Comparison of genomic prediction methods for longitudinal female fertility in Brahman cattle

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Introduction

Longevity = the ultimate cow fertility phenotype

Comprised of:

- yearly pregnancy
- yearly anoestrus and rebreeding
- yearly maintenance

Complicated phenotype → Different biological drivers at each point in life → heifer *vs* young cow *vs* mature cow *vs* old cow

Added challenge: *Australia*

└> extensive production environment, challenging climate

Objective: Explore new methods for genomic prediction of cow longevity and longitudinal fertility

Methods

Commercial, Australian Brahman cows

- Bred to first calve at ~3yrs old
- Remain in herd until first pregnancy failure
- Extremely high selection pressure for fertility

Phenotypes

1) Lifetime number of calves
2) Stayability to 4 yrs – 2 calves by 4 yrs old (binary)
3) Stayability to 5 yrs – 3 calves by 5 yrs old (binary)

ssBLUP using blupf90 software

3759 genotyped cows
35670 pedigreed animals

Cow contemporary groups fit as fixed effects

Year of birth (1981-2015)
Month of birth (Sept-Feb)

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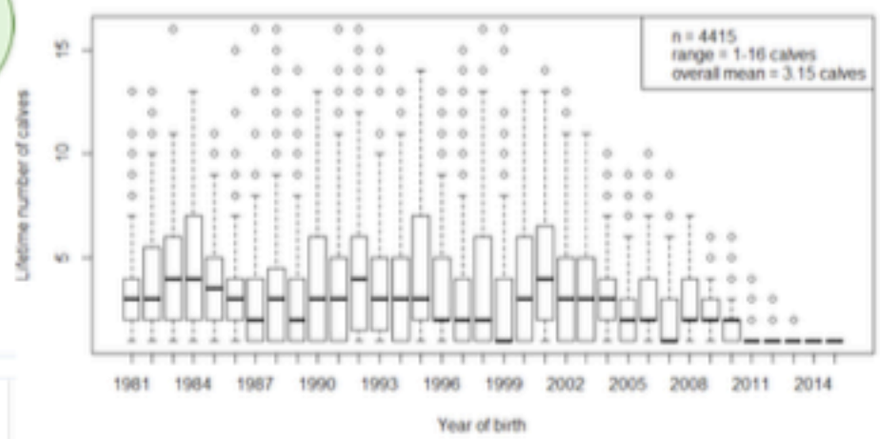
Figure 1: Number of cows to successfully reach each fertility milestone

Figure 2: Distribution of lifetime number of calves



Phenotype	h^2	n = ref / val popn	Pred. accuracy	5-fold x-validation acc.
Lifetime number of calves	0.11	3984 / 431	0.60	0.22 (SE 0.06)
Stayability to 4yrs	0.13	8995 / 399	0.13	---
Stayability to 5yrs	0.15	8571 / 399	0.12	---

- Validation populations represent the most recent year cohorts
- For 5-fold cross validation, 20% of dataset was randomly allocated to validation group in turn (n = 883)
- $accuracy = \frac{r(phen,EBV)}{\sqrt{h2}}$

Conclusions

- Lowly heritable traits
  - Those measured earlier in life were marginally more heritable
- A measure combining effect of heifer pregnancy and subsequent rebreeding decreased prediction accuracy (ie: stayability vs lifetime number of calves)
  - Stayability = likely combining two distinct traits into one measure
- High prediction accuracy for lifetime number of calves is likely biased, as recent cohorts are either still in production or have a low lifetime number of calves (Fig. 2)

Selection for longevity shows potential, but limitations exist

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