



THE UNIVERSITY  
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191845

*Mayura*

WAGYU BEEF



# Non- Additive Genetic Effects in Wagyu

## Busting the Breeder Myth of “Nicking”

**Rudi McEwin**

Supervisors: Prof. Wayne Pitchford & Dr. Michelle Hebart

# Phenotype = Genotype x Environment

Genotype is made up of Additive & Non-additive Genetic components



- 1) Animals can only be as good as the genes they inherit
- 2) If you mate superior animals to superior animals then their progeny will be superior
- 3) BREEDERS BELIEVE that if you mate certain combinations of specific superior animals that their progeny will be even more superior and have even better performance
- 4) This extra performance is called **Nicking**





Line 1



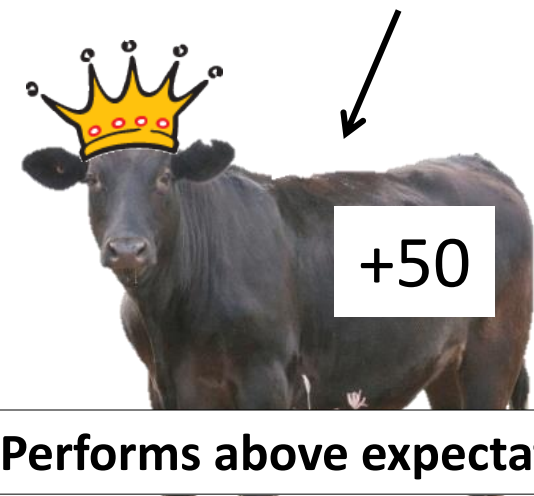
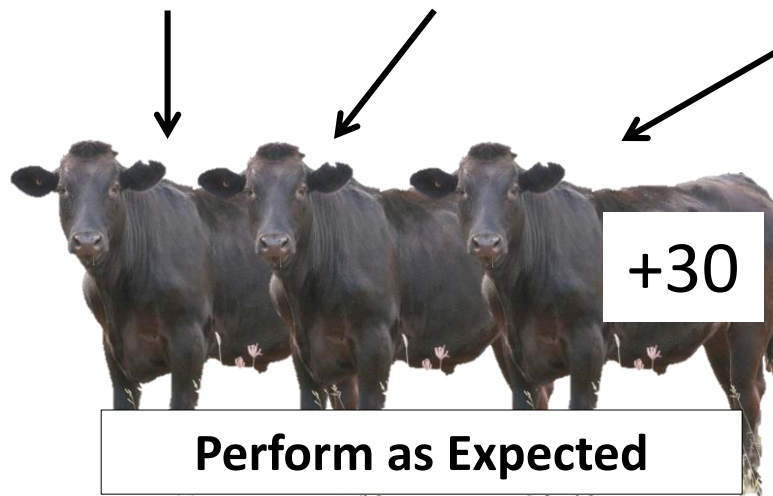
Line 2



Line 3



Line 4



# Project Aims & Hypothesis

## Aims

- Determine the magnitude of Non-additive genetics in mate selection strategies
- Prove or disprove the theory of “nicking”,
- Recommendation to producers

**Carcass Traits of Interest:** Marbling, Hot Standard Carcass Weight, Eye muscle Area and P8 site fat depth (AUS-Meat grading)

## Hypothesis

Non-additive genetic effects will be present through the mating of specific combinations of sire and dam lines, however its effect on carcass traits will be minor.

# Data Summary

Trait	Count	Mean	Min	Max	SD	CV (%)
<b>HSCW</b> (kg)	1357	412	213	550	38.5	9
<b>MS</b> (0 -12)	1357	8.0	2	12	2.0	23
<b>EMA</b> (cm <sup>2</sup> )	1345	95.1	64	132	10.0	10
<b>P8</b> (mm)	1357	15.7	2	50	6.0	37

- large carcass weights and a high marbling capability
- MS and P8 are the most highly variable;
- n=1357, where all progeny are from sires with  $\geq 10$  progeny each

# Model Summary

## Fixed Effects

- **Hot Standard Carcass Weight;** allows analysis of traits at a standardised carcass weight (except where hscw was the variate)
- **Kill-date;** “management Group” accounting for calving/weaning group, year and season effects. Correlation of 0.95 between birth-date and kill-date
- **Age of Dam;** Age groups of 2,3,4,5,6,7,8,9 and 10+
- **Sex;** Steers and Heifers
- **All two way interactions between hscw, kill-date, aod and sex;** significant at  $P < 0.05$



# Model Summary

## Random Effects

**1) Additive Genetic;** (animal model) Fitted as a relationship matrix based on pedigree

+

**2) Non-additive Genetic (SxMGS);** investigates Nicking interaction between sire line and dam line (as defined by the dams sire)

**3) Inbreeding;** ranged from 0 to 29% (mean = 5%), is a test of importance of dominance genetic effects which contributes to Nicking;

# So is it myth busted?...

Trait	Nicking	Inbreeding	Heritability
HSCW	0.5 %	0.0 %	37 %
P8	0.0 %	0.0 %	26 %
MS	0.0 %	0.0 %	42 %
EMA	0.6 %	0.0 %	33 %

\*heritability SE range 0.09-0.12

- Non-additive genetic effects account for a minor proportion of the phenotypic variance in single trait analysis.
- Not statistically significant ( $P > 0.05$ ; log likelihood ratio test used with a chi-squared test)





# Is Nicking important in Multi-Trait Selection?

- Index selection allows for selection of multiple desired traits at the same time.
- A selection index is an equation that includes multiple traits, each of which is weighted based on importance, to achieve a desired phenotypic outcome.
- Indexes present genetic gain (increase in performance) as \$/animal

$$\text{VALUE (\$)} = \text{HSCW} \times (4 + \text{MS})$$

Where a carcass with MS= 0 receives \$4/kg CW and every single increase in marble score (1-12) results in an additional \$1/kg CW



# So is it myth busted?...

Trait	Nicking	Inbreeding	Heritability
HSCW	0.52 %	0.0 %	37 %
P8	0.0 %	0.0 %	26 %
MS	0.0 %	0.0 %	42 %
EMA	0.6 %	0.0 %	33 %

<b>VALUE</b>	0%	0%	42 %
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\*heritability SE range 0.09-0.12

\*no statistical significance



# Genetic and Phenotypic correlations

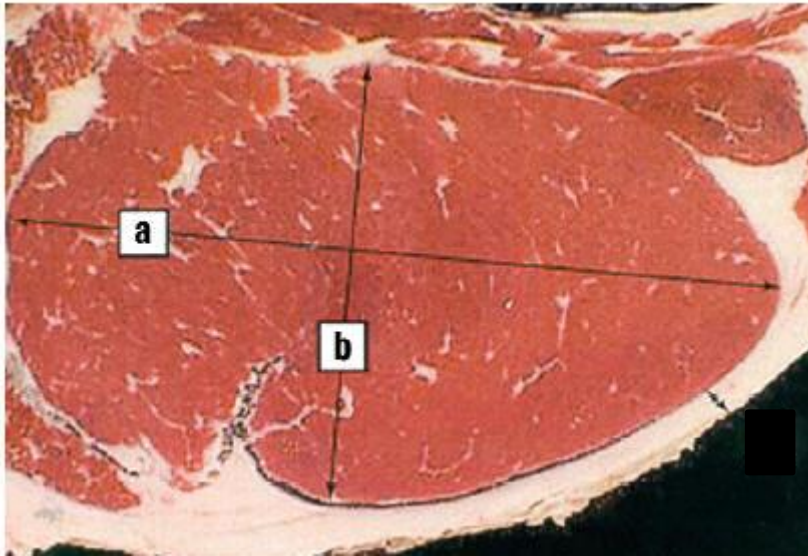
	HSCW	MS	EMA	P8
HSCW		0.07	0.09	-0.07
MS	0.05		0.25	-0.01
EMA	0.38	0.24		-0.19
P8	-0.25	-0.05	-0.79	

\*Standard errors range 0.03 to 0.05 (phenotypic correlation)

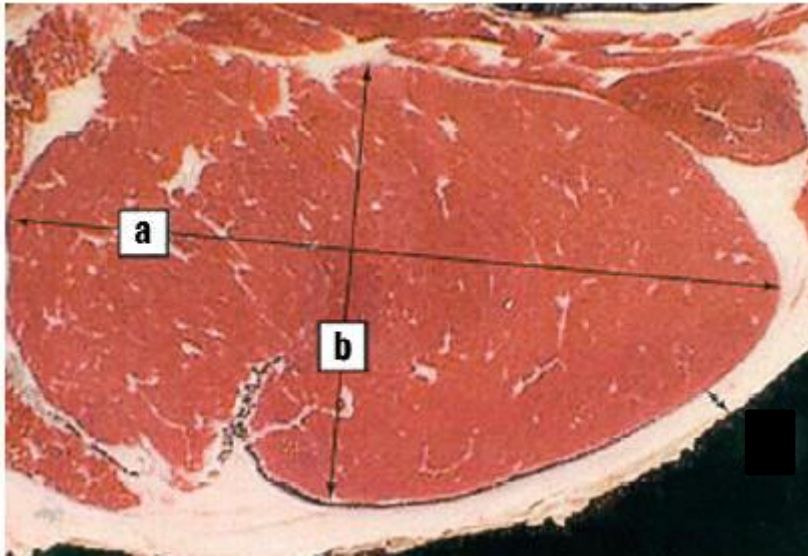
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# Explaining the relationship between eye muscle area and marbling

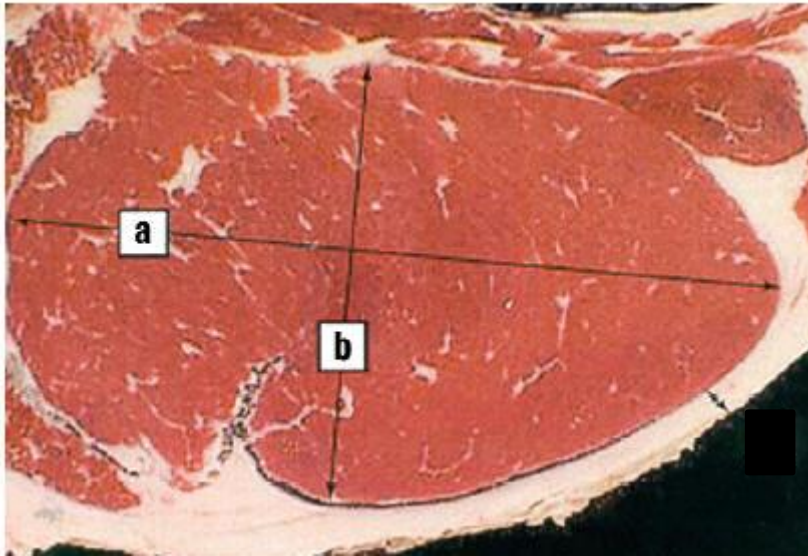


# Explaining the relationship between eye muscle area and marbling





# Explaining the relationship between eye muscle area and marbling



Aus-Meat Marble Score	1	2	3	4	5	6	7	8	9	10	11	12
IMF %	1	3	5	8	11	14	17	19	21	24	27	30

$$\text{Lean Muscle Area (LMA)} = \frac{100 - \text{IMF}\%}{100} \times \text{EMA}$$



# Genetic/Phenotypic correlations with the new trait

	HSCW	MS	EMA	P8	LMA
HSCW		0.07	0.09	-0.07	0.0006
MS	0.05		0.25	-0.01	<b>-0.37</b>
EMA	0.38	0.24		-0.19	<b>0.79</b>
P8	-0.25	-0.05	-0.79		-0.20
LMA	0.27	<b>-0.37</b>	<b>0.77</b>	-0.81	

\*Standard errors range 0.03 to 0.05 (phenotypic correlation)

\*Standard errors range 0.09 to 0.25 (genetic correlation)

# Lean Muscle Area & Nicking?

Trait	Nicking	Inbreeding	Heritability
HSCW	0.52 %	0.0 %	37 %
P8	0.0 %	0.0 %	26 %
MS	0.0 %	0.0 %	42 %
EMA	0.6 %	0.0 %	33 %
VALUE	0.0 %	0.0 %	42 %

<b>LMA</b>	2.3%	0.0%	33 %
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\*heritability SE range 0.09-0.12

\*no statistical significance



# Producer Recommendation

- Non-additive genetic effects (Nicking) had negligible impact on phenotype.
- BREEDPLAN Works!! →
- **Producers are most likely seeing variation in accuracy around the additive genetic value and interpreting it as “Nicking”**
- Additive genetics far more important (Hill, Goddard & Visscher 2008)
- Mating strategies should minimise inbreeding



## Future Work

- Re-run including more animals (marbling fineness)
- Include genomics work to define genetic structure above that by defined by the pedigree.





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