

Genomics: An Australian perspective

Ben Hayes and many others



THE UNIVERSITY
OF QUEENSLAND
AUSTRALIA

QAAFI
Queensland Alliance
for Agriculture & Food Innovation

Working together with the
Queensland Government



Queensland
Government

Outline

- What are we breeding for?
- How do we get there?



What are we breeding for?

- **Balance**



What are we breeding for?

• Dairy

Balanced Performance Index (BPI)

- Economic index
- Blends production, type and health traits for maximum profit
- In line with farmer preferences



Health Weighted Index (HWI)

- Fast track fertility and mastitis resistance

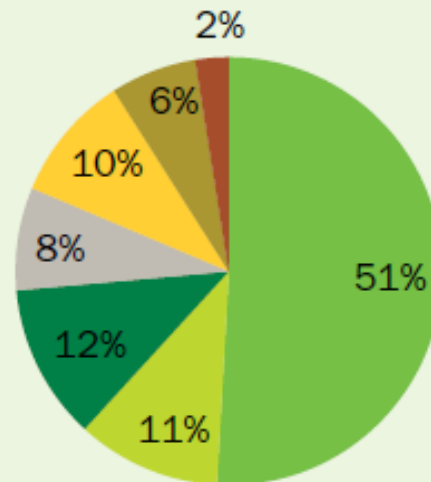


Type Weighted Index (TWI)

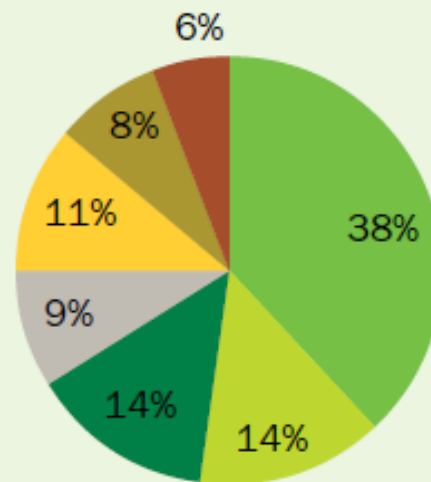
- Fast track type



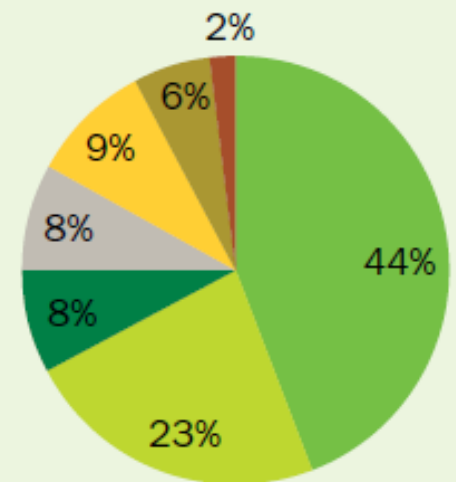
Balanced Performance Index



Health Weighted Index



Type Weighted Index



■ ASI - Production ■ Fertility ■ Cell Count ■ Feed Efficiency ■ Type ■ Survival ■ Workability



What are we breeding for?

- Lamb
 - Growth, Fat depth, eye muscle area
 - Reproduction, worm egg count (WEC)



What are we breeding for?

- Lamb
 - Growth, Fat depth, eye muscle area
 - Reproduction, worm egg count (WEC)
 - Lean meat yield
 - Eating quality index -> tenderness, intra-muscular fat, taste panel



What are breeding for?

- Beef
- Southern Australia
 - Growth, carcass, reproduction, intramuscular fat, feed efficiency
- Northern Australia
 - Growth, reproduction
 - Feed efficiency, meat quality on the horizon



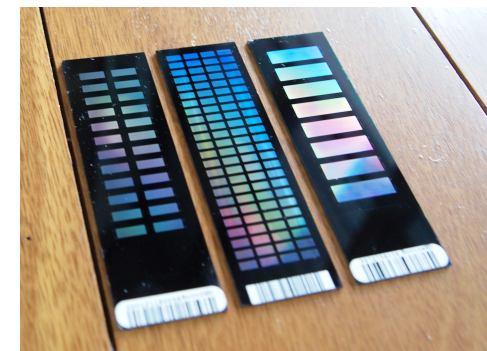
Outline

- What are we breeding for?
- How do we get there?



How do we get there?

- Genomics offers the (only?) opportunity to breed for better balance between easy to measure traits and hard to measure traits
- Need large populations animals that have traits measured and are genotyped
- Different industries have tackled this in different ways



How do we get there?



- Dairy

- Ginfo project – genotype 60,000 cows in commercial dairy herds (main emphasis good fertility records)
- Accuracies genomic breeding values for young genomic bulls now quite high

Trait	Accuracy
BPI	79
Production	87
Survival	69
Fertility	69
Feed efficiency	54

Genomic selection and AI

- Double rate of genetic gain



How do we get there?



SHEEP
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- Lamb
 - Information nucleus (industry rams used on large research stations)
 - >30,000 genotypes
- Genomic breeding values for
 - Lean meat yield and dressing%
 - Carcass eye muscle and fat
 - Intra-muscular fat and shear force
- Multi-trait single step analyses (AGBU team)



How do we get there?



- Beef
 - Beef Information nucleus for carcass traits, feed efficiency
 - Combination of industry funding and MLA
 - Large fertility projects, one on research stations, another on commercial properties
 - Multi-trait single step for some breeds (AGBU team)
 - Days to calving ~0.3-0.5 accuracy

How do we get there?



- Two big challenges for the future
 1. How to maintain genomic selection reference populations? We will always need them.
 2. How to make genomic breeding values work across breeds?
 - Otherwise enormous reference population needed for each breed/composite

How do we get there?

- Current 50K works well strictly within breeds
- Does not work across breeds
- Composites?
- Accuracy erodes rapidly with generations



How do we get there?



SHEEP
BREEDER
FORUM



- Sequence data -> causal mutation in data set

1000 bull genomes Run6

- 2703 Sequenced Animals (Taurus, Indicus), 11x
- ~55 Breeds: Dairy, Beef, Dual Purpose, Crosses, Composites



Sheep catching up!



SHEEP
BREEDER
FORUM



- Run2 of SheepGenomesDB contains 935 diverse sheep yielding >50 million variants!!
- *James Kijas, Rudiger Brauning, Shannon Clarke, Alan McCulloch, Noelle Cockett, Gary Saunders, Marina Naval Sanchez, Sean McWilliam, Hans Daetwyler*



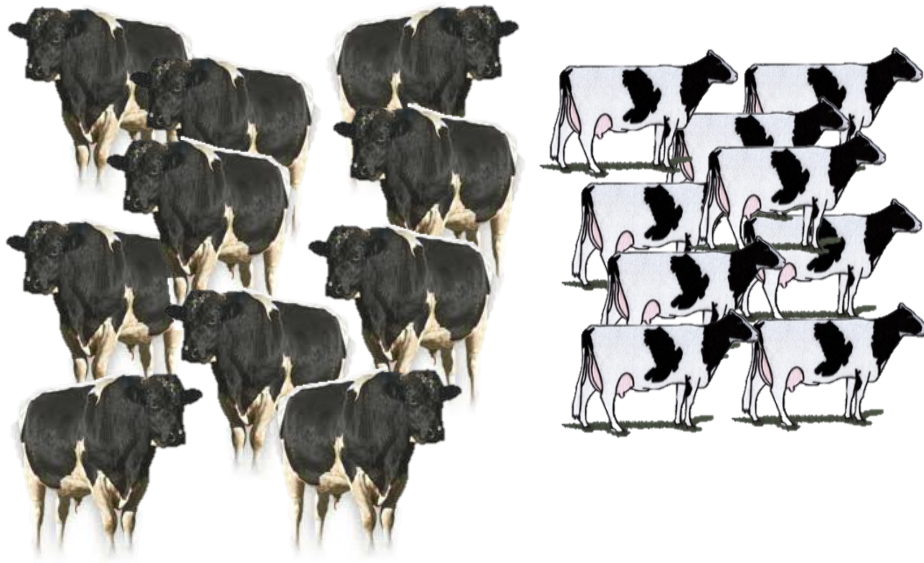
How do we get there?



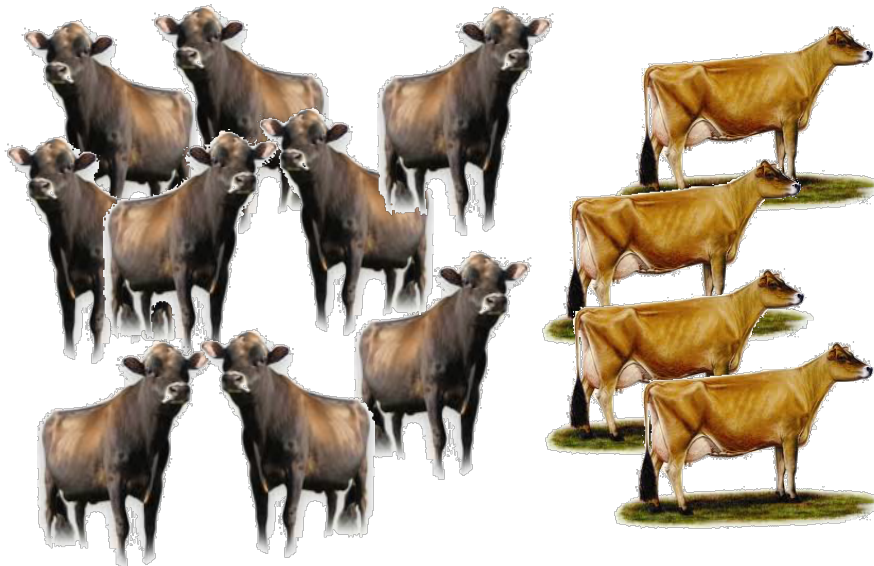
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- Sequence data -> causal mutation in data set



Holstein 14,055 Individuals



Jersey 5,259 Individuals



Reds 1,012 Individuals

*Impute sequence data
into all individuals*

Across breed prediction

	Fertility	Temperament
50K SNP	0.06	0.10
630K SNP	0.22	0.24
Sequence data	0.28	0.26

Conclusion

- Most industries now aiming for breeding goals which balance production, fertility, meat quality, feed efficiency and disease resistance



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- Genomic breeding values opens the opportunity to breed for these traits



Conclusion

- Most industries now aiming for breeding goals which balance production, fertility, meat quality, feed efficiency and disease resistance
- Genomic breeding values opens the opportunity to breed for these traits
- Major challenges in the future
 - building and maintaining reference populations
 - Making genomic selection work across breeds
 - Integrating new sequence variants into single step



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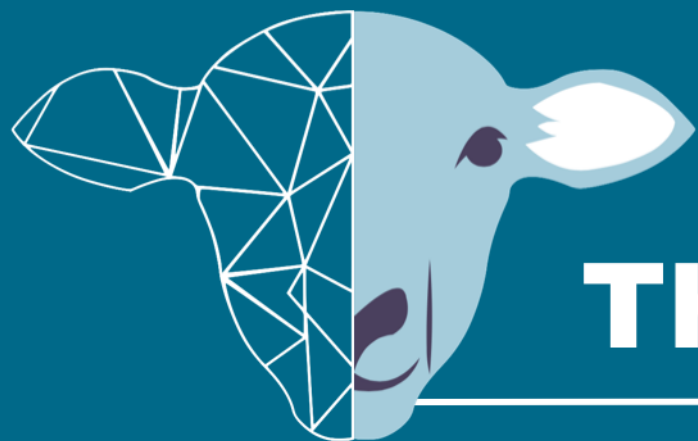
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Thank you.
