



Breeding for Poll in AACo: Modelling to implementation



AACo

Very brief introduction

Established in 1824, we are Australia's oldest continuously operating company.

Today we are the proud custodians of 6.5 million hectares or 16 million acres of land in Queensland and the Northern Territory, which represents ~1% of Australia.

We are one of Australia's largest integrated cattle and beef producers, operating a network of 30 stations, farms and feedlots.





Part 1: Matthew

MDC Project – Animal Wellbeing Extension and Adoption Partnership

Addresses two of the complex challenges facing Northern Australian livestock producers:

- Horned cattle
- Improving the management of reproductive diseases in extensive cattle herds

Develop detailed cost benefit analyses and adoption pathways

- Support producers to develop their own management plan & improve their skills and knowledge





Why Breed for Poll?

Long Term Goal: transition to a polled enterprise

- Eliminate the need for dehorning
- Economic loss due to bruising can largely be attributed to horns
- Safer for our staff
- Increasing consumer demand/market pressure
- Accurate genetic test for poll which is integrated with normal stud practice



Polled Genetics

The polled gene (P) is dominant

PP Bull x HH Cow	P	P
H	HP	HP
H	HP	HP



Heterozygous Polled – 100%
All Phenotypically Polled (or scurred)



Polled Genetics

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Heterozygous (PH) Polled – 100%
All Phenotypically Polled (or scurred)

PH Bull x HH Cow	P	H
H	HP	HH
H	HP	HH



Heterozygous Polled – 50%
Homozygous (HH) Horned – 50%
Half Phenotypically polled



Polled Genetics

The polled gene (P) is dominant

PP Bull x PH Cow	P	P
P	PP	PP
H	PH	PH



Homozygous Polled – 50%
Heterozygous Polled – 50%

PH Bull x PH Cow	P	H
P	PP	PH
H	PH	HH



Homozygous Polled – 25%
Heterozygous Polled – 50%
Homozygous Horned – 25%



Polled Case study

Three polled bulls joined to Full Blood cows that were all horned (HH)



Bull	Geno	Calves	Poll Genotype	Poll Phenotype
R6022	PH	62	38	35
R7217	PH	62	34	29
R7333	PP	47	47	47

What are Scurs ?



- Scurs are incompletely developed horns that are generally attached only to the skin.
- Found in heterozygous Poll cattle
- Large variation in size
- Most common in males
- Hard to measure early in life

Poll Case Study in Males

Three polled bulls joined to Full Blood cows that were all horned (HH)

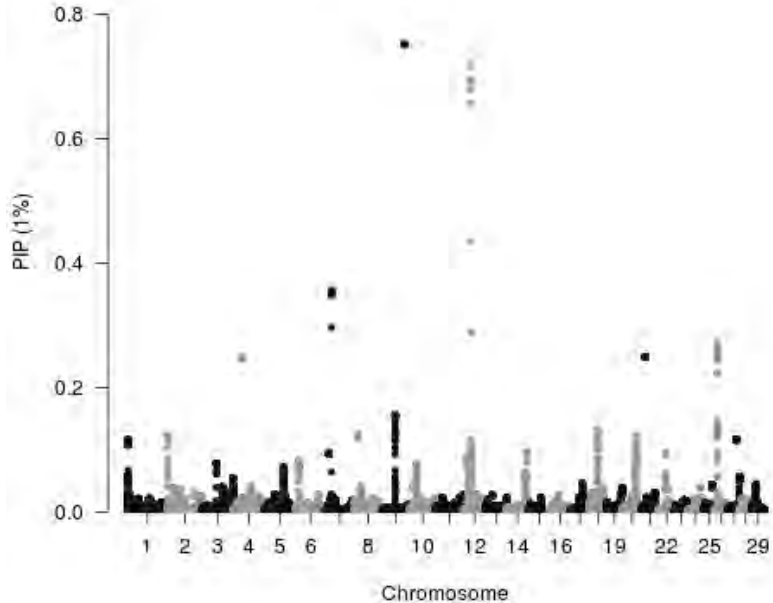


Bull	Geno	Calves	Poll Geno	Clean Poll and Not Dehorned
R6022	PH	30	14	12
R7217	PH	29	14	9
R7333	PP	24	24	24

*Typically 10%-25% of PH males have scurs that are horn like

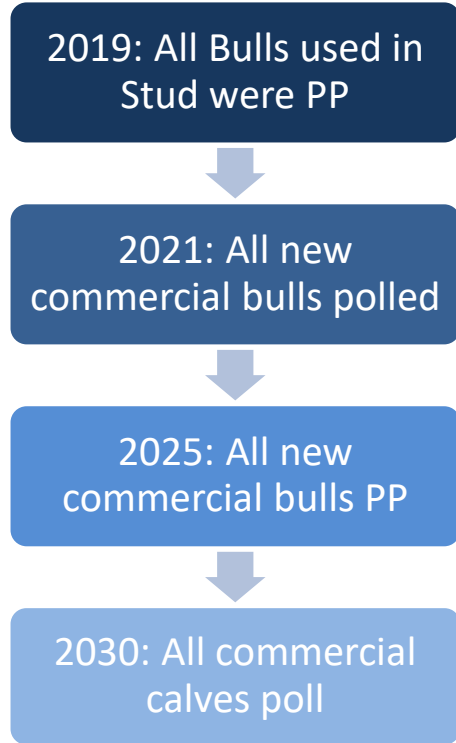
- 16% were dehorned
- 41% of Males had scurs

Genetics of Scurs



- Traditionally it was thought that scurs were due to a single gene
- Some evidence that multiple genes involved
 - In scientific literature
 - In this preliminary ACo analysis
- Large associations on 9 & 12, explain approx. 9% of the genetic variance
- Highly Heritable (0.5+)
 - Can be selected on

Mitchell Poll Program



Year Brand	PP	% of Stud Polled
2024	60%	99%
2023	50%	99%
2022	44%	98%
2021	30%	100%
2020	22%	79%
2019	23%	83%
2018	16%	65%
2017	12%	55%



Poll Brandings at Anthony Lagoon



Year	% Polled Males	% Polled Females
2022	31%	47%
2023	24%	47%
2024	39%	61%

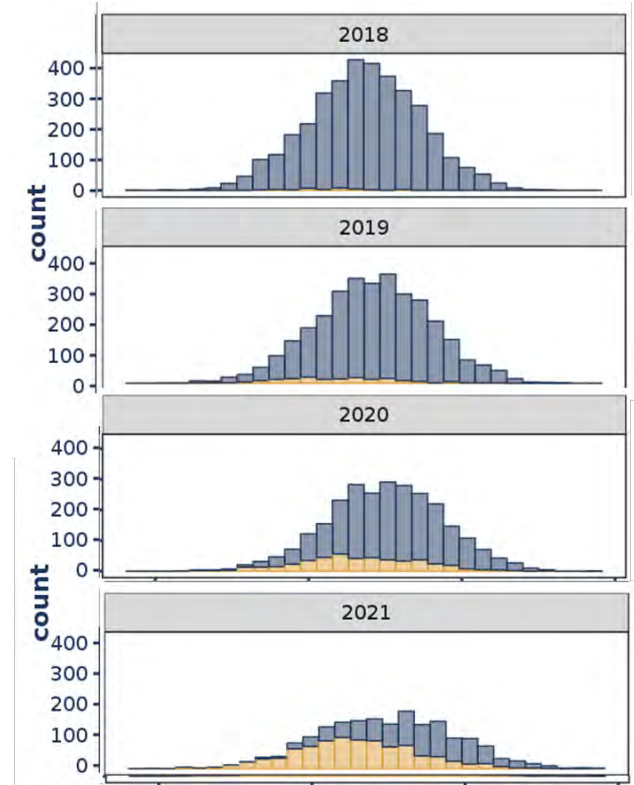
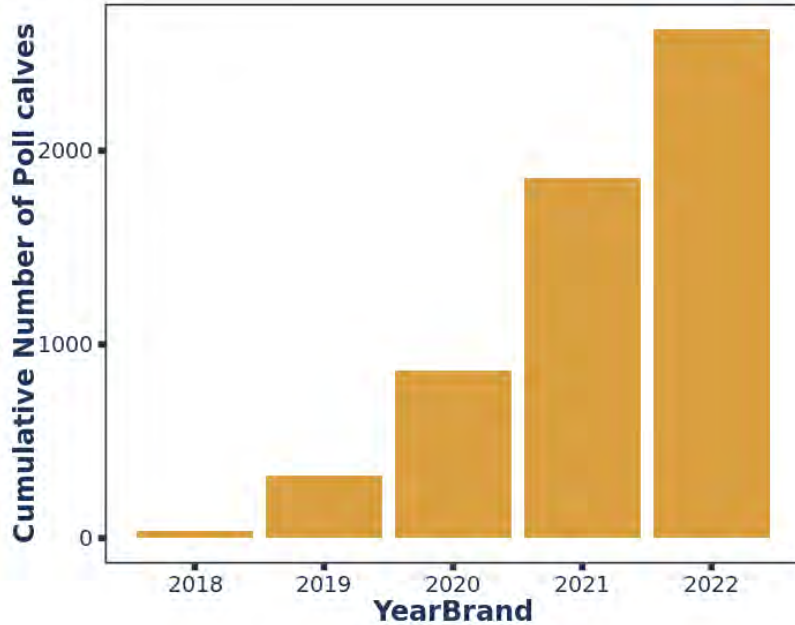
Wagyu Poll Program – Marathon not a Sprint

Challenges in breeding Poll Wagyu:

- Inbreeding
- Genetic Merit
- Scurs



Wagyu Poll Program



Managing Inbreeding in Poll Wagyu

- The poll program has a small number of founders
- Matings are carefully planned to avoid inbreeding and maintain diversity



	% matings to half sibs	
Bull	Poll	FB
R6022	1.4	1.7
R7333	18.1	1.3
Typical full blood bull		
R0046	0.7	6.1

Take Home Messages

- Animal Welfare is here to stay
- Developing quality poll bulls is a marathon not a sprint
- Breeding these bulls is a balancing act
 - Inbreeding
 - Genetic merit
- Scurs are a production issue
 - Continually monitor within our breeding systems
 - Keep up to date with emerging research





Part 2: James

Digital Twin Development

Challenges

- Selecting for polled, particularly in Wagyu is challenging:
 - *Incidence of polled in Wagyu is low*
 - *Minimal genetic diversity*
 - *Balance selection pressure for polled with other traits and inbreeding*

Solution: digital twin

- Precise simulated version of breeding program in a beef business
- PREDICT program outcome BEFORE execution / joining
- Measures genetic gain AND inbreeding (ROH)




Genomic Simulation Software

- Kira Villiers
- Inputs: real genotypes
- Simulates crosses
- Previously demonstrated in wheat, barramundi

JOURNAL ARTICLE

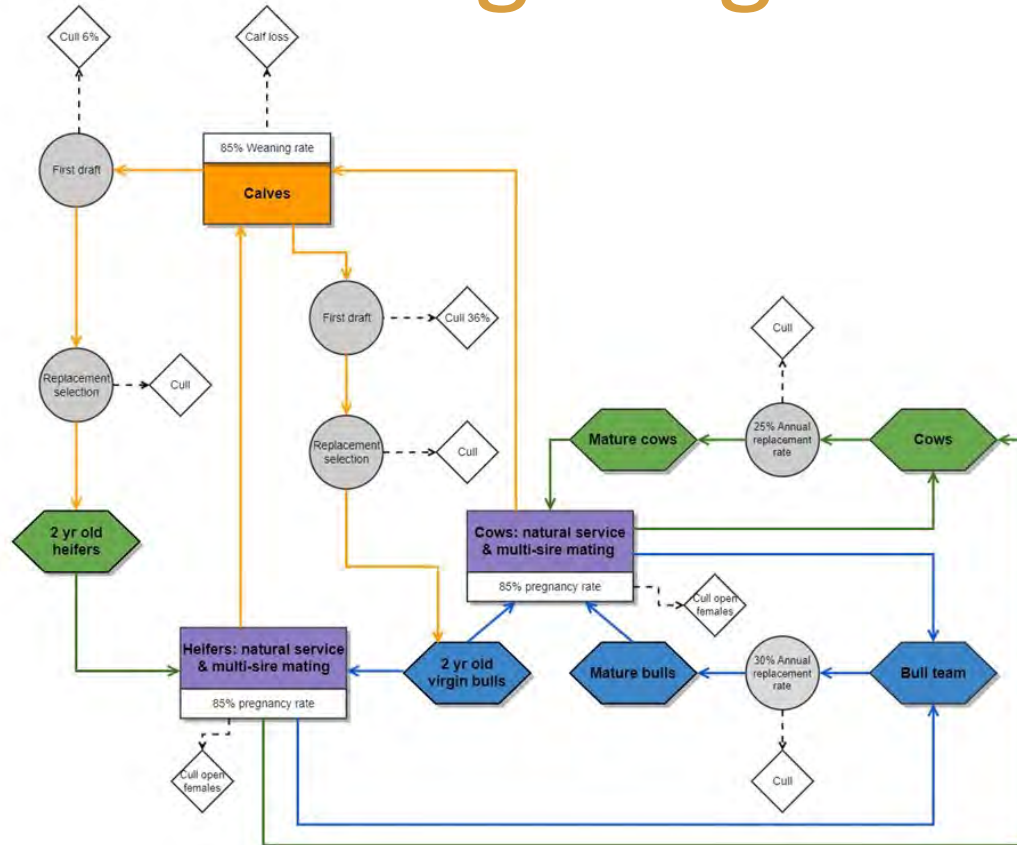
genomicSimulation: fast R functions for stochastic simulation of breeding programs 

Kira Villiers , Eric Dinglasan, Ben J Hayes, Kai P Voss-Fels

G3 Genes|Genomes|Genetics, Volume 12, Issue 10, October 2022, jkac216,

Crosses REAL animals to generate SIMULATED offspring for multiple generations

Inputs: Breeding Program



Inputs: Genomic Data

- Parental genotypes
- SNP effects for:
 - Marbling
 - Feedlot Days
 - 400 Day Weight
 - Feed Intake
 - Mature Cow Weight
- Combined into selection index (\$)

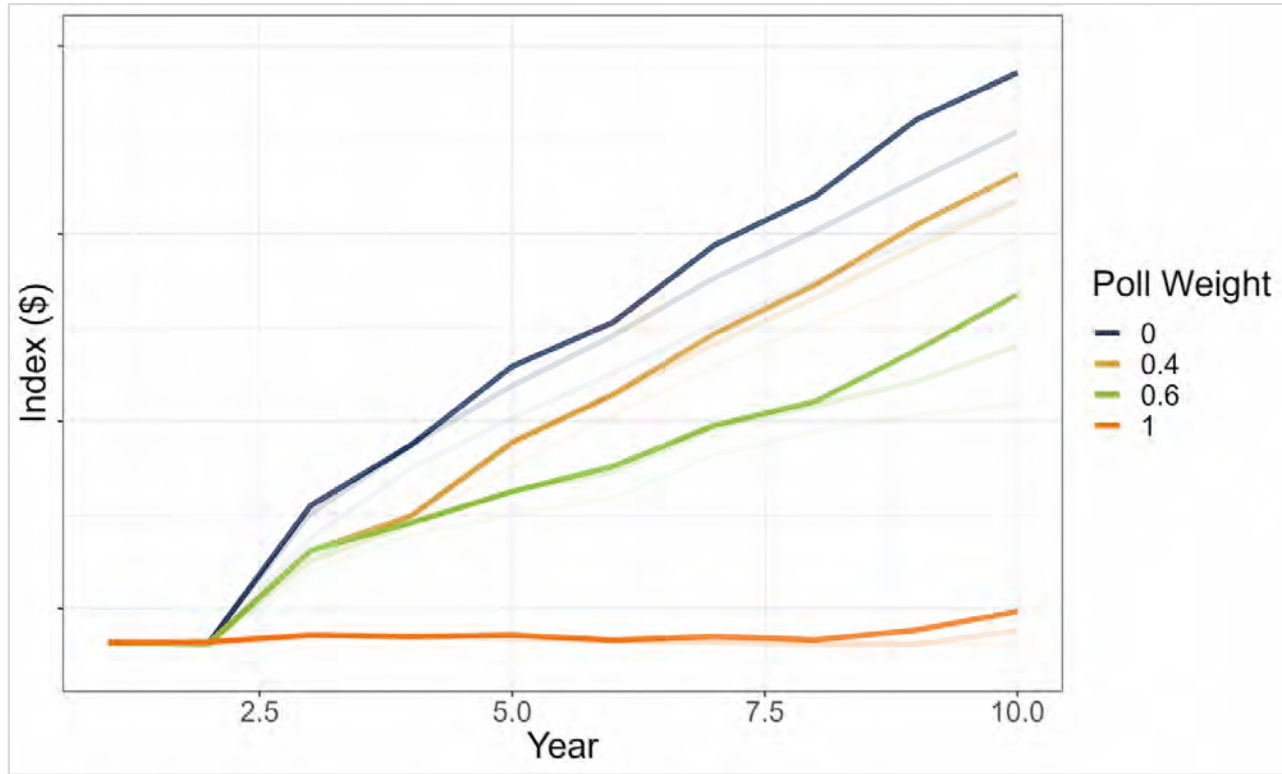


Execution

- Test different 'poll weights'
- Test different breeding programs:
 - Natural Service (NS)
 - Artificial insemination (AI)
 - In vitro fertilization/embryo transfer (IVF)
- **What is the optimal combination of selection pressure and breeding programs to achieve a polled herd?**
 - **While balancing genetic gain & inbreeding**



Genetic Gain (index)



IVF

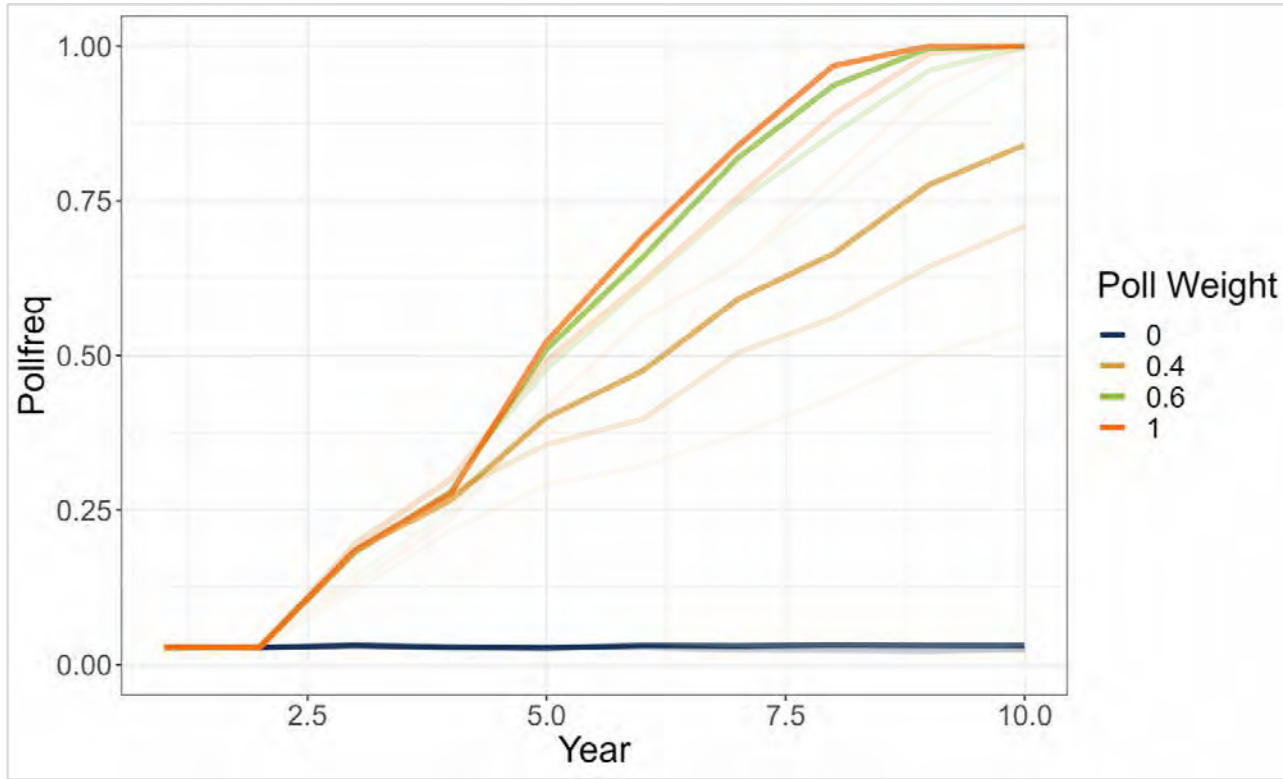


Results

- Selecting only for polled reduces genetic gain for other traits
- Real "opportunity cost" of genetic gain for index
- IVF has the highest genetic gain over 10 years



Genetic Gain (poll)



IVF

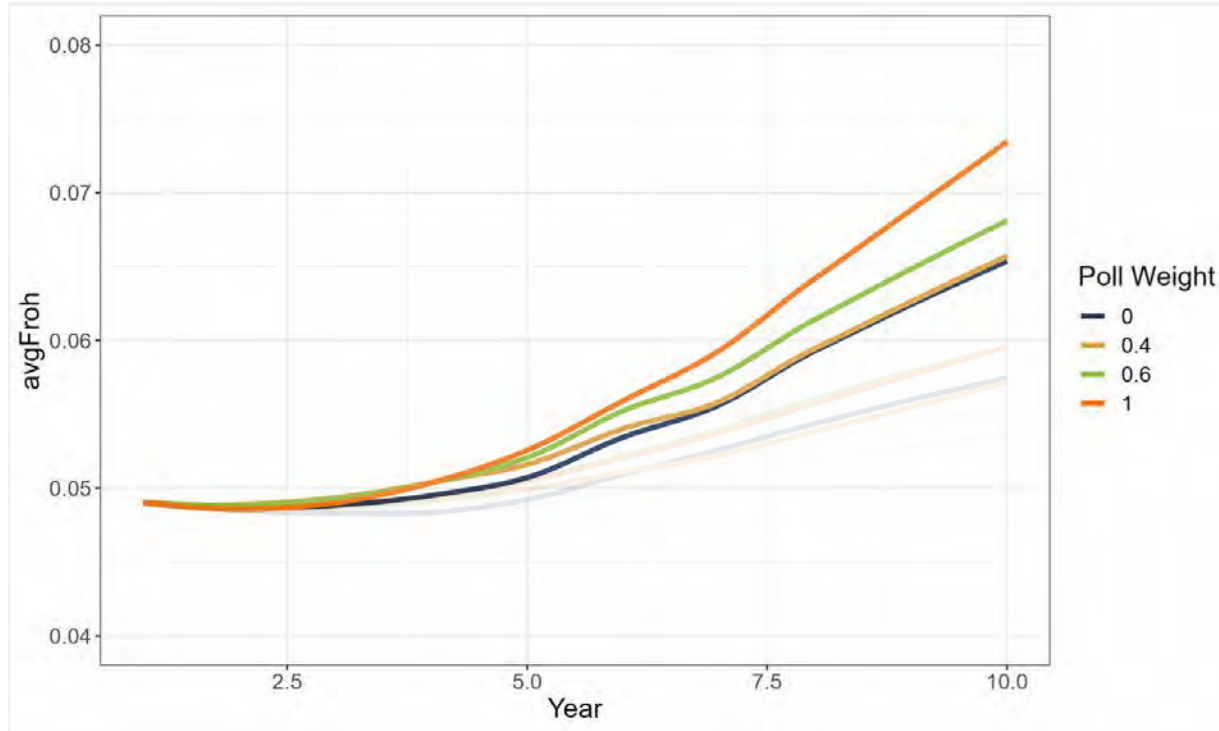


Results

- No point exceeding 60% weighting on polled
- IVF breeding program also the fastest to 100% polled (8 years)



Inbreeding (ROH)



IVF



Results

- Inbreeding rates higher when applying 100% weight to polled
- Higher inbreeding a significant drawback of IVF breeding program



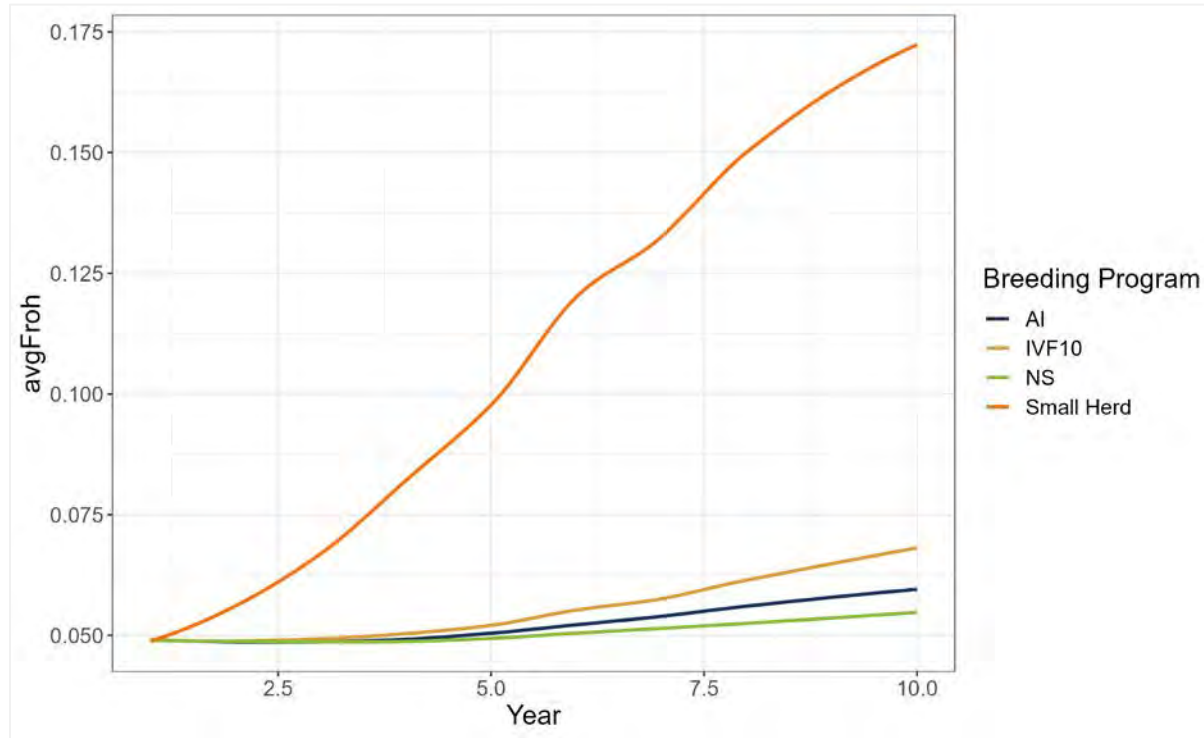
Case Study: Small Herd

- Adaptability of the digital twin
- What happens when you use IVF ONLY?
- What happens in a smaller herd when selecting for polled ONLY?

- Take 0.6 polled weight as baseline



Case Study: Small Herd



Key Takeaways

- Achieving 100% polled wagyu herd feasible
- IVF breeding programs = faster BUT results in higher inbreeding rates
- Selection pressure beyond 60% is reduces genetic gain without increasing rate of poll

Future Direction

- Recessive genetic conditions
- Better management of inbreeding (Mate selection and allocation)
- Expand to commercial herds
- Dashboard version

Acknowledgments

- Future beef
- MLA - MDC
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- Kira Villiers
- Prof. Ben Hayes
- Dr Gerhard Moser





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Title



Title





Title



Disease Management at the Studs

'Bulls delivered to the breeding properties are free of preventable diseases'

- In excess of 12K tests performed across AACo
- Majority of tests were to clear BVDV PIs from the studs
 - YB 2019 – 5% of weaners were PIs
 - Implemented a Pestiguard vaccination program
 - YB 2022 – 1 PI identified
 - 2023: test subsample of weaners for exposure to BVDV



Project Year 2 – Northern Bull Testing

- Tricamper sample required to test for Vibrio and Trich
- Testing approx. 1000 bulls (majority from Northern Properties)
 - Understand Disease Prevalence
 - Attempt eradication
- Bulls require an annual Vibrovax Booster



UQ vets testing bulls for Trichomoniasis and Vibriosis at Wylarah

Disease Management Project Objectives

Aim: Increase weaning rates across all of AACo by 5%

Actions across AACo:

- Understand the prevalence of Vibriosis, Trichomoniasis, Pestivirus and Leptospirosis
- Data collection to inform management practices
 - Vaccination programs
 - Breeder herd age profiles
 - Understand & manage the risks of cattle movements



Venereal Diseases – Vibriosis and Trichomoniasis

- Bulls are the typical carriers
 - Bulls older than 5 years of age become long-term carriers of infection
- Infections can result in delayed conceptions, abortions or infertility
- Typical Vibrio management strategy: vaccinate heifers and bulls
- No Trich Vaccine currently available in Australia
- CashCow findings
 - 50% of mobs had evidence of Vibrio infection, with 10% recording widespread infection
 - 68% of producers vaccinated annually
- Trich research
 - NT & NQ recorded an average prevalence of 15.4% and 13.8%



Pestivirus and Leptospirosis

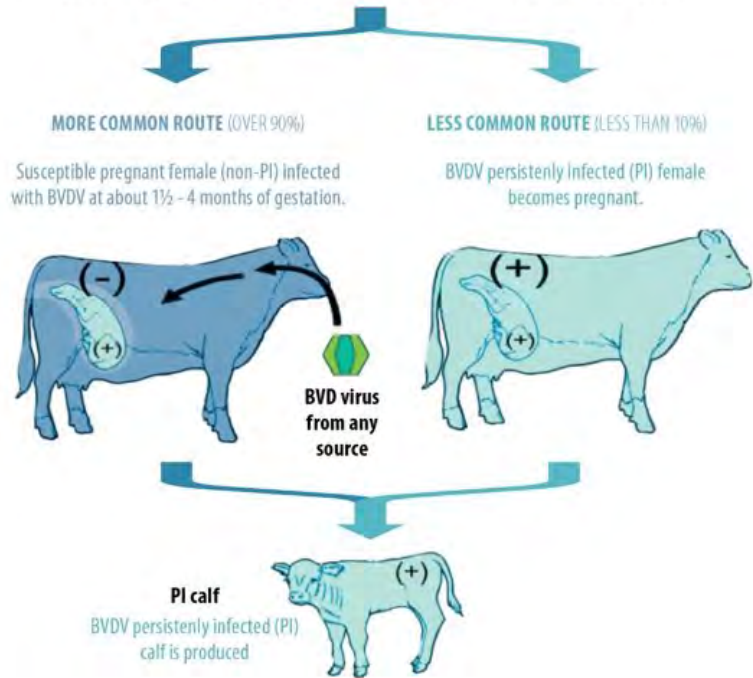
Pestivirus:

- Spread by direct contact
- CashCow Findings: ~10 – 30% of breeder mobs had evidence of widespread recent infection
- Two main testing approaches
 - Seroprevalence
 - Identifying Persistently Infected animals 'PIs'

Leptospirosis:

- Spread by urine from infected animals
- About 10% of mobs had evidence of recent infection
- Zoonotic disease

2 WAYS PI CALVES ARE PRODUCED



Animal Welfare at AACo

AACo is committed to developing a lifetime wellbeing production system



- Animal Health & Welfare committee:
 - Pursue continuous improvements in animal care
 - Operations excellence, sustainability brand & innovation
- Biosecurity training days for operational staff
 - Disease identification & management procedures
- Reducing the impact of & where possible eliminating the need for surgical procedures
 - Utilise pain relief
 - Breeding for poll