Enhancing the hill flock
- maintaining momentum without funding

Janet Roden
Innovis

CYNLLUN
HYRDDOD
MYNYDD
HILL RAM
SCHEME

Where we were five years ago

- Little genetic progress in hill flocks
  - Amer et al. , 2015

- Few flocks recording performance

- Low use of EBVs when purchasing rams
  - Pollott et al, 2021

- "Rams with EBVs are not available to me.."
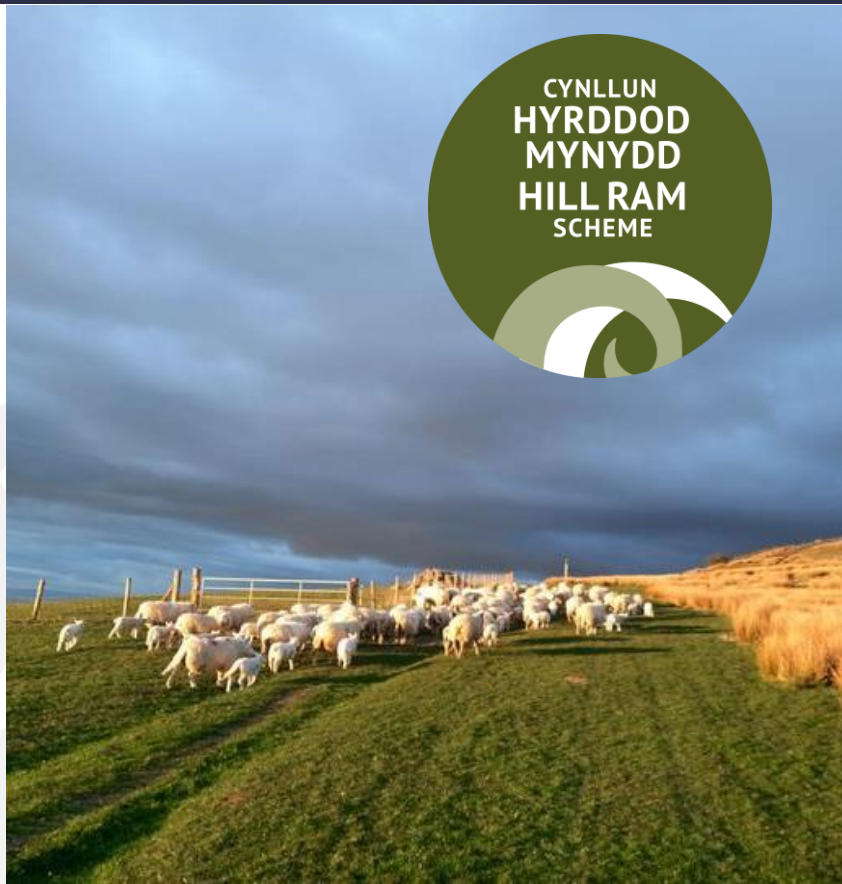 - HCC attitudes survey and 2021 Breed survey

Hill Ram Scheme – aims

Increase the number of recorded hill flocks in Wales (target 45)

Facilitate genetic improvement in hill environment – DNA parentage

Achieve critical mass of improved sheep

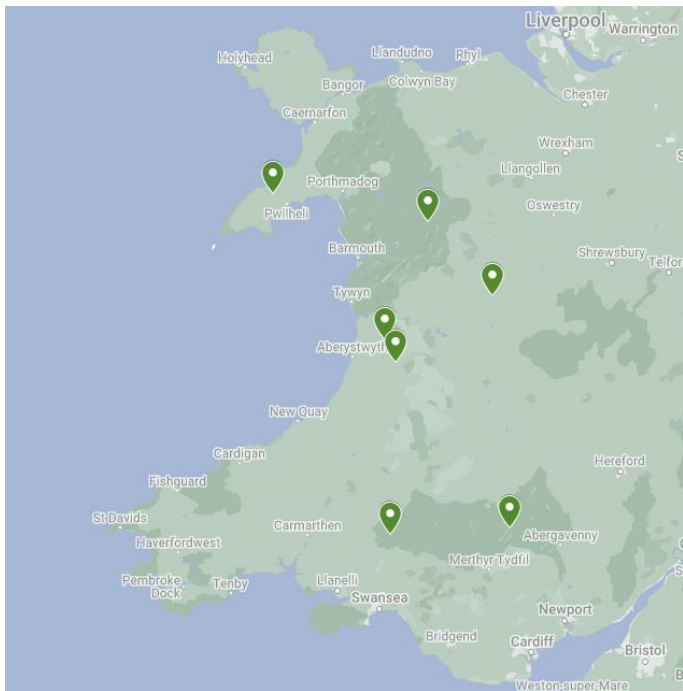Make it easier to buy and sell recorded rams

What does Hill Ram Scheme do?

RDP funded financial support: 2018-2023

- Setting up and using DNA parentage

- Signet recording and US scanning

- Development of Hill Index and new EBVs

- Training and advice

  - Recording, use of EID etc

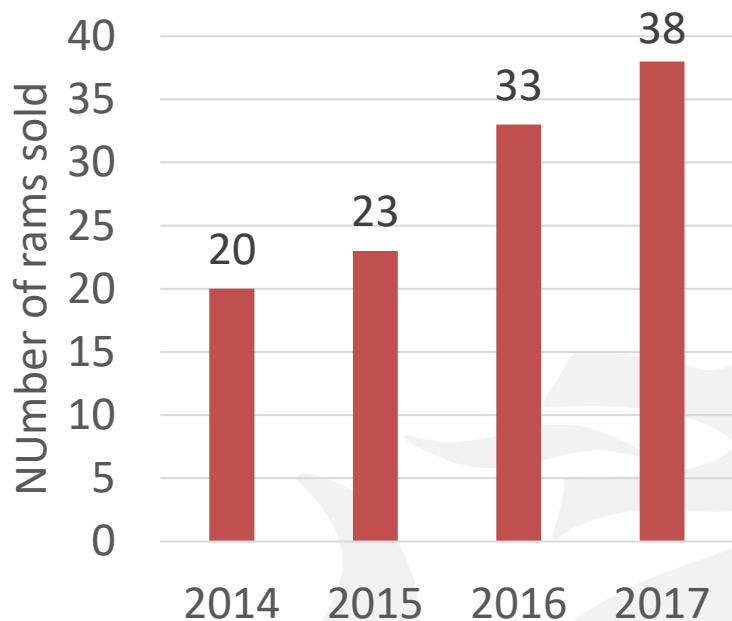 - Use and interpretation of EBVs

  - Marketing rams

How it started:

How it's going:

Diolch Lowri J

hybucig.cymru
meatpromotion.wales

Autumn 2021 – Rams sold/retained

Central Sale 75

Off farm   65

Regional sales- 91

Retained for future breeding- 88

Total 228

2019
7 DNA flocks
2642 ewes genotyped
2541 Lambs

+ 1 manual recorder

2020
30 DNA flocks
+ **8012** ewes genotyped
9175 lambs

+ **5** manual recorders

2021
48 DNA flocks
+ ~ 9500 ewes genotyped
14 410 lambs

+ **9** manual recorders

2022
40 DNA
+ ~ 1796 ewes genotyped
15 027 lambs

+ **16** manual recorders

The future…….

Funding after 2023?

Harnessing the power of genomics

Maintaining critical mass

Genomics data – adding value

- Parentage assignment

- Gene tests
  - e.g yellow fat, scrapie, GDF-9

- Genomic breeding values

Genotyping

GenomNZ

Ewes and lambs genotyped on 17K XT SNP chip (~ 44 000)

Lambs 60K SNP chip (~ 15 000)

Rams genotyped on 600K SNP chip (~630)

Genotyping Ewes - Autumn 2019

Parentage assignment

Most flocks > 95% assignment
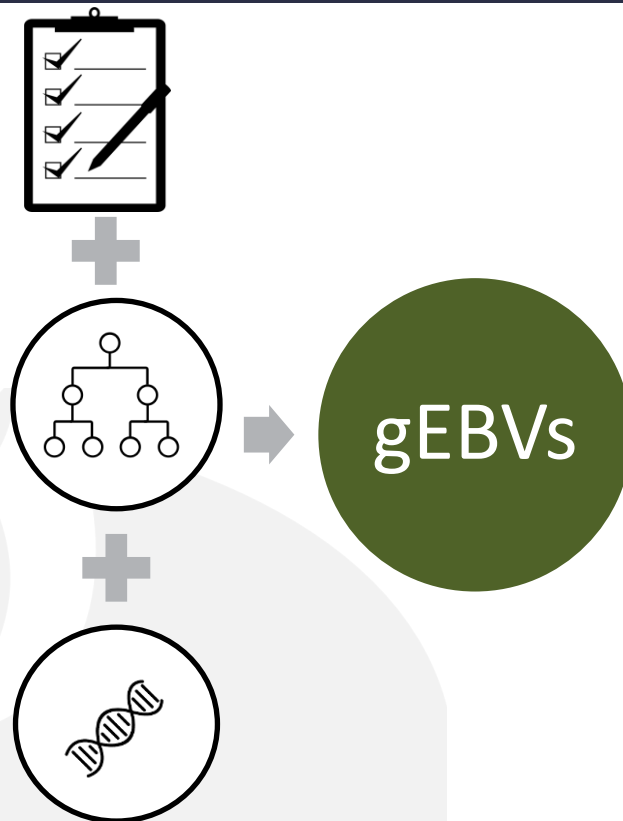
A few flocks < 90% assignment

- unknown ewes

- unknown sires

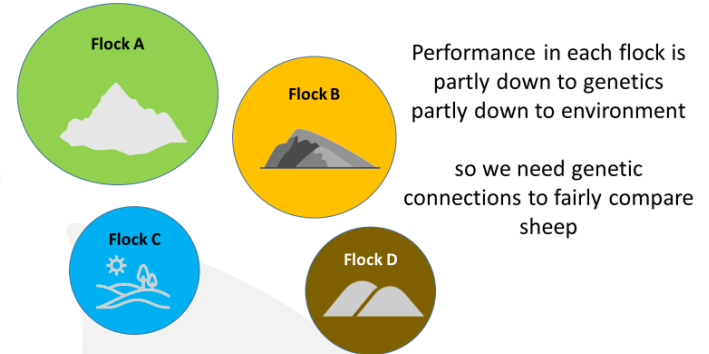- incomplete sampling of flock

Genomic breeding values ?

Single step genomic evaluation

- uses pedigree + genomic data to estimate **genes shared** between animals **more accurately**

- only useful if performance records (phenotypes) available

gEBVs

Why could genomic breeding values add value?

- More accurate selection decisions
  - maternal traits – sex limited
  - traits measured over the ewe's lifetime
  - traits that are hard to measure

Flock A

Flock B

Performance in each flock is partly down to genetics partly down to environment
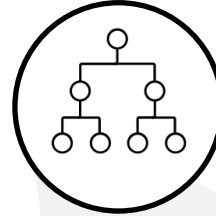
so we need genetic connections to fairly compare sheep

Flock C

Flock D

- Genomic relationships strengthen genetic connectedness (Yu et al, 2017)
  - Shared DNA but not (necessarily) shared parents

Team Effort on Hill Sheep Genomics

SRUC: Samir Id Lahoucine, Massimiliano Cosso, Abbygail Wells and Ann McLaren, Mike Coffey

HCC: Heather McCalman

Innovis: Janet Roden and Kim Hay

AHDB/Signet: Kim Matthews, Laura Eyles, Wendy Knight, Samuel Boon, Marco Winters and Victoria Ashworth

Thanks to SRUC for SBF genotypes and Innovis for Cheviot genotypes

Data used for genomic hill sheep breeding values

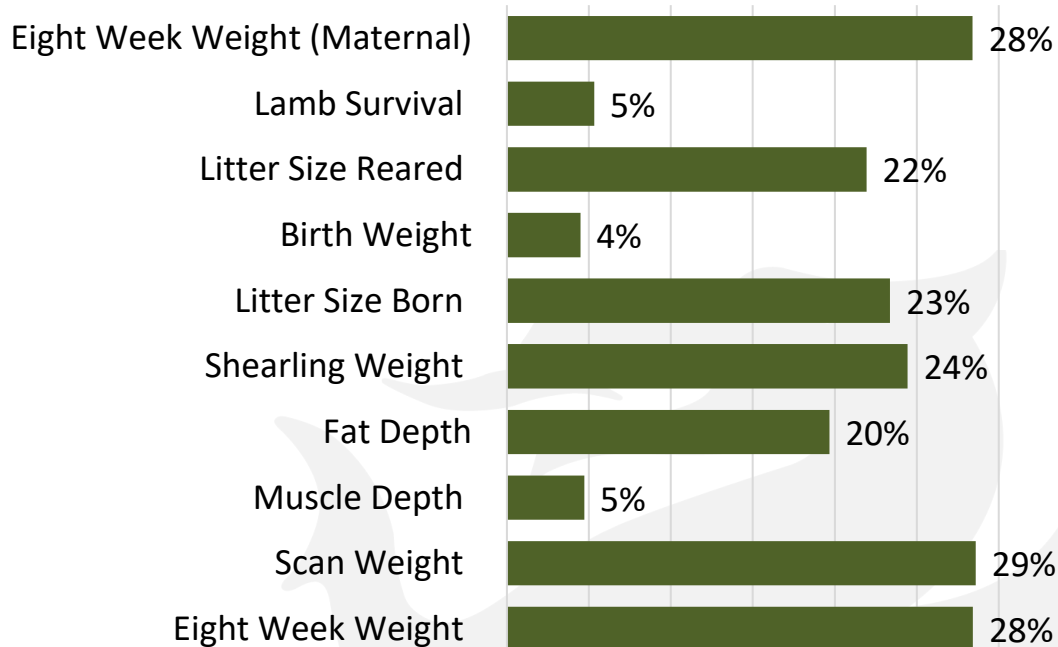| Breed	n genotypes
Welsh Mountain	35,408
Hardy Speckle	3,506
North Country Cheviot Hill	1,832
Scotch Blackface	1,037
Brecon Hill Chev	701
Sth Welsh Mountn	570
Beulah	13
North Country Cheviot Park	3

The whole dataset included 910,000 animals.

Breeds: Welsh Mountain, Beulah, Scotch blackface, Roughfell, Herdwick, Hebridean, Hardy Speckle, South Wales Mountain, Swaledale, North Country Cheviot Park, North Country Cheviot Hill, South Country Cheviot, Black Welsh Mountain and Brecon Hill Chev.

Genotypes: 43,070 animals with 53,401 imputed SNPs

Increase % accuracy when adding Genotypes

Trait	Increase %
Eight Week Weight (Maternal)	28%
Lamb Survival	5%
Litter Size Reared	22%
Birth Weight	4%
Litter Size Born	23%
Shearling Weight	24%
Fat Depth	20%
Muscle Depth	5%
Scan Weight	29%
Eight Week Weight	28%

Adding genotypes into the genetic evaluation resulted in substantial increases in accuracy

How different are the genomic results?

	Non-Genotyped to 2009 (123,090)	Non-Genotyped from 2010 onwards (45,737)	Genotyped Only (37,157)
Lamb Survival EBV	0.99	0.87	0.80
Eight Week Weight EBV	1.00	0.96	0.68
Litter Size Born EBV	1.00	0.96	0.63
Maternal Ability EBV	1.00	0.97	0.66
Mature Size EBV (Shearling Wt)	1.00	0.95	0.68
Scan Weight EBV	1.00	0.96	0.68
Muscle Depth EBV	1.00	0.98	0.80
Fat Depth EBV	1.00	0.95	0.72

No impact on old non-genotyped sheep

Most impact on genotyped sheep

The correlations between genomic and non-genomic evaluations

Relationship between EBV and Progeny Data

634 Welsh Mountain rams (>9 scanned progeny**)**

	Correlations between:		
	old EBV and new EBV	old EBV and average progeny phenotype	new EBV and average progeny phenotype
Scan weight	0.86	0.30	0.40
Muscle depth*	0.97	0.26	0.31
Fat depth*	0.93	0.32	0.41

* Weight adjusted to 30kg
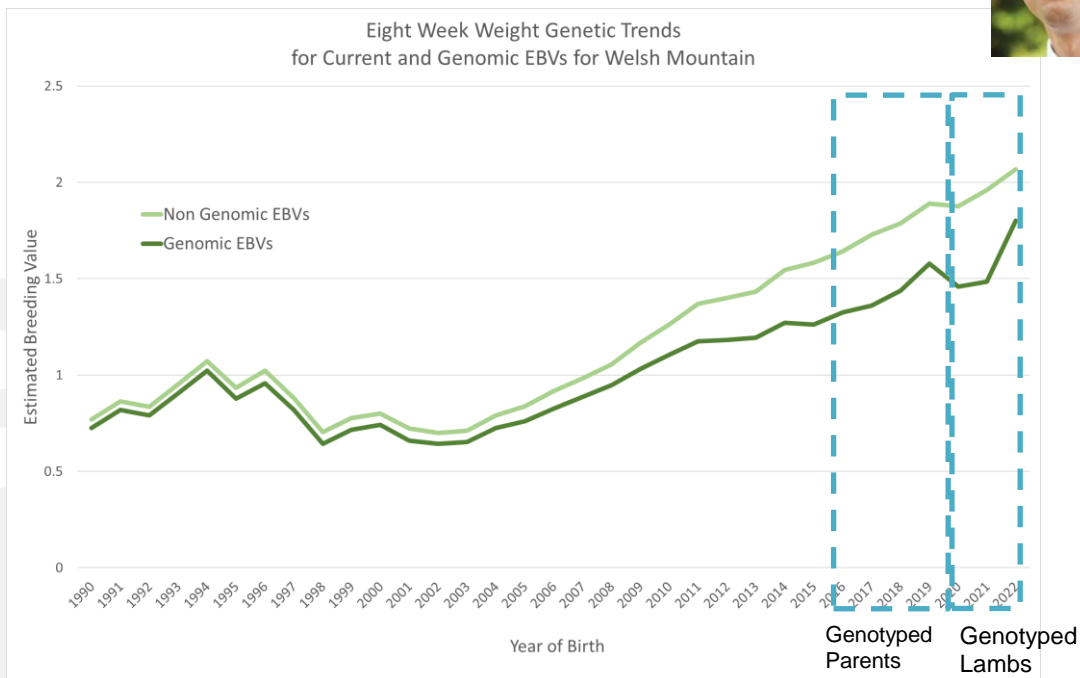
Highly correlated

Genomic BVs more closely related to progeny phenotype
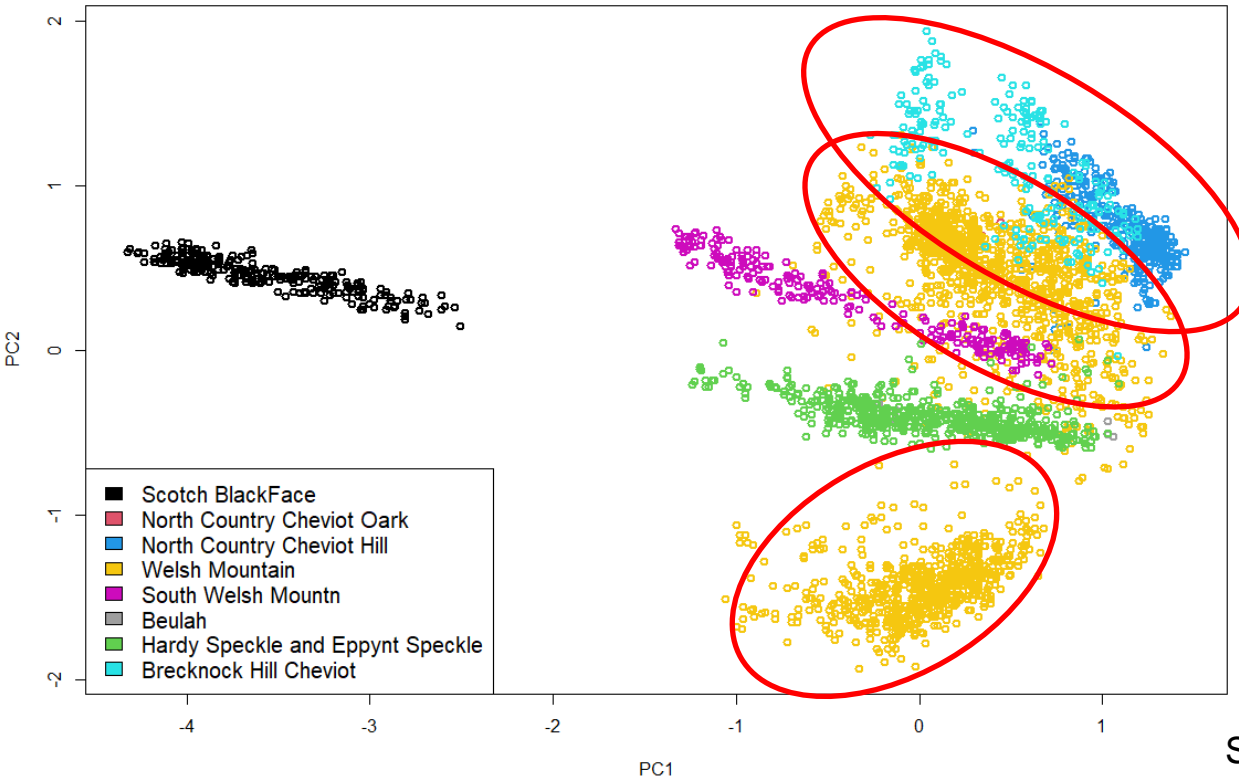
#PhenotypeIsKing

What impact does genomics have on trends?

- Genomic data may suggest lower rates of gain

- Potentially reducing the gap (bias?) between
  - Recorded/unrecorded?
  - Linked/unlinked?

- Will avoiding overprediction increase stability and lead to faster long term gain?
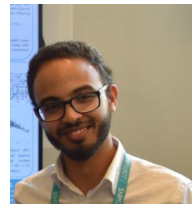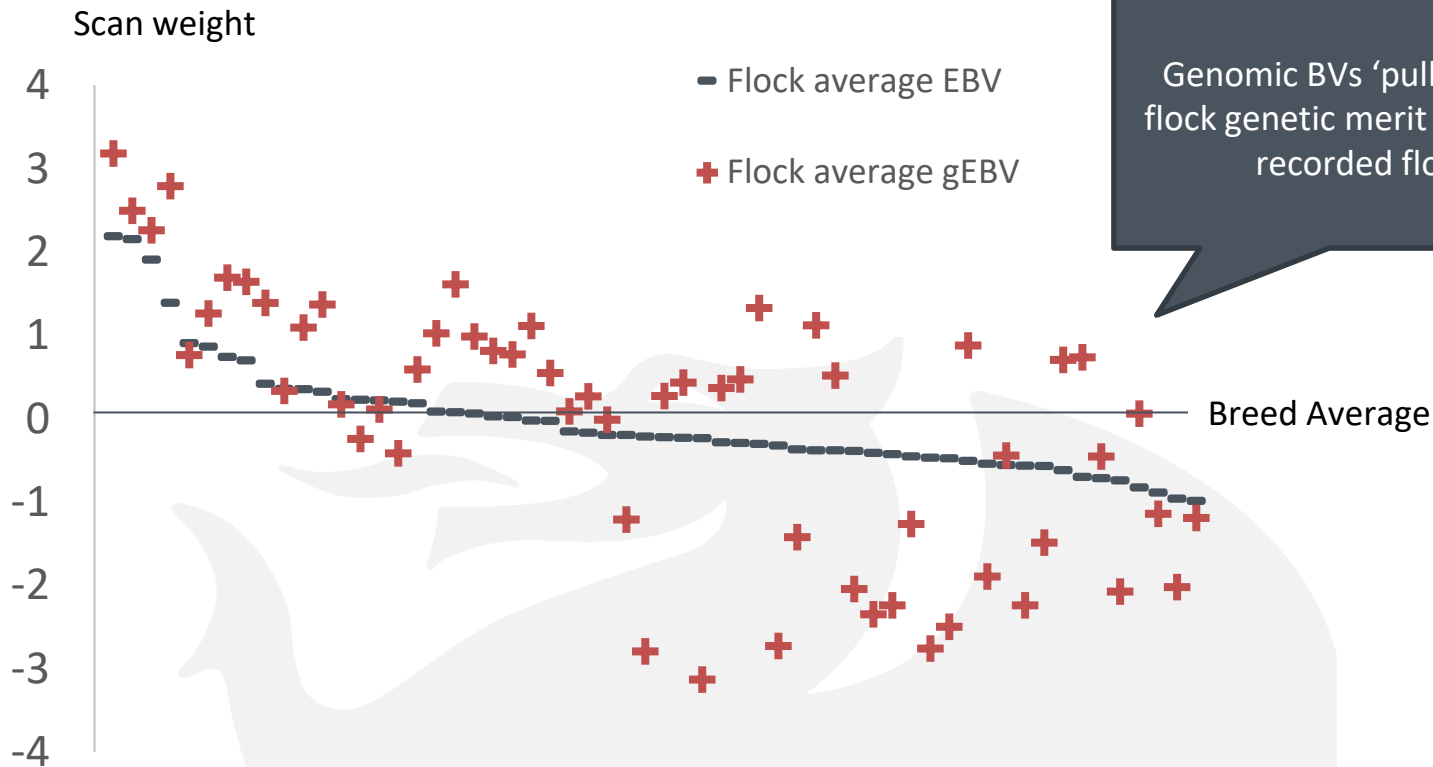

Eight Week Weight Genetic Trends
for Current and Genomic EBVs for Welsh Mountain

Non Genomic EBVs
Genomic EBVs

Estimated Breeding Value

Year of Birth

Genotyped Parents   Genotyped Lambs

Principal component analysis 1 and 2

- Clear breed type clusters can be observed, with Cheviot breed types are overlapping.

- Interestingly there are two clusters of Welsh Mountain sheep.

- One tending to be closer to the Cheviot types and the other more distinct.

Samir Id Lahoucine, 2022

Legend:
- ■ Scotch BlackFace
- ■ North Country Cheviot Oark
- ■ North Country Cheviot Hill
- ■ Welsh Mountain
- ■ South Welsh Mountn
- ■ Beulah
- ■ Hardy Speckle and Eppynt Speckle
- ■ Brecknock Hill Cheviot

HCC Hill Ram scheme – momentum

– Increase in number of recorded flocks

– Recorded rams available for most 'types'

– Increasing number of recorded rams sold

– EBVs and Index – fit for the future (few years)

– Huge phenotypic and genomic data resource available

– Genomic values bring the promise of higher rates of progress
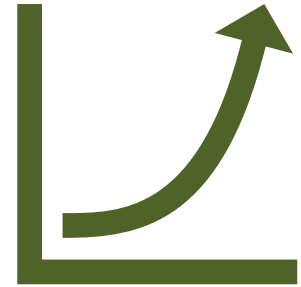
Adding value to their hill flocks.............

Thank You

Diolch yn Fawr

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