Breeding for ewe longevity

WP1 - Sustainable Sheep Production (SusSheP)

SRUC - Nicola Lambe, Ann McLaren
Teagasc – Noirin McHugh ; Sheep Ireland - Thierry Pabiou, Eamon Wall
NSG - Inger-Anne Boman

Sustainable Sheep Production (SusSheP)

SusSheP - 3 year European project (2017-2020) with 4 European partners:

Norway, France, Ireland & UK.

Overall aim: to increase the sustainability and profitability of European Sheep Production by addressing key industry focused problems.

<u>**Key objectives**</u> :

- Provide **new genetic tools** for farmers to increase **longevity** of ewes.
- Quantify **labour input** and **carbon hoofprint** in contrasting sheep systems.
- Develop more socially acceptable **methods of AI,** looking at **ewe breed effects** (for oestrus, cervical mucus, sperm transport).
- Maximise **knowledge transfer** and uptake of methods by farming community.

WP1 – Genetics of ewe longevity

Objectives:

1. Characterise factors affecting longevity
2. Identify early life predictors
3. Calculate heritability
4. Investigate potential to incorporate in national breeding indexes
5. Develop new protocols to record on-farm

Sheep systems



	Norway	Ireland	UK
Data source	The Norwegian Sheep Recording System	Sheep Ireland	SRUC Hill sheep breeding project
Breeds	Norwegian White	Mixed (mainly Texel, Suffolk, Charollais, Belclare, and Vendeen sired animals)	Scottish Blackface
Production system	Summer in woods / mountains; housed in winter	Mainly lowland/ upland	Hill
No. records	113,319	23,880	3,224
Years recorded	2011-2016	2010-2016	2003-2016

Recordable reasons for cull/death

NORWAY	IRELAND	UK
Not shown heat	Abnormal	Age
Barren	Age	Teeth
Abortion	BCS	Body condition / Size
Lambing difficulty	Breeding	Mastitis
Udder conformation	Died	Other known disease
Damage to udder/teats	EBV	Injury / Accident
Mastitis	Feet	Legs / Feet
Abdominal wall hernia	Mastitis	Other physical reason
Vaginal prolapse	Prolapse	Bad lambing
Bowel prolapse	Rupture	Reproductive disorder
Leg problems	Slaughtered	Non-breeder
Other known disease	Teeth	Died – reason unknown
Taken by predator (7 sub-reasons)	Udder	Missing – presumed dead
Taken by dog	Unknown	Other known reason
Accident		
Old age		
Bad mothering ability		
Bad disposition		
Wrong grazing behaviour		
Poor usability		
Due to production management		
Feed shortage		
Other known reason		

SRUC

Cull / death reasons

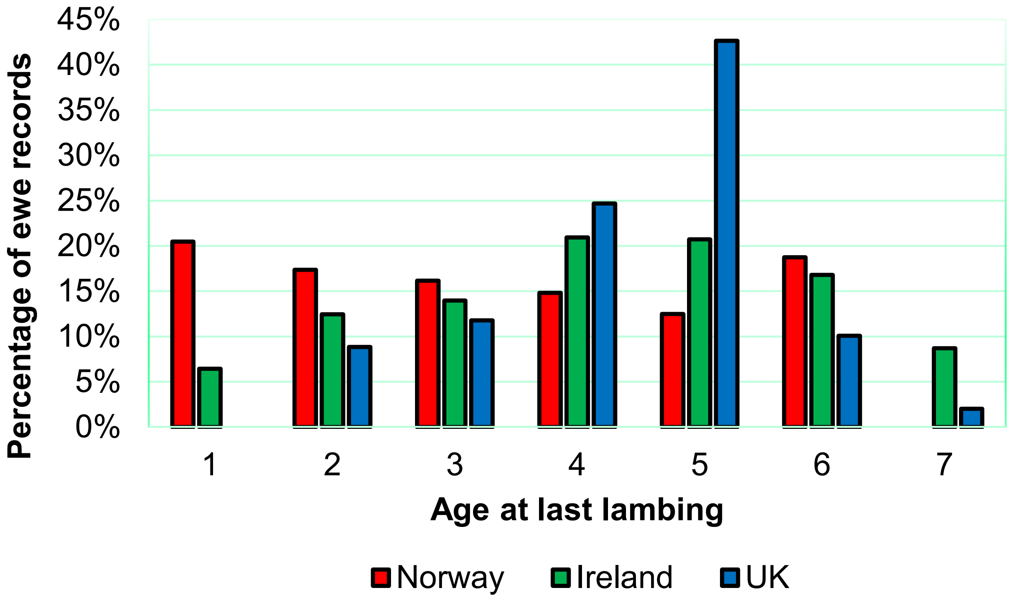
Norway	Ireland	UK
Mastitis **(19.9%)**	Age **(20.9%)**	Teeth **(38.9%)**
Udder problems **(16.9%)**	Died (reason unknown) **(19.9%)**	Age **(23.5%)**
Age **(12.4%)**	Slaughtered **(15.9%)**	Body condition **(6.8%)**
Non-breeder **(6.3%)**	Mastitis **(13.5%)**	Missing – presumed dead **(6.8%)**
	Unknown reason **(6.4%)**	Reproductive disorder **(5.4%)**
	Body condition **(5.7%)**	
	Udder problems **(5.7%)**	
Other reasons n=19 **(44.5%)**	Other reasons n=7 **(12.0%)**	Other reasons n=9 **(18.6%)**

Defining longevity

- Age at last lambing

	Norway				Ireland				UK			
Trait	Av.	S.D.	Min	Max	Av.	S.D.	Min	Max	Av.	S.D.	Min	Max
Age at last recorded lambing event (yrs)	**3.38**	1.79	1	6	**4.22**	1.68	1	7	**4.35**	1.12	2	7

- Distributions differ between countries.
- Possibly influenced by:
  - breed type
  - production environment
  - production aims
  - age at first lambing
  - markets…



Early life predictors?

- No consistent predictors
- Explained low % variation in longevity
- Age at first lambing had strong effect (IRE)
  - 1yo (4.6y) < 2yo (5.3y)
- Breed make-up had strong effect (IRE)

ns = not significant
* = significant
** = moderately significant
*** = highly significant

Effects fitted in the models	Norway	Ireland	UK
Ewe birth year	✓***	✓***	✓***
Flock of birth	✓***	✓***	✓*
Dam age	✓***	✓ns	✓*
Ewe birth weight	✓ns	✓***	✓ns
Birth litter size of ewe	✓**	✓***	✓ns
Ewe weight – 6-8 weeks old	✓ns	✓**	✓ns
Ewe weight – 14-20 weeks old	✓ns	✓ns	✓ns
Ewe weight – 6-8 weeks old (squared)	✓ns		✓ns
Ewe weight – 14-20 weeks old (squared)	✓ns		✓*
Ewe age at first lambing		✓***	
Breed proportion of Texel (%)		✓***	
Breed proportion of Suffolk (%)		✓***	
Breed proportion of Belclare (%)		✓***	
Breed proportion of Charollais (%)		✓ns	
Breed proportion of Vendeen (%)		✓*	
Ewe birth year x Flock of birth	✓***		✓***
Variance accounted for by model (R^2)	10.8%	31.0%	3.5%

Genetic analysis – UK hill sheep

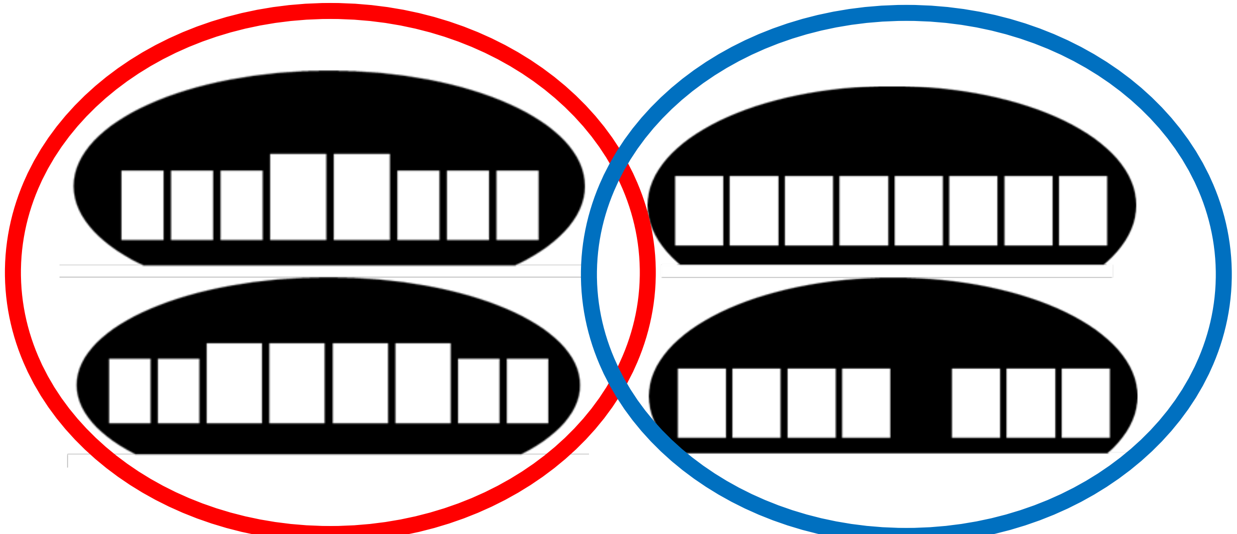
SRUC

- Data
  - 5,198 Scottish Blackface ewes
  - born 1996 – 2011
  - From 2 SRUC research hill flocks

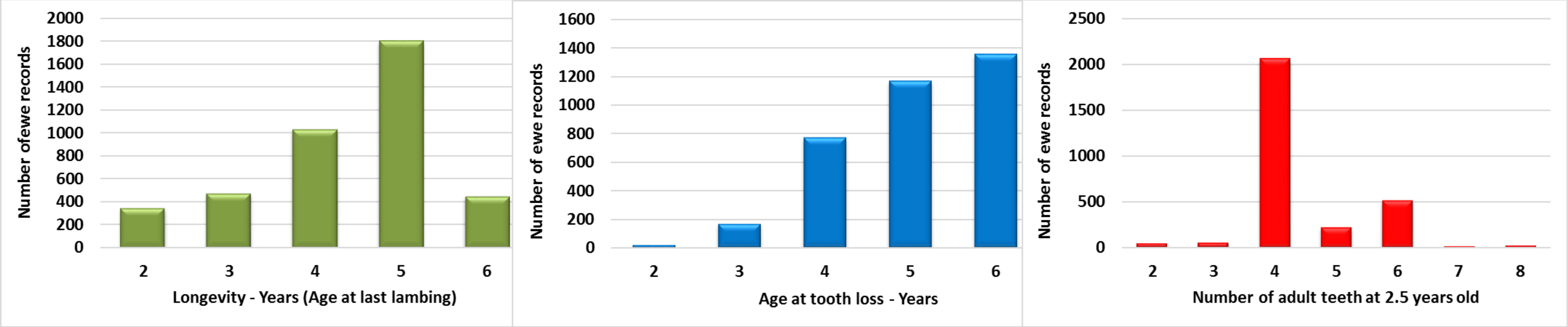
- Traits investigated
  - **Longevity (years) –** age at last lambing
  - **Age at tooth loss (years)**
  - **Number of adult teeth** present at 2.5 years old

Materials & Methods

- Teeth traits:
  - Every ewe tooth scored in autumn each year
  - Ewes culled if any of the 4 centre teeth missing
  - Genetic analysis



Results



Trait	Min.	Max.	Average	Standard Dev.
Longevity (years)	2	>6	4.38	1.09
Age at tooth loss (years)	2	>6	5.05	0.93
Number of adult teeth (count)	2	8	4.43	0.92

Results

- Under genetic control – low heritabilities

Trait	Longevity	Age at tooth loss	Number of adult teeth
Longevity (years)	**0.12**		
Age at tooth loss (years)		**0.23**	
Number of adult teeth at 2.5 years old (count)			**0.24**

Results

- Under genetic control – low heritabilities
- Similar genetic control – longevity & age at tooth loss
- No genetic associations with number of teeth at 2.5y

Trait	Longevity	Age at tooth loss	Number of adult teeth
Longevity (years)	**0.12**	0.93	-0.10
Age at tooth loss (years)		**0.23**	-0.09
Number of adult teeth at 2.5 years old (count)			**0.24**

Heritabilities from previous trials

- Age at last lambing

Breed	Trait	h^2	
Dorset	LONG	0.11	McLaren et al. (2017)
Lleyn	LONG	0.05	McLaren et al. (2017)

- Mastitis traits

Breed	Trait	h^2	
Texel	SCC	0.11	McLaren et al. (2017)
Texel	CMT	0.09	McLaren et al. (2017)
Mixed	Mastitis	0.04	O'Brien et al. (2016)

Next steps

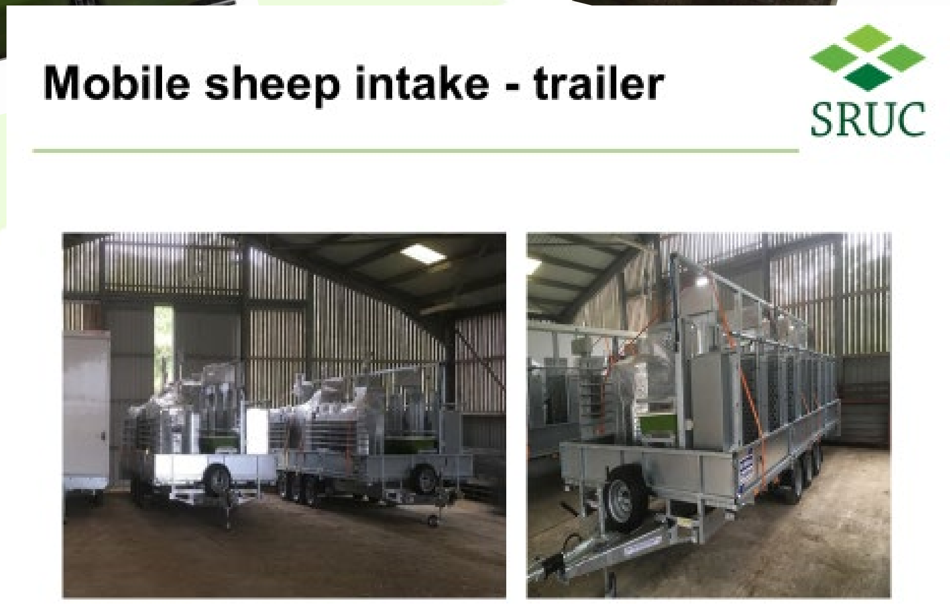
- Investigate:
  - another ewe longevity trait – stayability
  - genetic associations with other production traits
  - recommendations for recording ewe longevity
  - incorporation into national genetic evaluations / selection indices

Feed efficiency

SRUC – Nicola Lambe, Harriet Wishart, Ann McLaren, Rachel Gateley
AFBI – Aurelie Aubry

Leading the way in Agriculture and Rural Research, Education and Consulting

Feed intake recording



2 Pilot Trials at Kirkton

SRUC

Pilot 1

- Jan-Mar 2018
- Setup and test
- Can individual differences be recorded?

Pilot 2

- Aug-Dec 2018
- Finishing male lambs
- Identify feeding behaviour and efficiency differences

Pilot 1 – Shed setup

2x water crates

2x Concentrate crates
Finishing pellets
500g per lamb per day

16x roughage troughs
Grass nuts
Ad lib

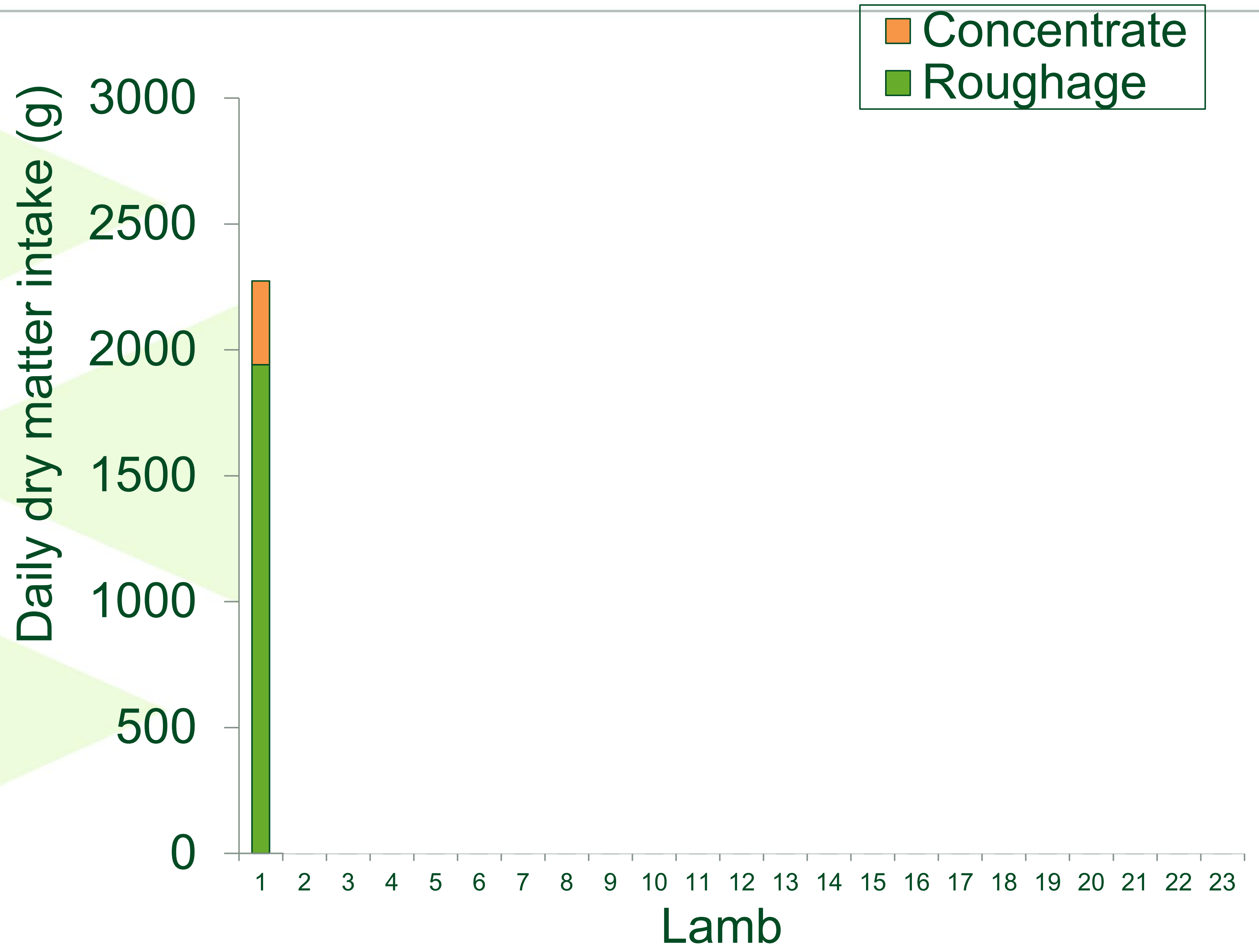
Pilot 1 – Trial design

- Jan to Mar 2018
  - 4 weeks of setup and problem solving
  - 44 day intake recorded

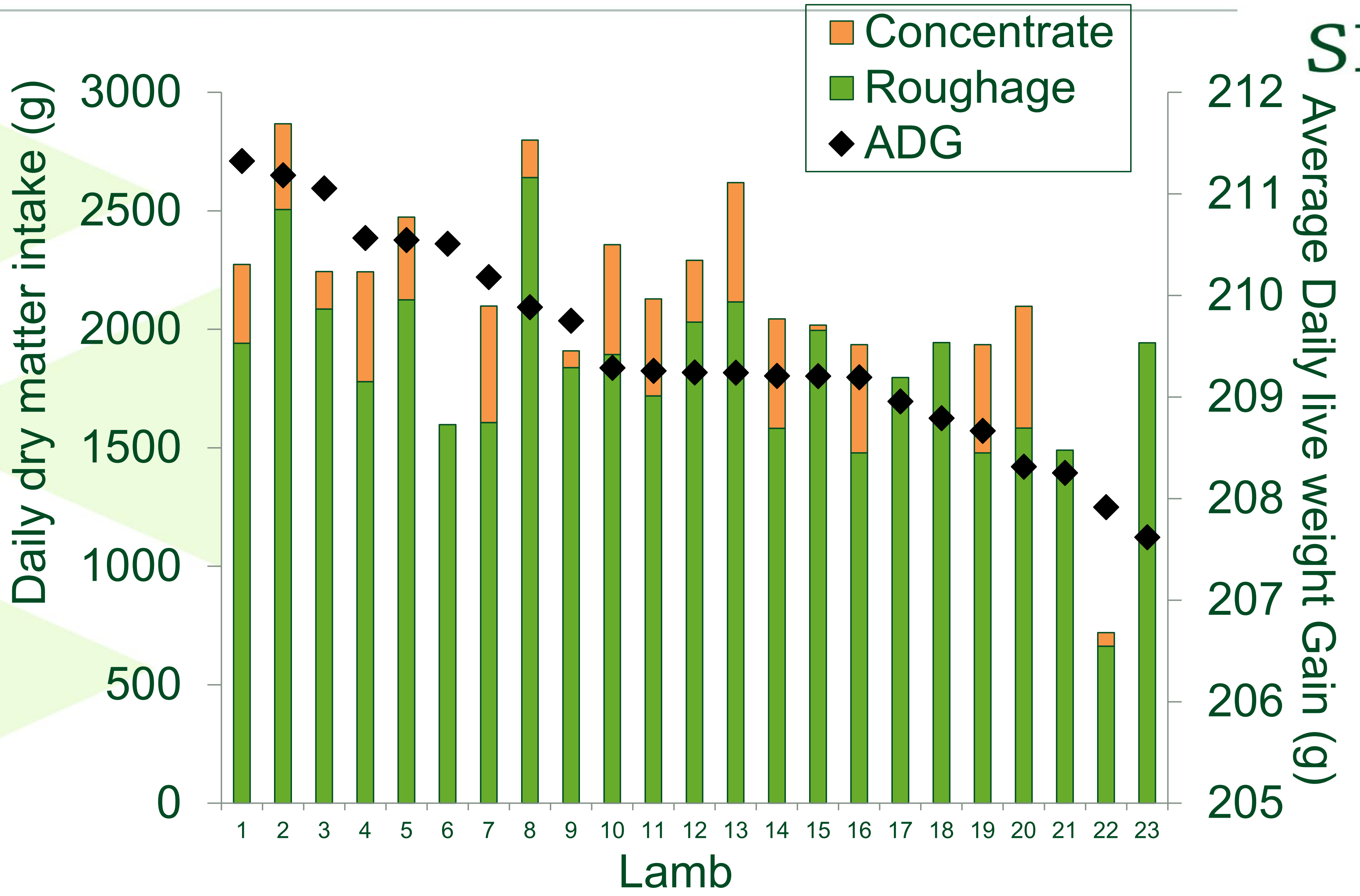
Analysed

- 23 Scottish Blackfaces
- 43 day roughage intake
- 17 day concentrate intake

Pilot 1 - Intake and gain by lamb



Pilot 1 - Intake and gain by lamb



Pilot 2

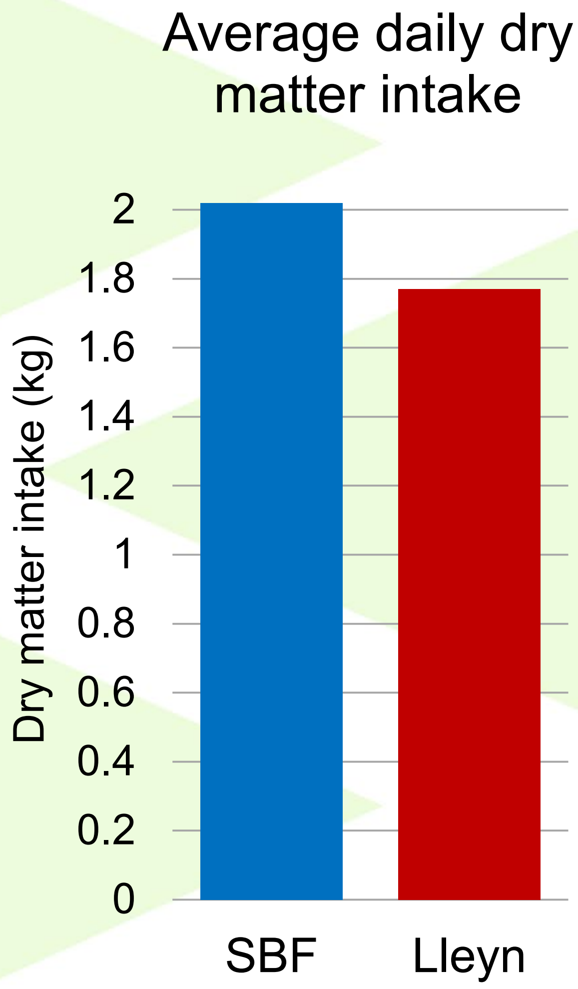
2x water crates

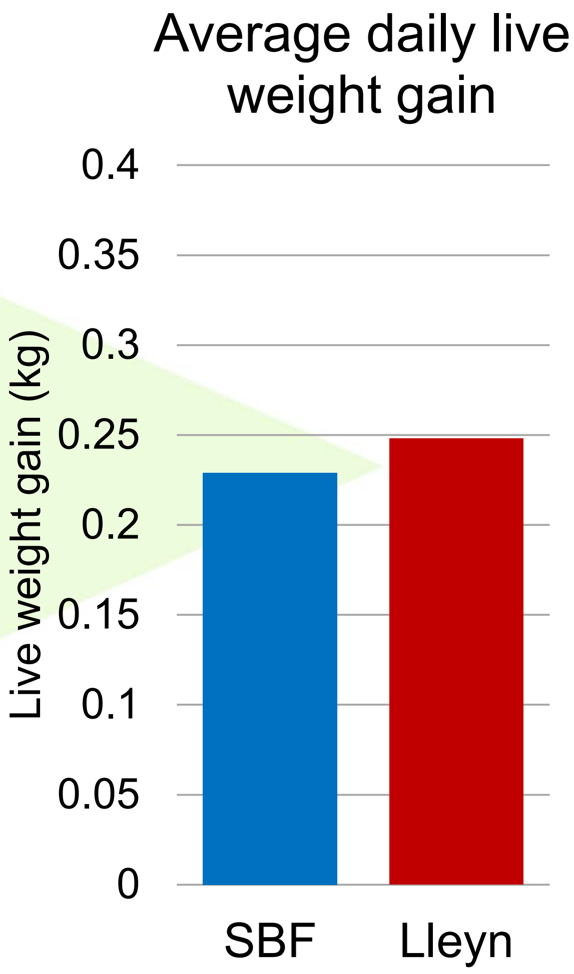
16x roughage troughs
Finishing pellets
Ad lib

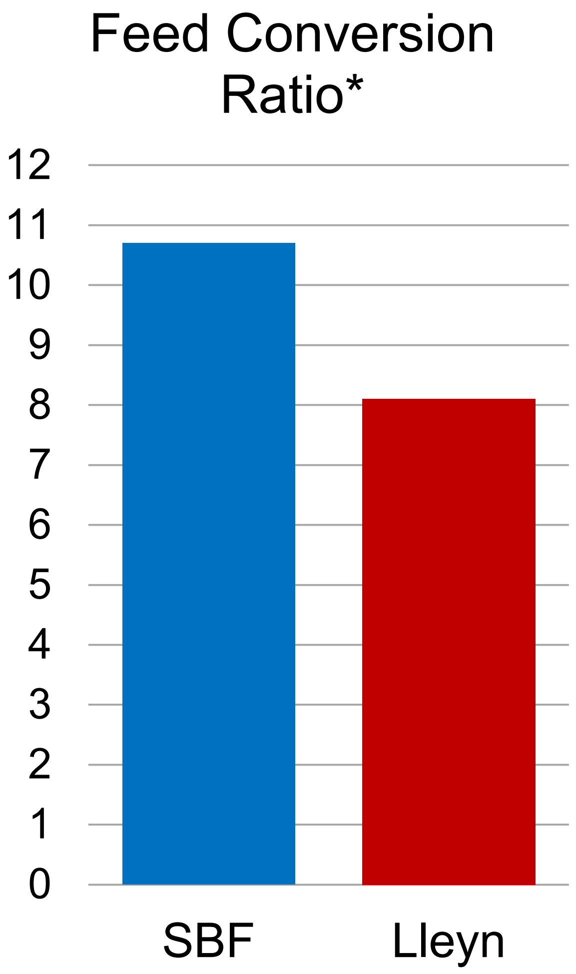
Pilot 2 – Trial design

- 120 male finishing lambs
  - 75% Scottish Blackfaces
  - 25% Lleyn
  - ~4 months old
  - Ave. 24.3kg at start

Pilot 2 – preliminary results

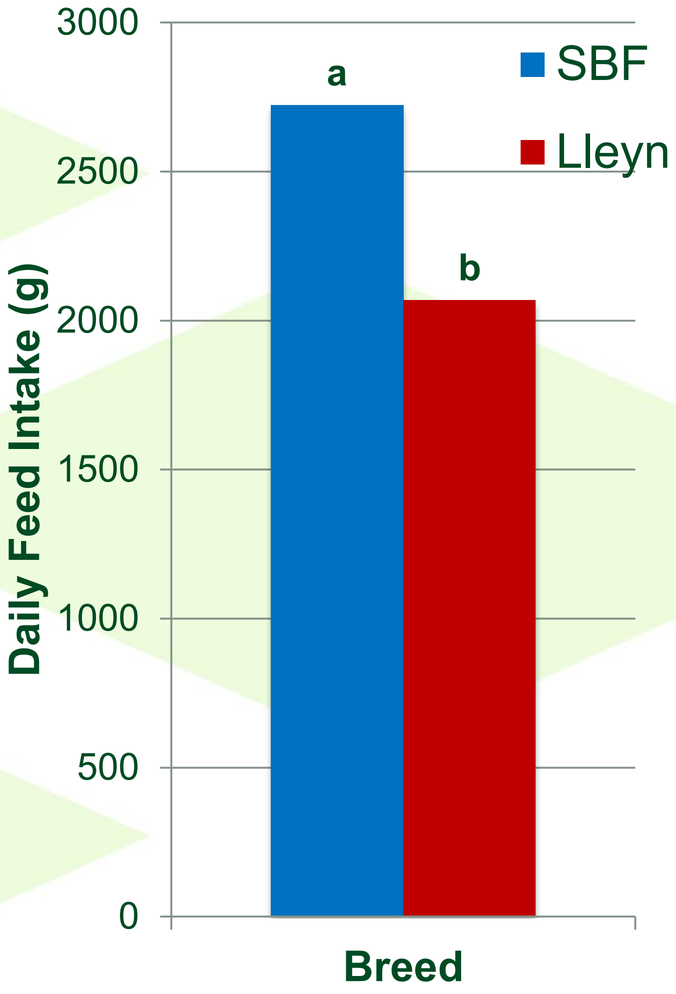






*kg feed per kg live weight gain

Pilot 2 - feeding behaviour



Scottish Blackface:

- ate more concentrates per day
- spent longer feeding
- were responsible for 95% of bullying events
  - mounting, head butting, pawing, pushing a lamb in the feeder

Possible effects of mixed-breed management?

Rachel Gately, BSc Hons dissertation, 2019

Conclusions

Pilot trial 1

- Variation in intake occurs
- Feed intake can be recorded
- Individual efficiency can be identified

Pilot trial 2

- 7-14 days needed to train lambs
- Can be used for finishing lambs
- Promising data for feed efficiency

Automated feeding system at AFBI

- To easily compare individual intakes and performance within and between groups of animals.
- **Experimental set up:**
  - 4 replicated large pens (n = 10-12 lambs in each)
  - Each pen comprises of:
    - ✓ 4 feed boxes
    - ✓ 1 concentrate feeder (with animal weighing platform)
    - ✓ 1 water intake system (with animal weighing platform)

Ongoing Sheep Feed Efficiency research at AFBI

AGRI-FOOD & BIOSCIENCES INSTITUTE

- Comparing the net feed efficiency of progeny from different sires (different EBVs for muscle)
  - Part of the RamCompare NI project
  - Intake and LWG measured over 44 days on 80 lambs in 2018 and 80 lambs in 2019
  - Zero grazed grass, with or without concentrates
  - Meat quality and yield parameters (shear force, colour, SMY)

RamCOMPARE
The Research Challenge Fund
AHDB
AgriSearch NI Driving Excellence & Innovation
Signet
Sheep Ireland www.sheep.ie
dunbia A DIVISION OF DAWN MEATS
Department of Agriculture, Environment and Rural Affairs www.daera-ni.gov.uk
LMC Livestock & Meat Commission

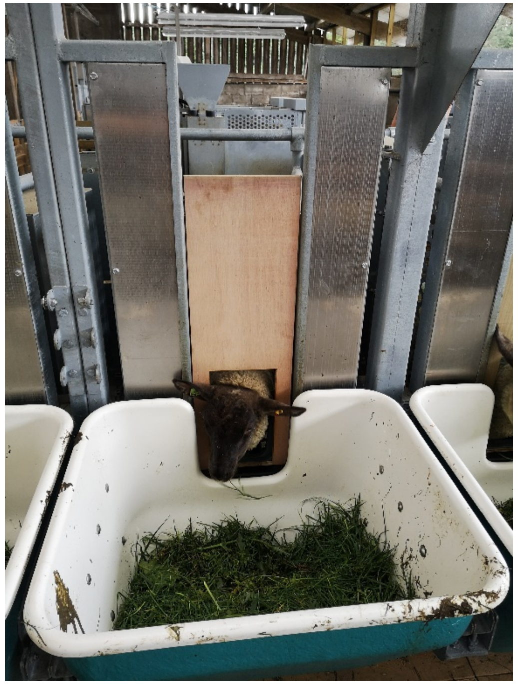
- Assessment of low cost tools to measure feed intake in sheep (2019)
  - Part of the GreenBreed project (DAFM funded)
  - Intake and LWG of 60 ewe lambs of 3 different genetic merits
  - Grass silage only
  - Feed intakes compared with alternative methods

Teagasc
Agriculture and Food Development Authority

Sheep Feed Efficiency: how to improve the research programme

- Since 2018, additional measurements are used to make continued improvements, to better determine:
  - Accuracy of the automatic measures (animal identification, individual intakes)
  - Thresholds and limitations of the system (eg number of animals per box)
  - Animal behaviour, including ideal adaptation period
  - Calibration requirements
  - Physical environments (shape of the feed gates, etc)

- Next steps will refine protocols to measure and analyse:
  - Water intake
  - Automatic animal weighing
  - Feeding behaviours



Grass to Gas (2019-2022):

Strategies to mitigate GHG emissions from pasture-based sheep systems

Objectives:

- Validate predictors of **feed intake** and **feed efficiency**
- Determine the relationships between:
  - indoor vs outdoor (grazing) FE
  - indoors vs outdoors **methane production**
  - FE vs methane production – indoors and outdoors
- Investigate genetic & genomic strategies to reduce methane from pasture-based sheep systems
- Quantify economic and environmental benefits
- Deliver applied, sustainable solutions to reduce methane emissions from sheep

Acknowledgements

SRUC

Funding:

defra
Department for Environment Food and Rural Affairs

Scottish Government
Riaghaltas na h-Alba
gov.scot

ERA-NET SUSAN

CIEL

Support:

SRUC Farm Staff

BioControl
Technology for biology

HILL lamb finishing 2018

	Days weaning to slaughter	Live wt (kg)	KO%	Price
Control	65	42.1	44.4	£68.61
Selection	59	42.6	43.1	£70.17
Lleyn	72	41.4	47.9	£74.75

- In comparison PARK lambs (on grass and hoppers):
  - SBF lambs finished in 66d
  - Lleyn lambs finished in 59d