

Genetic Improvement of Heifer Pregnancy and Performance in Beef Cattle



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National Cattle Evaluation

- ▶ International beef genetic evaluation is breed-specific
 - EPD are not generally comparable across breeds
 - For any breed, NCE systems contain both common and novel traits
- ▶ Methods for EPD prediction are mature
 - Basic systems have been in place for more than 2 decades
 - We have validated the correspondence between expected and realized PD
 - Genetic trend shows pervasive industry adoption
 - *System development now follows the framework of economic relevance*
- ▶ To some extent, EPD are a genetic *black box* evaluation tool
 - Summation of all small, additive genetic effects
 - Individual genes are not identified

The screenshot displays a complex data table titled "National Beef Cattle Evaluation" with a sub-header "Red Angus". The table lists various traits such as Birth Weight (BW), Weaning Weight (WW), Yearling Weight (YW), and Carcass Weight (CW) across different years (2010-2020). Each row represents a specific trait and year, with columns for different breeds and their corresponding EBV values. The table is organized into sections for different breeds, including Red Angus, Hereford, and Simmental.

Genetic Evaluation of Fertility

ERT System	Reference	Methodology	Clients
Maternal Productivity	<i>Mwansa et al. (2002)</i>	MT – SI ^a	
Stayability	<i>Snelling et al. (1995)</i>	Threshold BLUP	
Cow Maintenance	<i>Evans et al. (2002)</i>	MT – SI	
Heifer Pregnancy	<i>Evans et al. (1999)</i> <i>Doyle et al. (2000)</i> <i>Eler et al. (2002)</i>	Threshold BLUP	

^a Multiple trait selection index (MT-SI)

“Genetic evaluation of fertility has largely been relegated to indicator traits such as scrotal circumference”

Crews and Enns (2008) • J. Professional Animal Scientist

The ERT Framework for Fertility EPD

“The aim... is to provide a principle and framework to guide the process of identifying traits for which EPD should be produced in the next generation of national cattle evaluations.”



B. L. Golden, et al. (2000)

32nd Beef Improvement Federation Annual Meetings

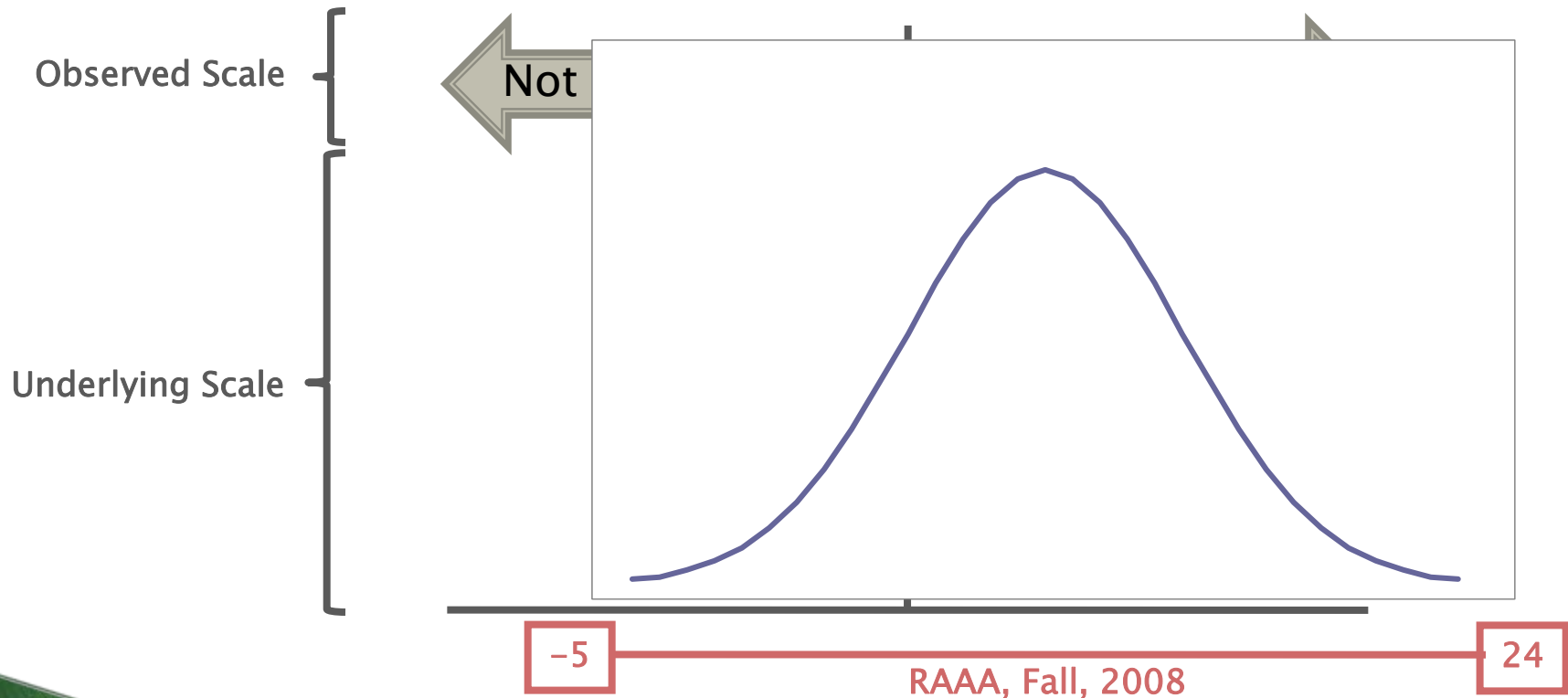
Proposed ERT and their indicators

Economically Relevant Trait	Indicators
Heifer Pregnancy Rate	Pregnancy Observations Yearling Scrotal Circumference

Adapted from Golden et al. (2000) Table 1.

Heifer Pregnancy EPD

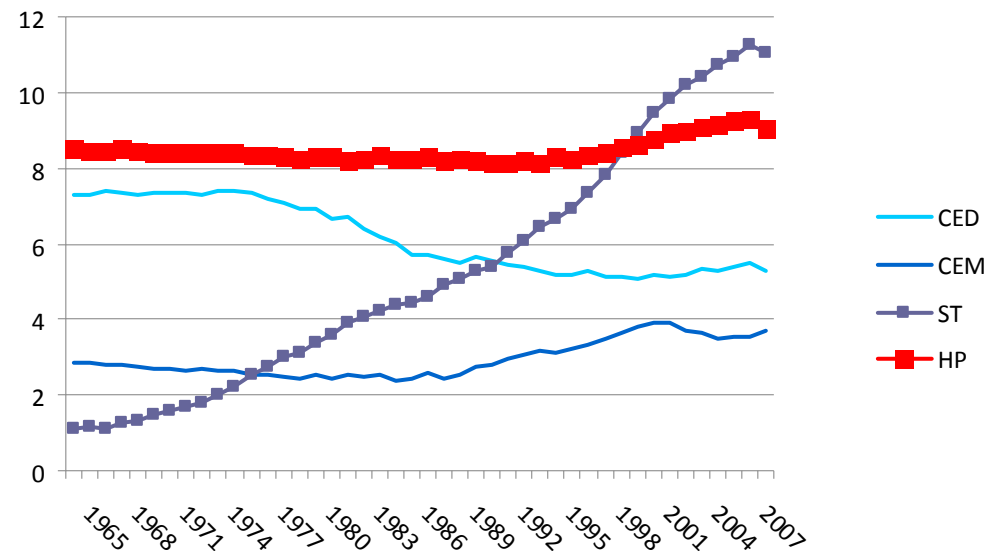
Heifer pregnancy = Probability that a heifer is pregnant at palpation (+120 d) following her yearling breeding season



RAAA Heifer Pregnancy NCE

Parameter	Estimate
h^2 (underlying scale)	0.24
var(G)	0.31
n (ACC > 0.50)	262
n (ACC > 0.60)	141
n (ACC > 0.70)	83

Genetic trends (1965–2008) for reproductive traits in Red Angus



Obtained and used with permission.

Building Better Beef...

Red Angus

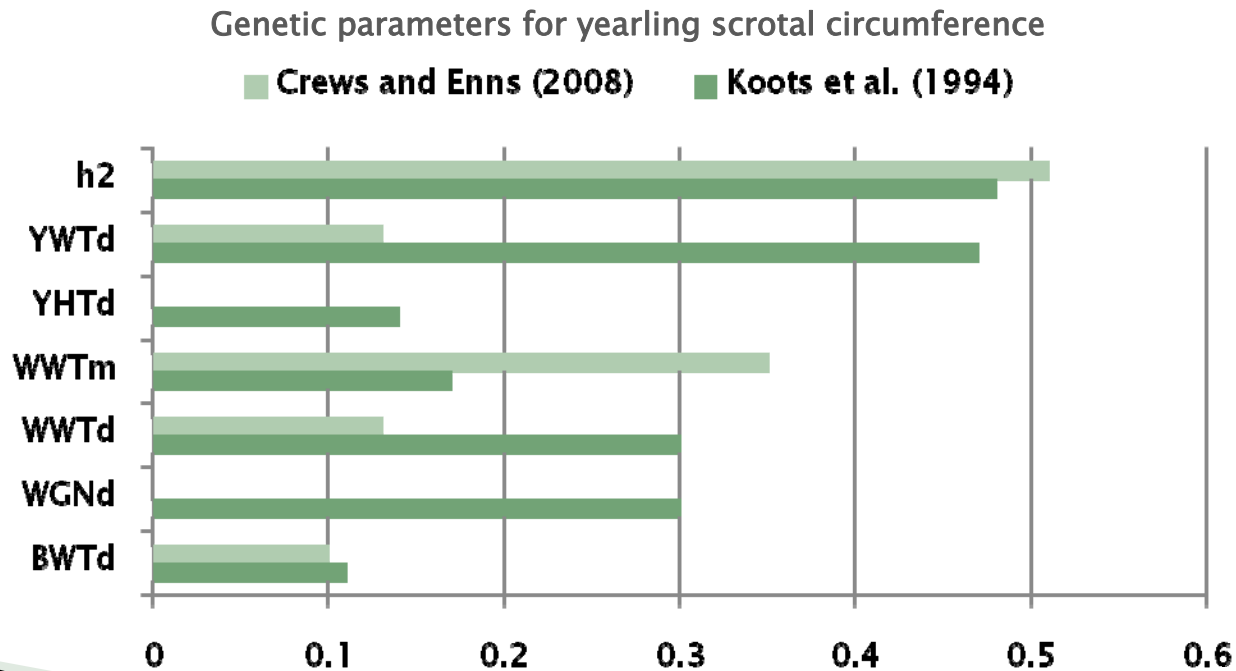
www.redangus.org

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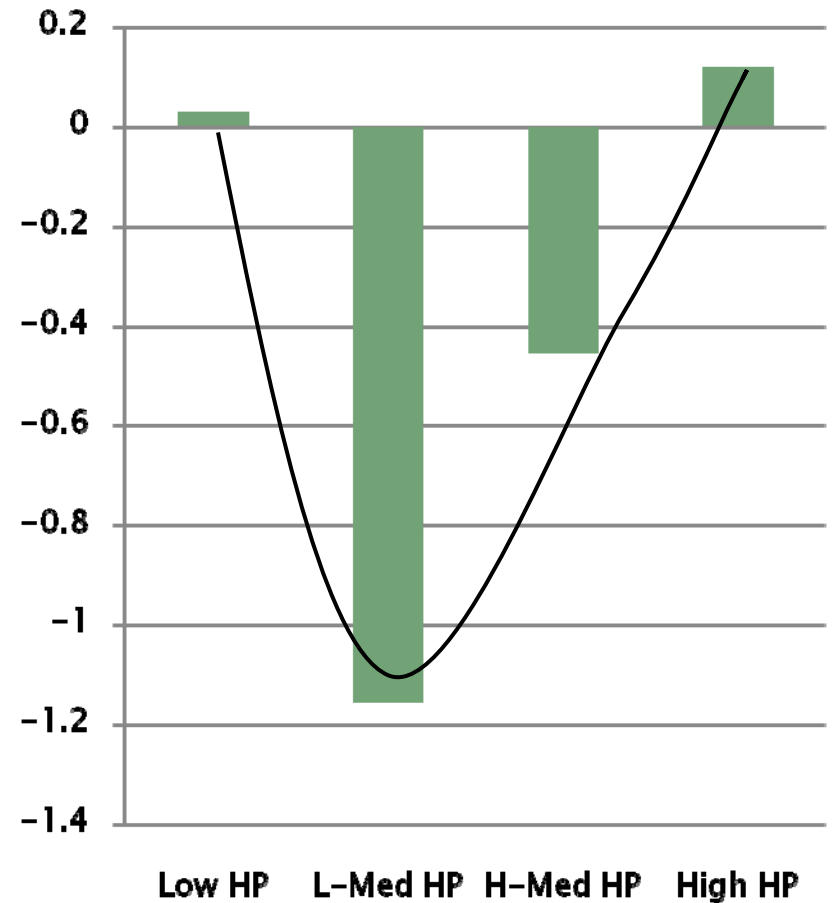
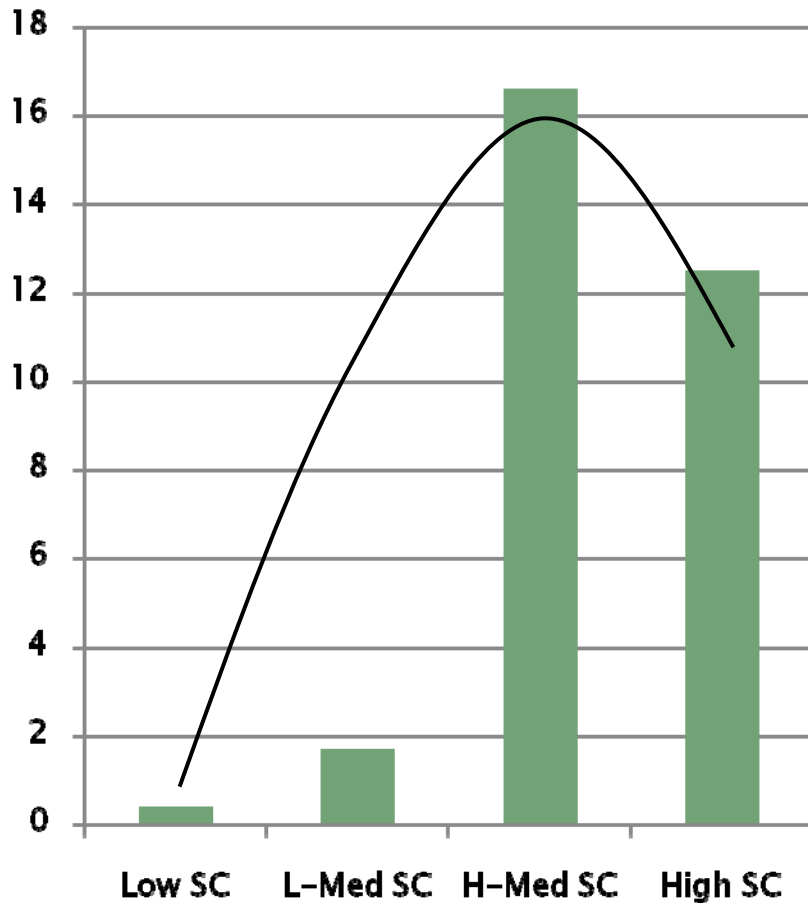
Yearling Scrotal Circumference

- ▶ Yearling scrotal circumference is a well known, intensively studied phenotype
 - Favorably related to bull fertility and semen attributes
 - Favorably related to age at puberty in female relatives (Brinks et al., 1978)
 - Easily measured indicator trait in beef cattle (BIF, 2002)



Heifer Pregnancy and Scrotal Circumference

Evidence of a “genetic disconnect”: Evans *et al.* (1999), $R_g \sim 0.002$



Non-linear genetic correlation?

A Novel Approach to Scrotal Expression

Hypothesis:

$$\text{YSC} = f(\text{growth}) + f(\text{fertility})$$

Model:

$$y = X\beta + e$$

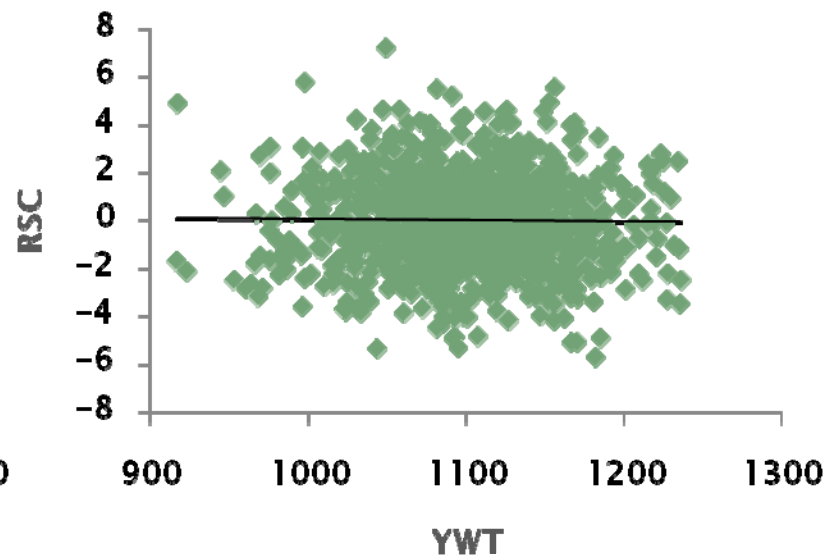
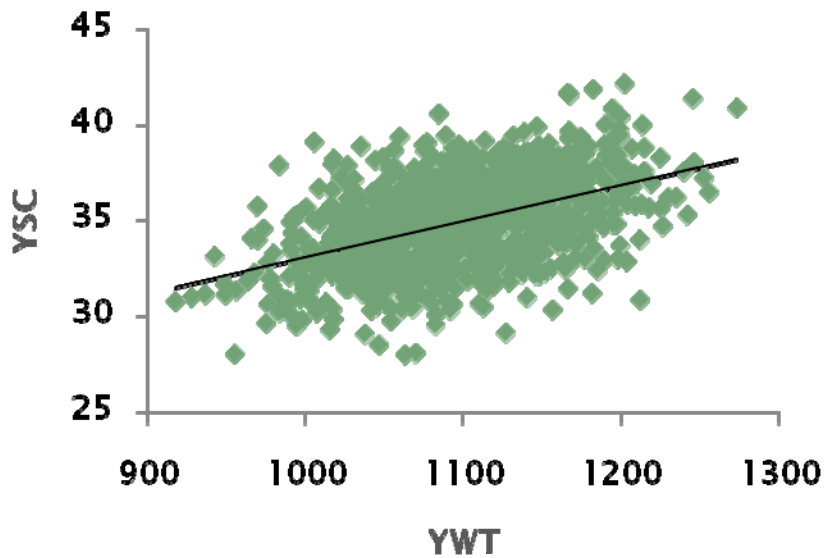
Definition:

e = Residual Scrotal (RSC)

Parameter	YSC	RSC
n	40,865	29,661
Mean, cm	35.0	0.00
Minimum, cm	20.8	-11.5
Maximum, cm	47.2	12.5
Phenotypic variance, cm ²	5.124	3.936
Heritability, h ²	0.51 ± 0.02	0.35 ± 0.02

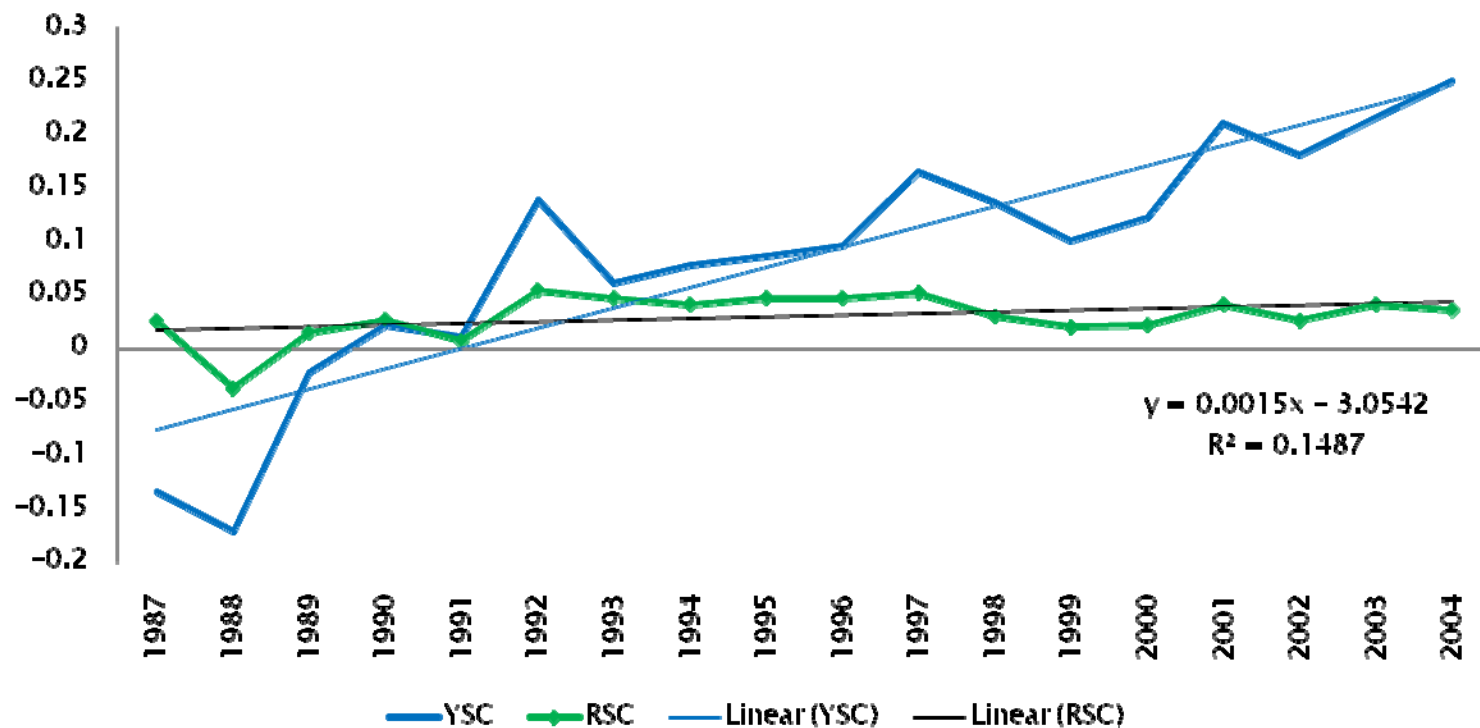
Adapted from Crews and Enns, *JAS In Prep (Data protected: RAAA/CGEL)*

Uncoupling SC and Growth



$$\begin{aligned}R(YWT, YSC) &= 0.45 \\R(YWT, RSC) &= 0.00 \\R_g(YSC, RSC) &= 0.94\end{aligned}$$

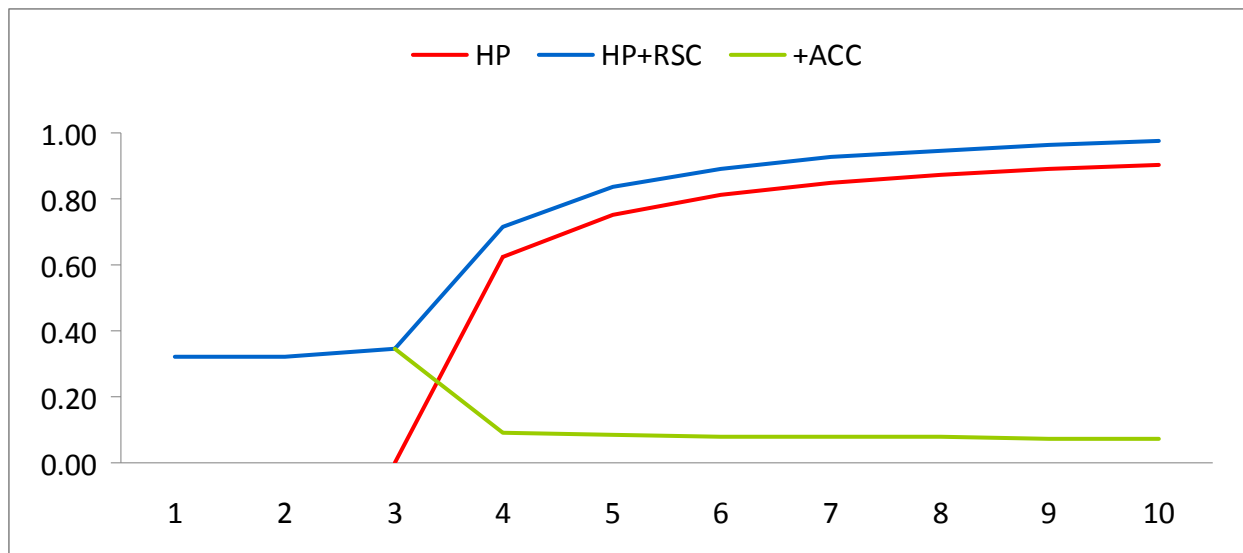
RAAA Genetic Trend: YSC and RSC



Genetic trend (1987–2004) for yearling (YSC) and residual scrotal (RSC)
(Data protected: RAAA/CGEL)

Future Research

- ▶ Methods to increase accuracy of evaluation of fertility ERT
 - RSC as an indicator of heifer pregnancy
 - General improvement in fertility NCE
 - Reduce the disconnect between YSC and heifer pregnancy
 - Identification of other novel fertility indicators



Take Home Messages

- ▶ There is an important distinction between fertility ERT and fertility indicators. When ERT are defined strictly as those traits with direct impact on revenue or cost, *scrotal circumference is not an ERT*, whereas heifer pregnancy, calving ease, stayability and cow maintenance energy are ERT.
 - Selection decisions should be made using EPD for ERT not indicators
- ▶ The value of scrotal circumference in genetic evaluation is to increase the accuracy with which we evaluate fertility. Novel approaches may be used to increase the association of scrotal circumference with fertility
 - With RSC, we might expect increased HP evaluation accuracy

Thanks.



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