)	Ram FEC EBV (2018)	Ram saliva EBV (2017)	Ram saliva EBV (2018)	High/low	Mean Lamb FEC EBV	Mean Lamb Saliva EBV
1	-0.39	-0.25	0.10	0.07	High	-0.194	0.042
2	0.43	0.26	-0.02	-0.04	Low	-0.038	-0.042
3	0.21	0.04	-0.06	-0.12	Low	-0.221	-0.064
4	0.05	-0.21	-0.13	-0.02	Low	-0.160	-0.016
5	-0.55	0.04	0.10	0.12	High	-0.065	0.043
6	-0.55	-1.06	0.09	0.04	High	-0.640	0.018
SED						0.1058	0.0119
P						<0.001	<0.001

# Conclusions

- Repeatability of duplicate samples on the same day for both FEC and saliva variable in this project
- Ranking of individuals by FEC and saliva showed some consistency but was relatively weak whereas ranking by serum was very consistent and highly significant
- High saliva EBV sires tended to produce offspring with higher saliva and serum IgA
- Should serum IgA be considered a more robust way of assessing genetic merit for worm resistance than either FEC or saliva IgA?

# The future

- Results from Moredun suggest very high heritability of serum IgA in a population of Soay sheep.
- FEC and serum sampling this year on some lambs
- Search for funding for next season

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