Nutritional Management of Replacement Heifers: Impacts on Fertility and Cow Longevity

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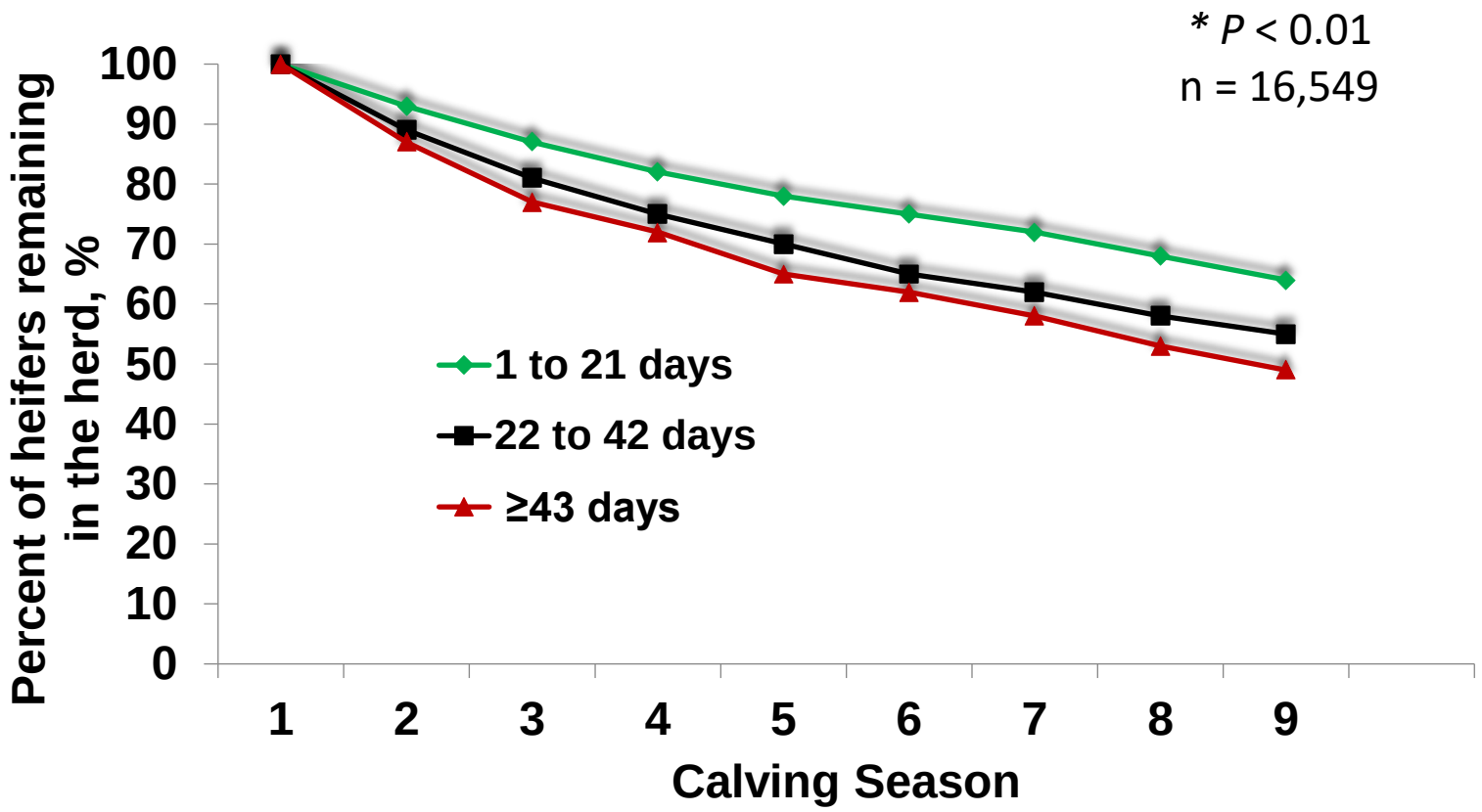
Introduction

- Major economic investment
- Develop or purchase?
- How do we select the right heifers?
- Maintain 365-d calving interval, wean marketable calf each year, adequate longevity (Hohenboken, 1988).
- Break even for heifer development

Pressure for heifers to:

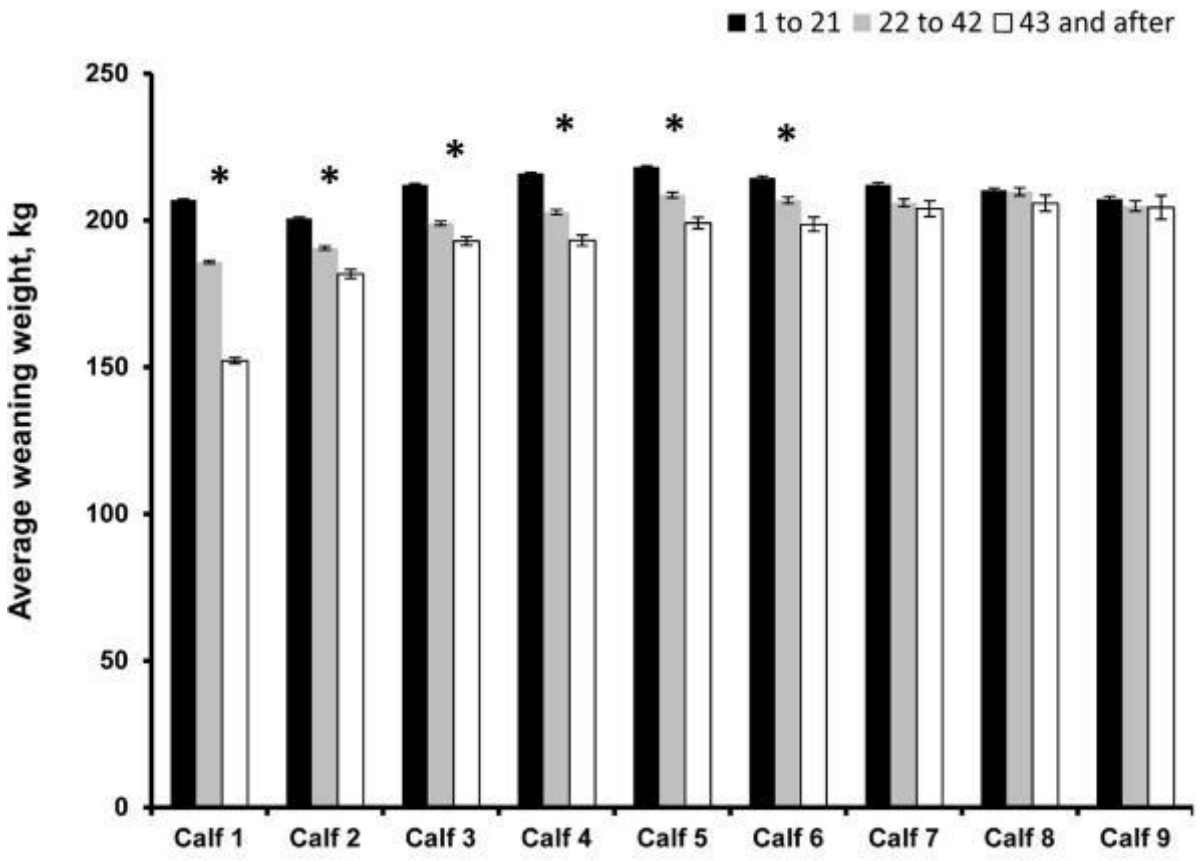
- ✓Attain puberty prior to the breeding season
- ✓Become pregnant to calve by 2 years of age
- ✓Calve without assistance
- ✓Wean a marketable calf
- ✓Rebreed as a first calf heifer and maintain a 365-d calving interval
- ✓**Maximizes heifer lifetime productivity**

Influence of Calving Period on Cow Longevity



Cushman et al., 2013

Influence of Calving Period on Weaning Weights



Cushman et al., 2013

Selection Pressure

- Select heifers that become pregnant **EARLY** in the breeding season
  - Only retain heifers bred in the first 30 days → market late bred heifers
  - Shorten breeding season length to 30 days → market open heifers as feeders
  - Utilize reproductive technologies → estrus synchronization

- **They will wean heavier calves and stay in the herd longer!**

Can management decisions impact puberty attainment?

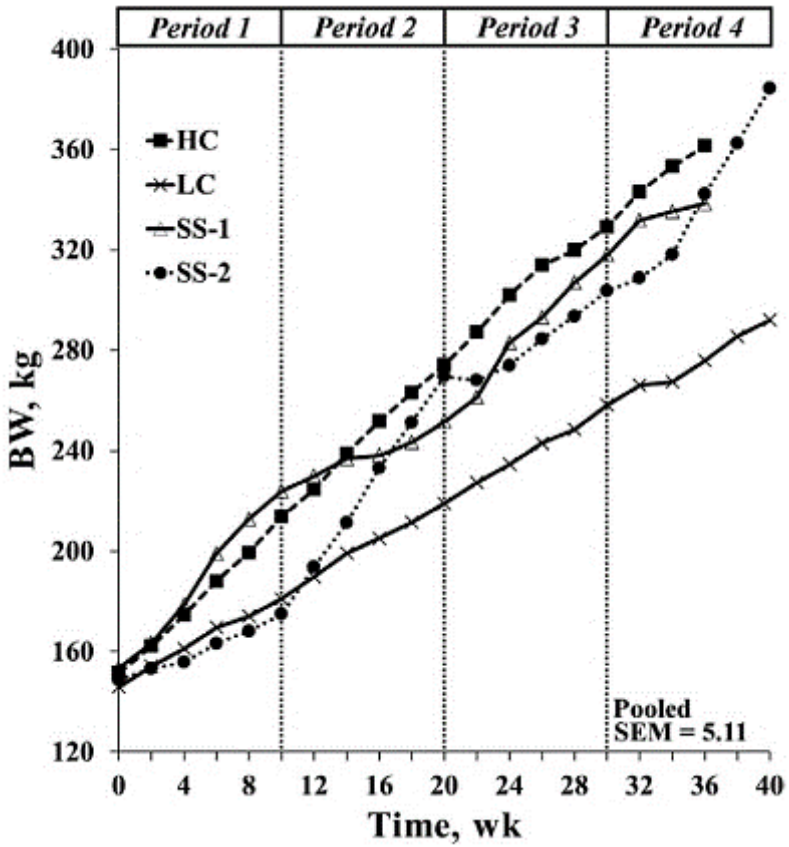
- **Pre-weaning** > Post-weaning
- Important developmental windows early in life (Day and Anderson, 1998).
- Age at puberty directly influenced by nutritional management during the first year of life.

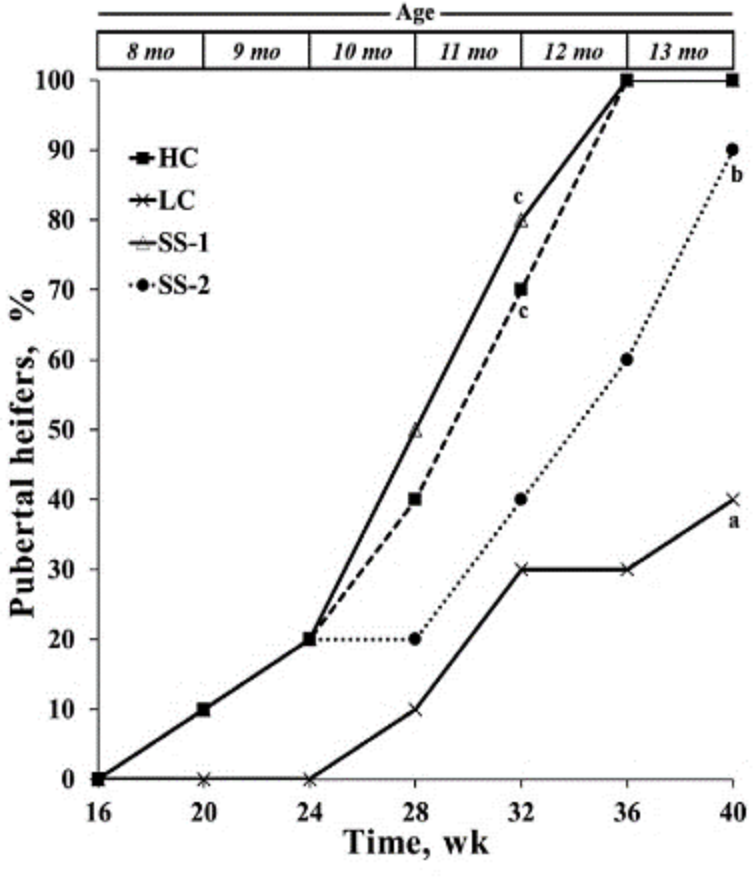
Stair-step Nutritional Regime to Program Onset of Puberty

- Cardoso et al., 2014
  - 40 crossbred heifers (1/2 Angus, 1/4 Hereford, 1/4 Brahman)
  - Weaned at approx. 3.5 mo of age (age at weaning = 109 ± 2 d)
  - **Low control (LC)** = low BW gain of 1.1 lb/d until 14 mo of age
  - **High control (HC)** = high BW gain of 2.2 lb/d until 14 mo of age
  - **Stair-step 1 (SS-1)** = high until 6.5 mo; low until 9 mo; high until 11.5 mo; low until 14 mo
  - **Stair-step 2 (SS-2)** = reverse sequence of SS-1, beginning with low gain

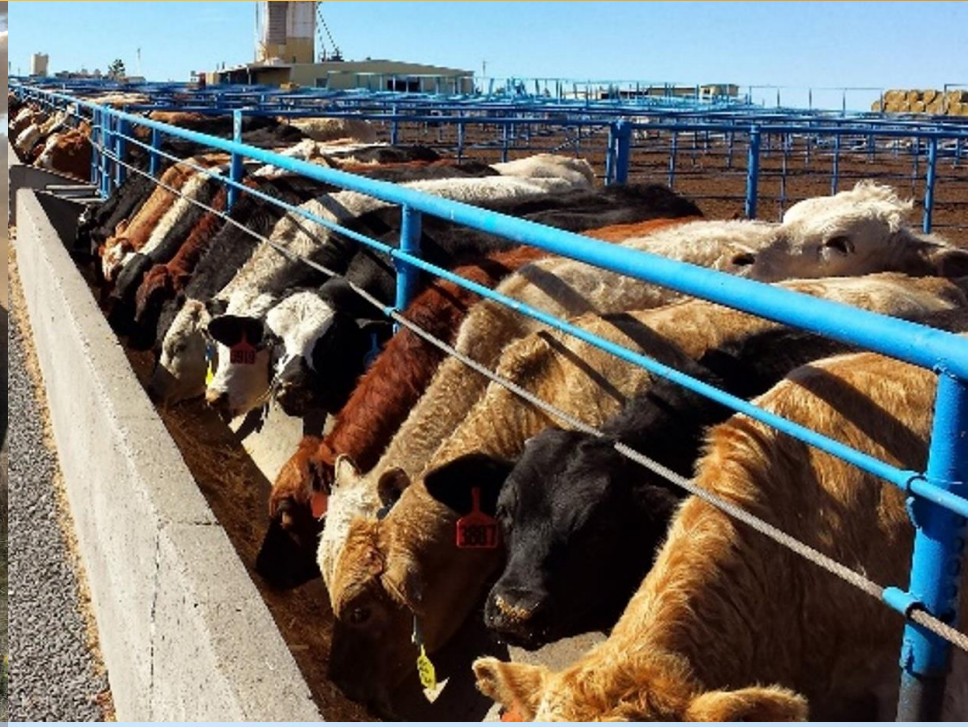
Cardoso et al., 2014

Stair-step Nutritional Regime to Program Onset of Puberty





Cardoso et al., 2014



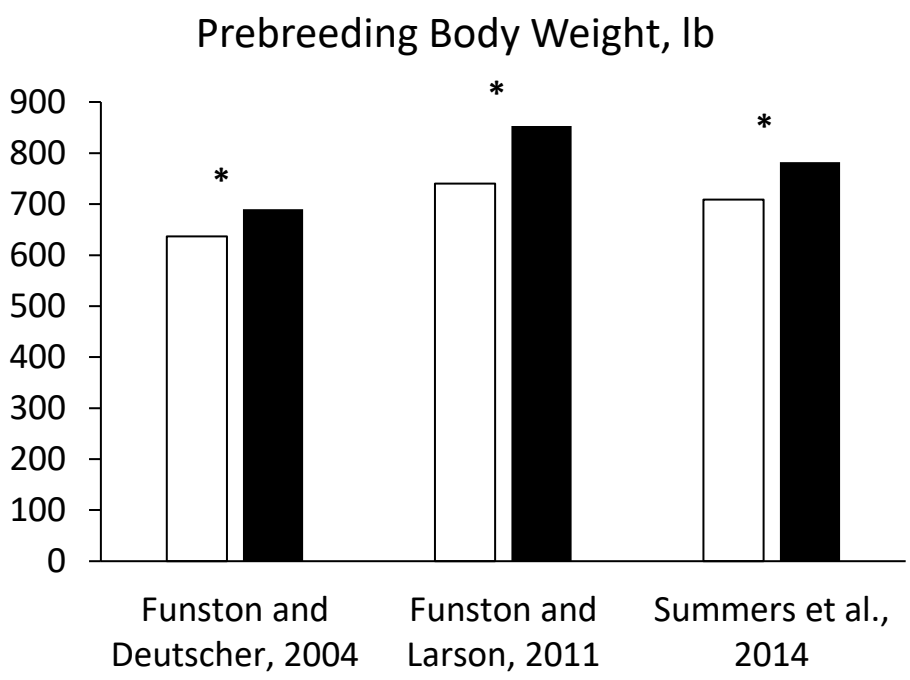
Post-weaning Nutritional Management

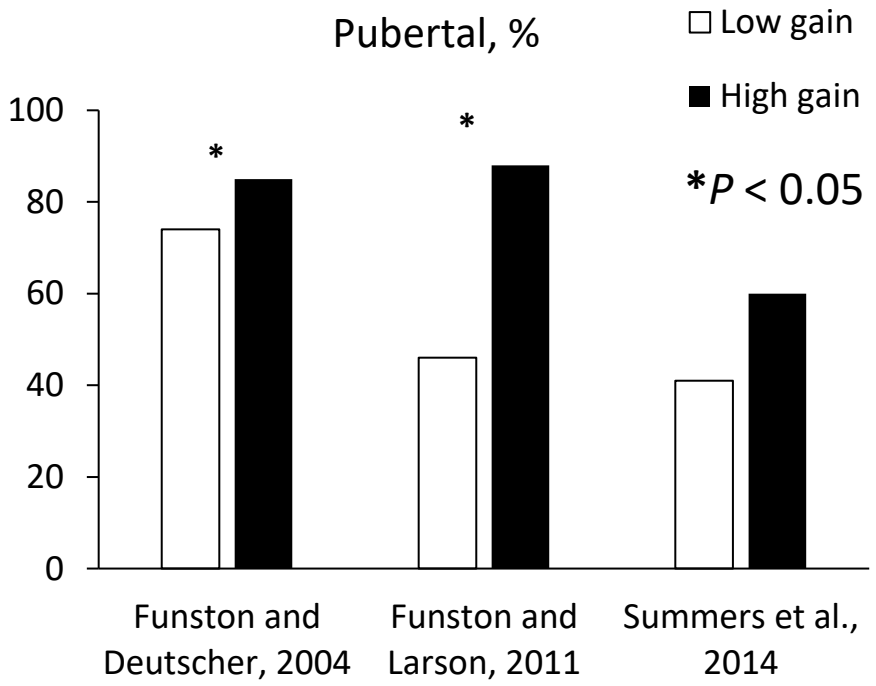
- Guidelines for replacement heifers to reach 60-65% of their mature BW by breeding (reviewed by Patterson et al., 1992)

- Lighter target body weight at breeding reduced development costs while not impairing reproductive performance (Funston and Deutscher, 2004; Larson et al., 2011; Mulliniks et al., 2013; Summers et al., 2014).

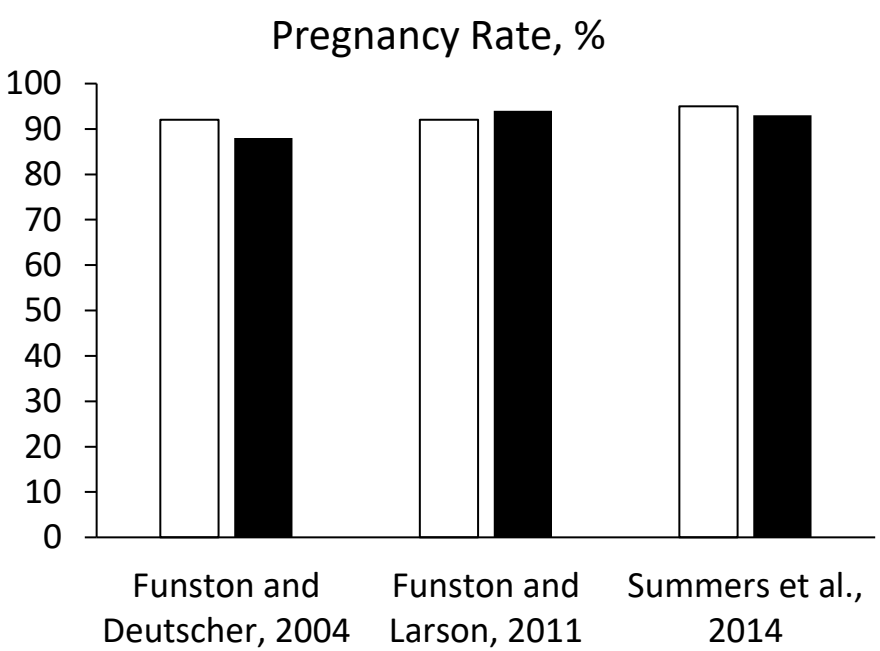
Can we use post-weaning management to select heifers better adapted to their future production environment?

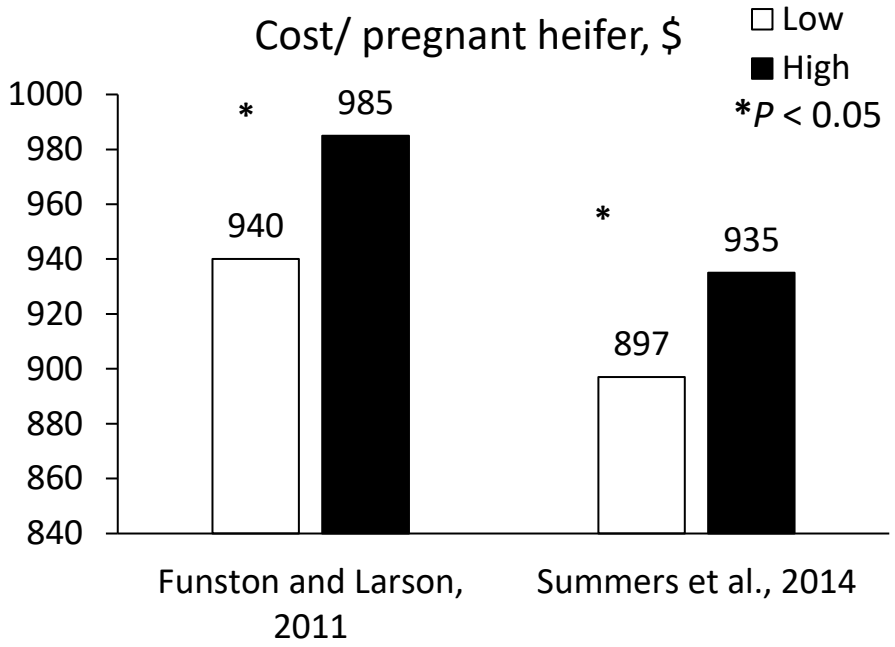
Target Body Weight Approach



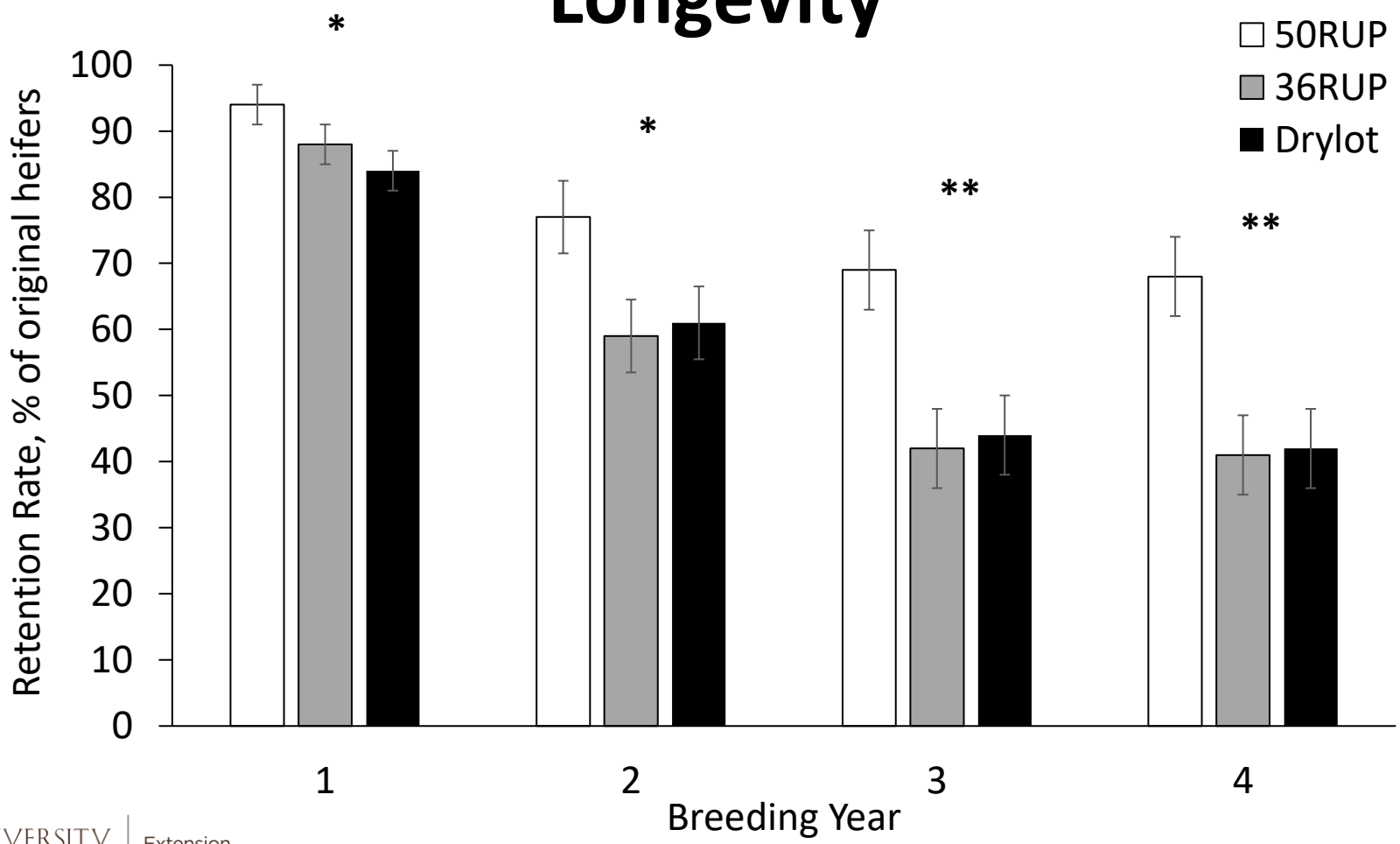


Target Body Weight Approach



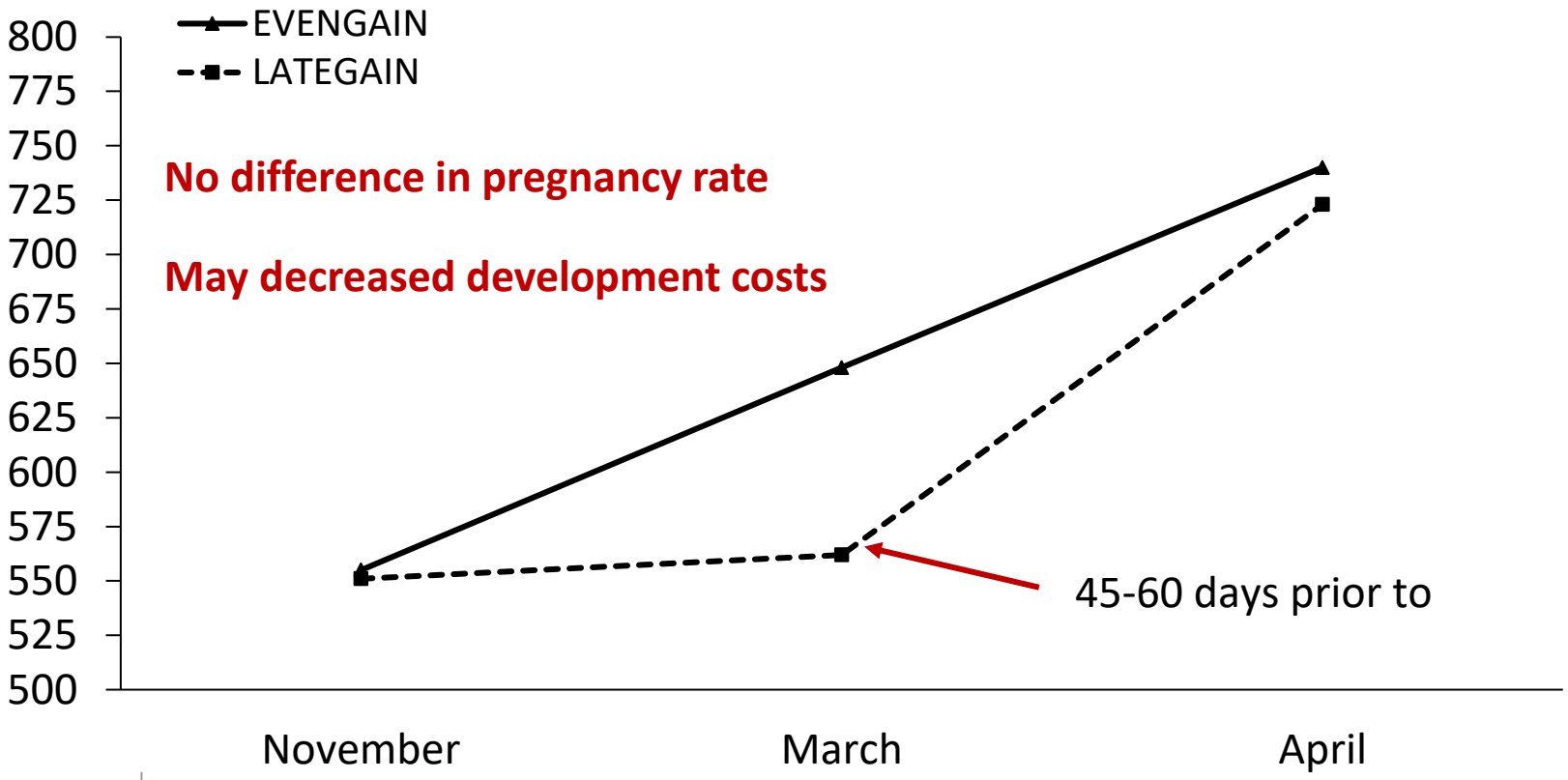


Nutritional Management Influences Longevity



Mulliniks et al., 2013

Influence of Timing of Weight Gain on Heifer Reproductive Performance



Lynch et al., 1997

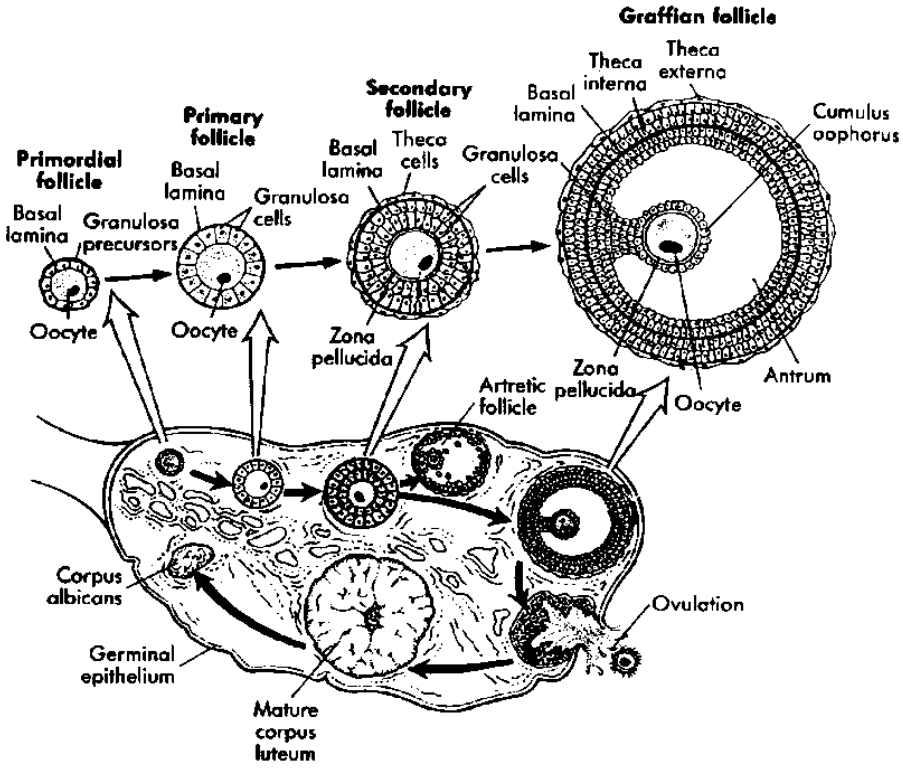
Influence of Timing of Weight Gain on Heifer Reproductive Performance

Treatment	Age at puberty[a]	Heifer pregnancy rate[a]	Mean Calving date[a]	Second-year pregnancy rate[a]	Reference
Even gain vs. Late gain	INCR[b]	NS	—	—	Lynch et al., 1997
Low-High vs. High	—	NS	NS	NS	Freetly et al., 2001
Corn Residue vs. Drylot	NS	NS[c]	NS	—	Summers et al., 2014
Low-High vs. Constant	NS	NS	NS	—	Rosasco et al., 2017

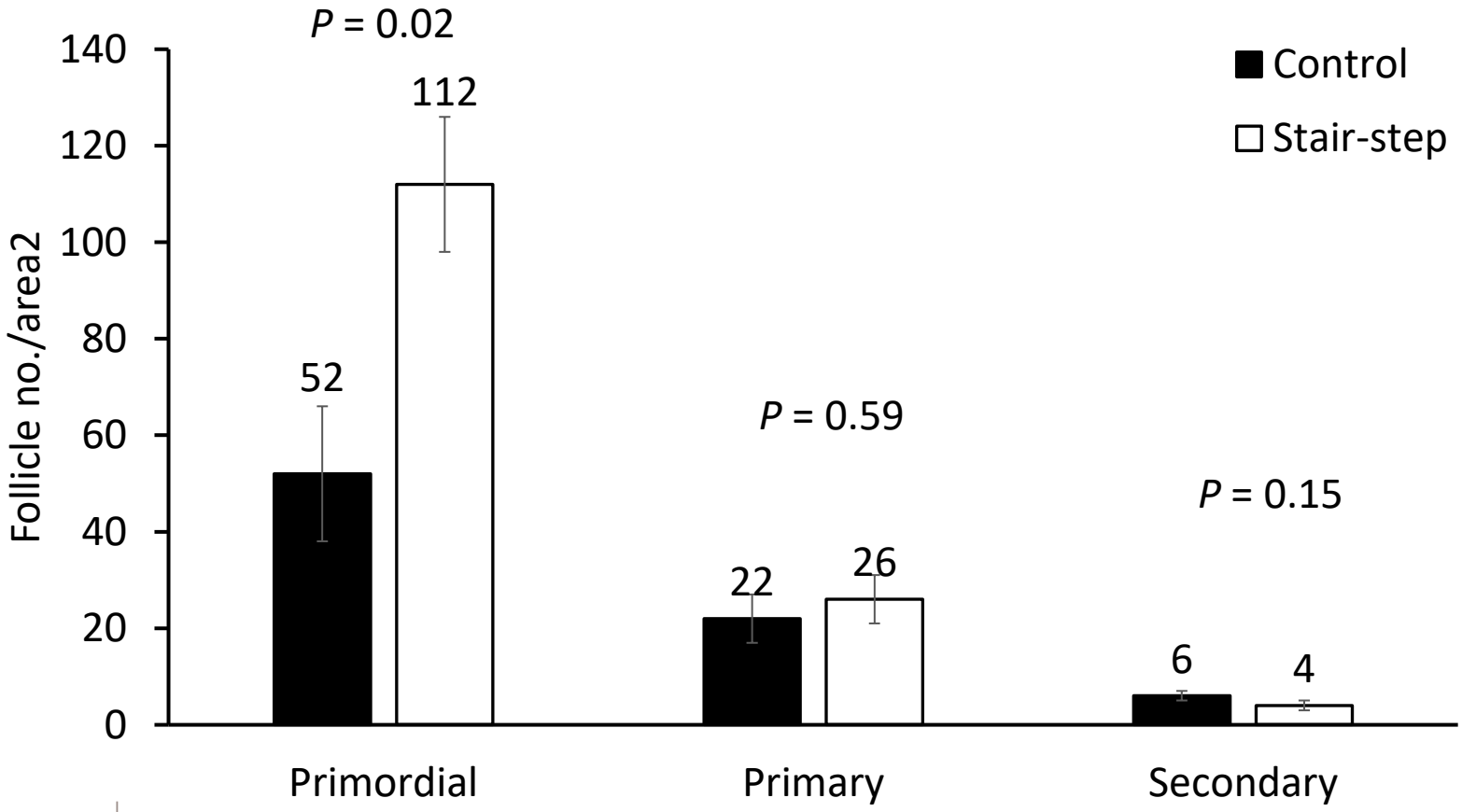
[a]Effect of reduced or late nutrient intake or growth compared with control; INCR = increased compared with control; DECR = decreased compared with control; NS = not significant.
[b]In year 2 only ($P < 0.01$).
[C]AI pregnancy rates were increased in corn residue vs drylot developed heifers.

The Ovarian Reserve

- Primordial follicles formed during gestation represent the ovarian reserve.
- The size of the ovarian reserve corresponds with fertility in cattle (Cushman et al., 2009; Mossa et al., 2012).



Stair-step Development System Impacts Ovarian Reserve



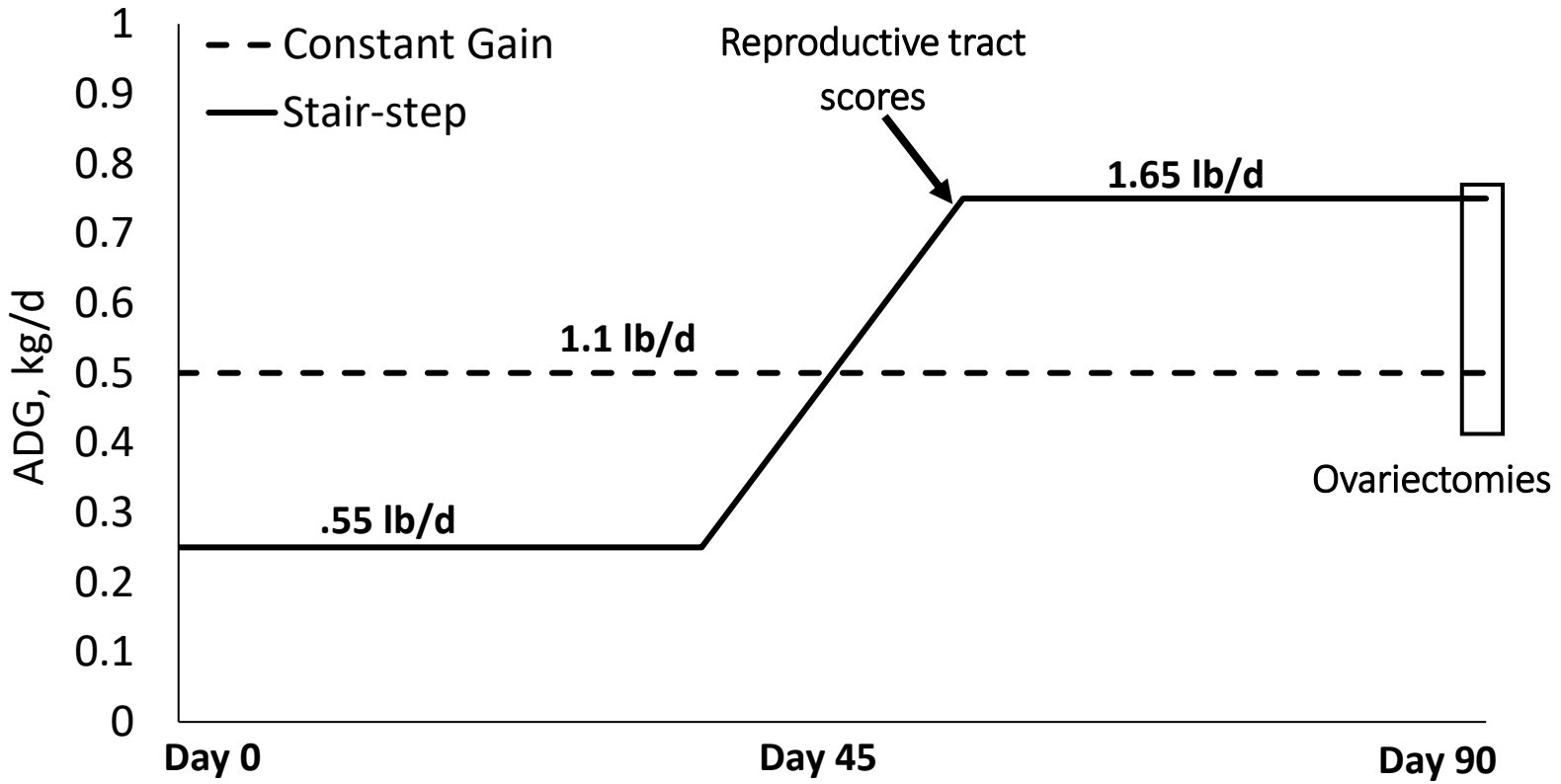
Freetly et al., 2014

Experimental Design

- Corona Range and Livestock Research Center in Corona, NM
- Treatments (n = 40)
  - Constant gain drylot (CG-d)
  - Stair-step drylot (SS-d)
  - Constant gain native range (CG-r)
  - Stair-step native range (SS-r)
- 90-d development period

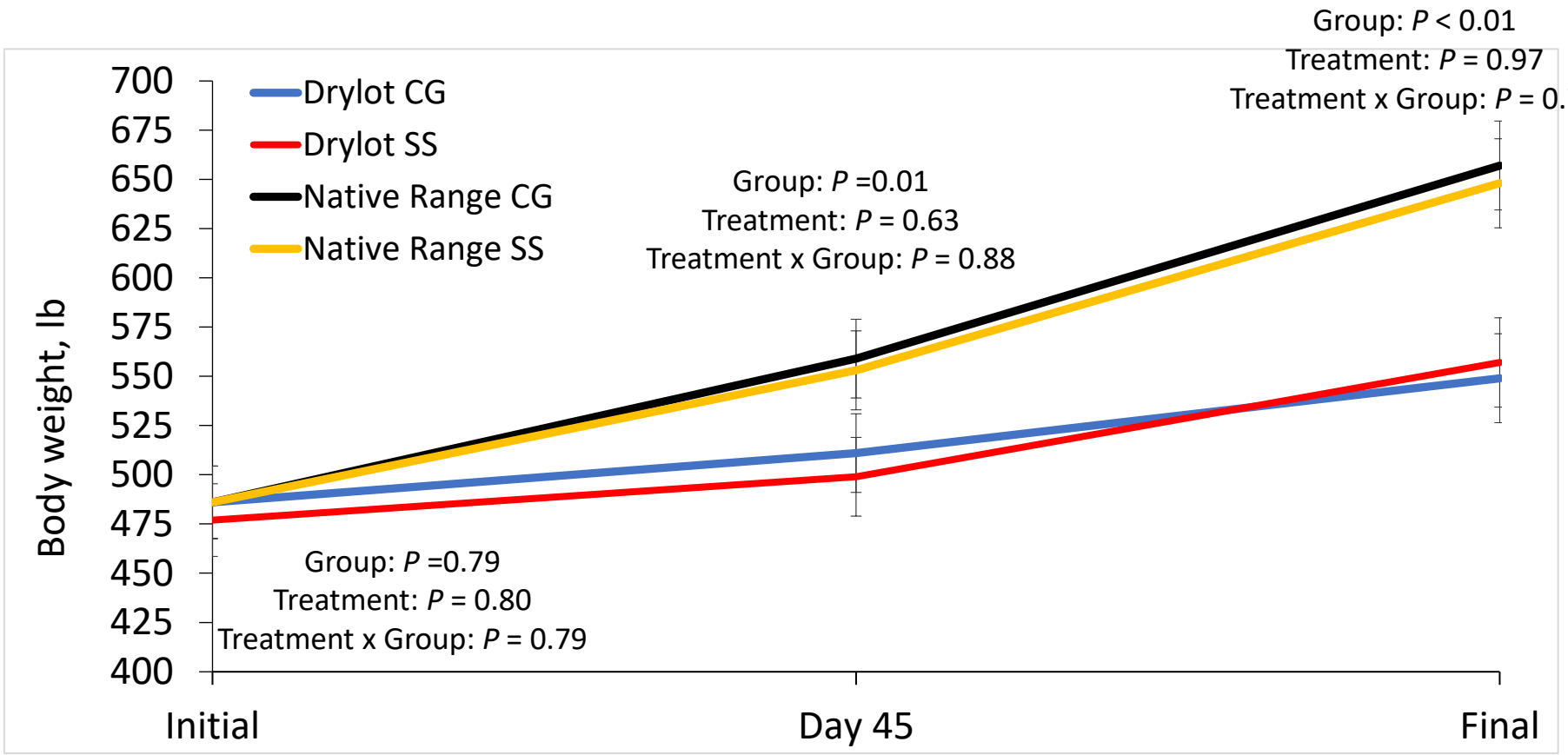
Rosasco et al., 2020

Experimental Design



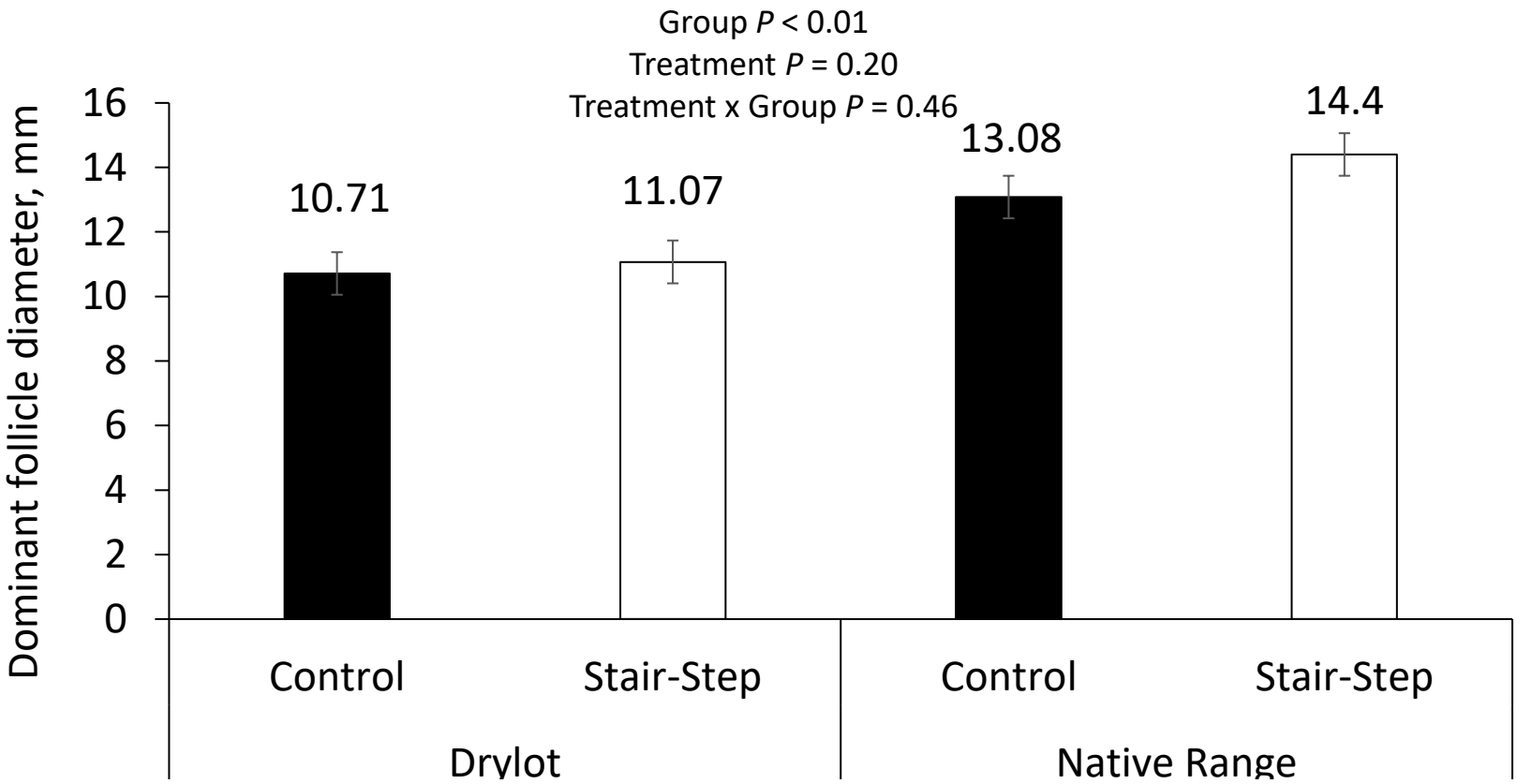
Rosasco et al., 2020

Effect of Nutritional Programing on Heifer BW



Rosasco et al., 2020

Effect of nutritional programming on heifer dominant follicle diameter



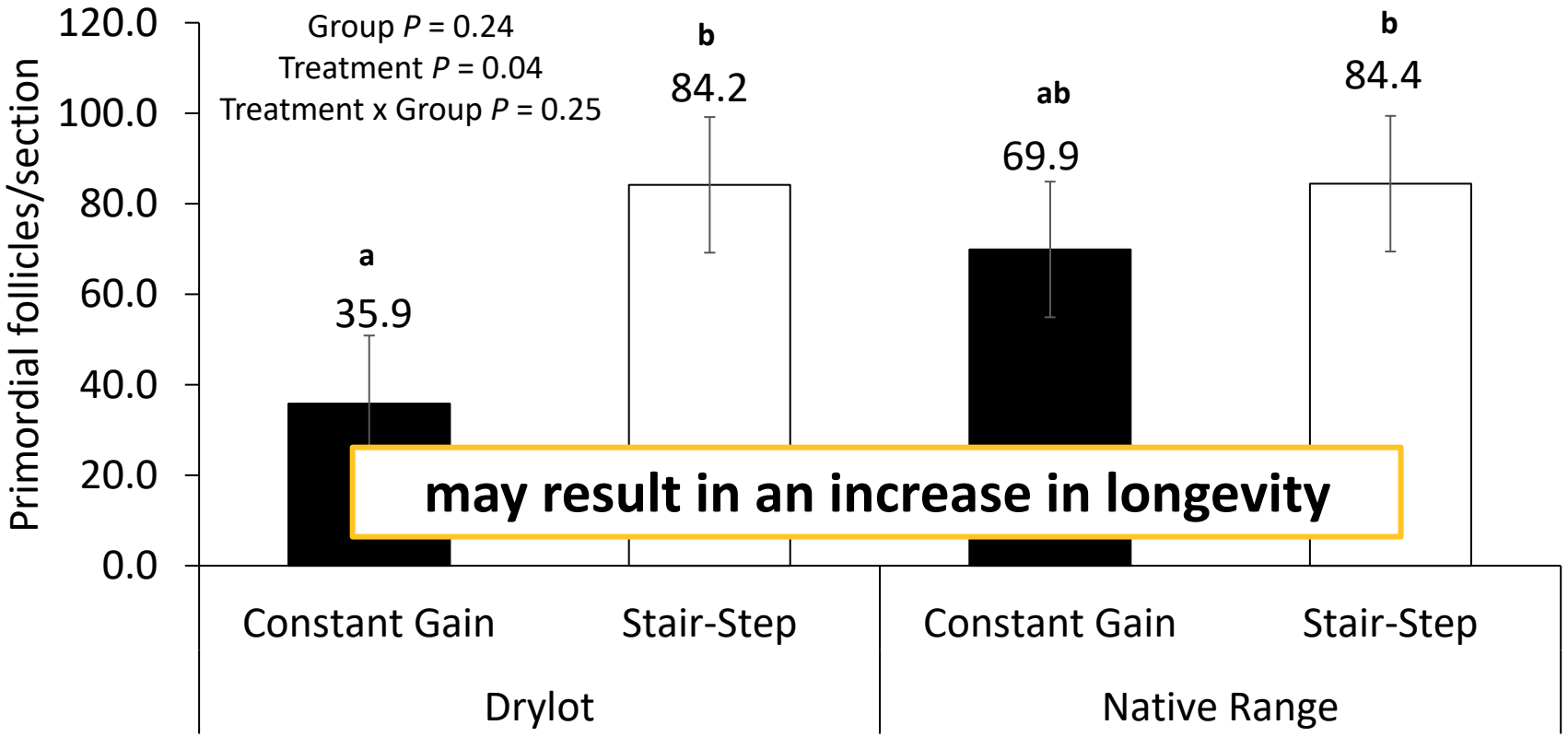
Rosasco et al., 2020

Effect of nutritional programing on heifer follicular fluid hormone concentrations

	Drylot		Native range			*P*-value		
Item	CG[1]	SS[2]	CG[1]	SS[2]	SEM	Trt	Group	Trt x Group
Estradiol, ng/mL	153.0[a]	158.5[a]	439.1[ab]	531.2[b]	110.5	0.65	<0.01	0.69
Progesterone, ng/mL	219.3	115.6	219.3	462.4	123.1	0.57	0.16	0.16
Estradiol:Progesterone	5.5	2.0	4.5	2.3	1.7	0.10	0.86	0.69

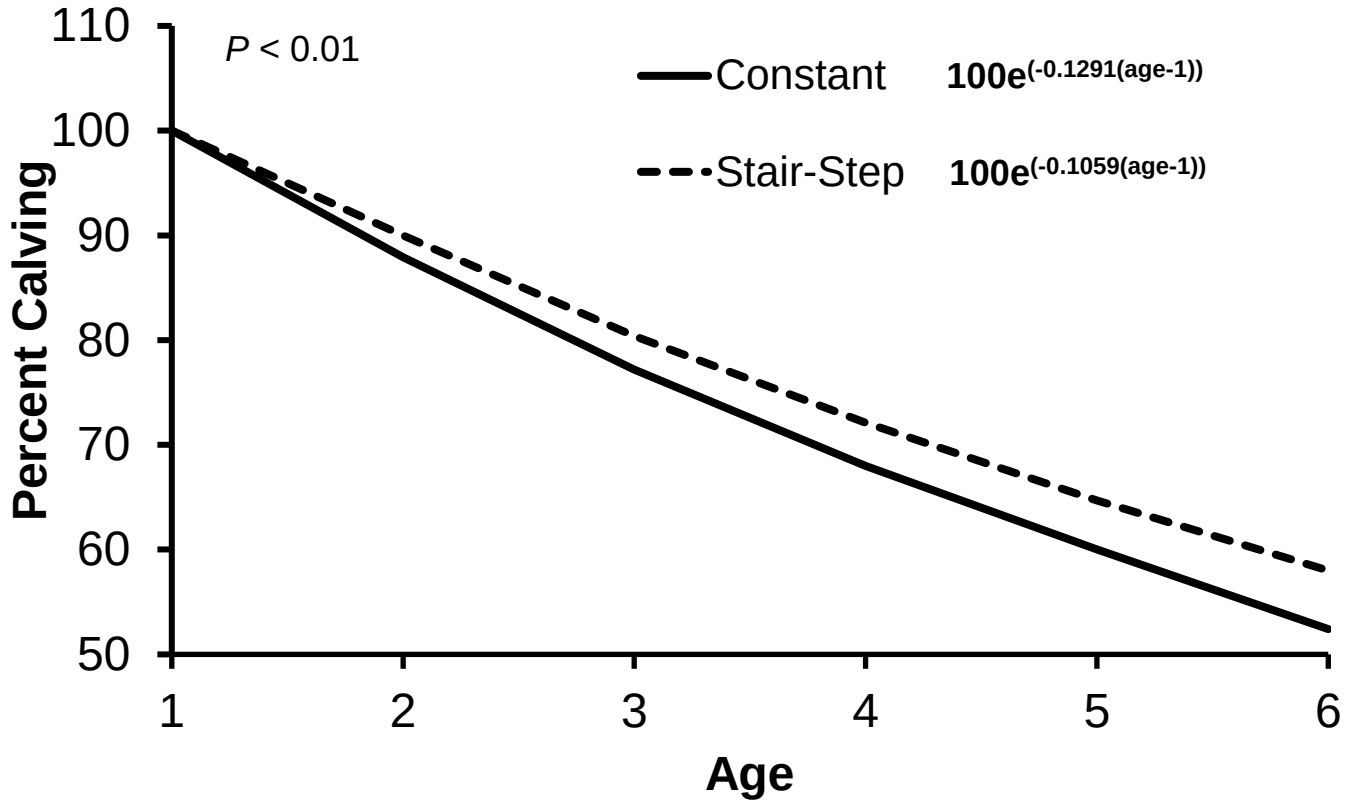
Rosasco et al., 2020

Effect of Nutritional Programing on the Ovarian Reserve



Rosasco et al., 2020

Herd survival is greater in Stair-Step heifers



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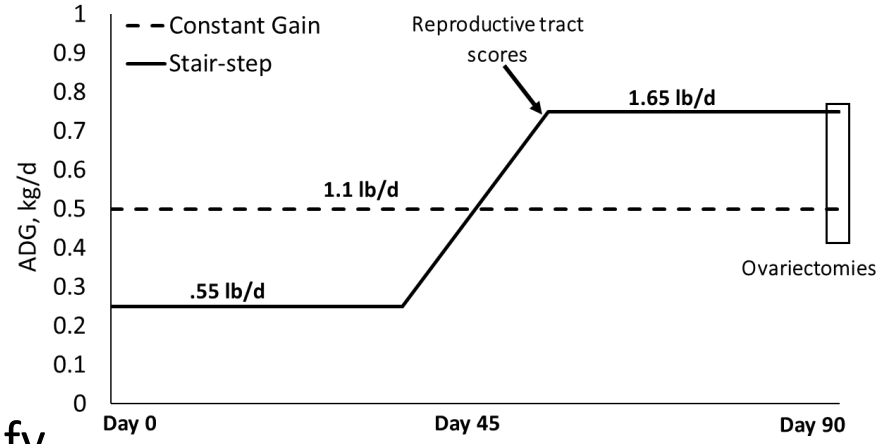
Freetly et al. 2021

Stair-step Nutritional Management

- No differences in:
  - Percent pubertal by breeding
  - Antral follicle count
  - Date of conception as a heifer
- If fertility is improved, what could be the mechanisms controlling this?
  - Circulating progesterone concentrations and uterine function

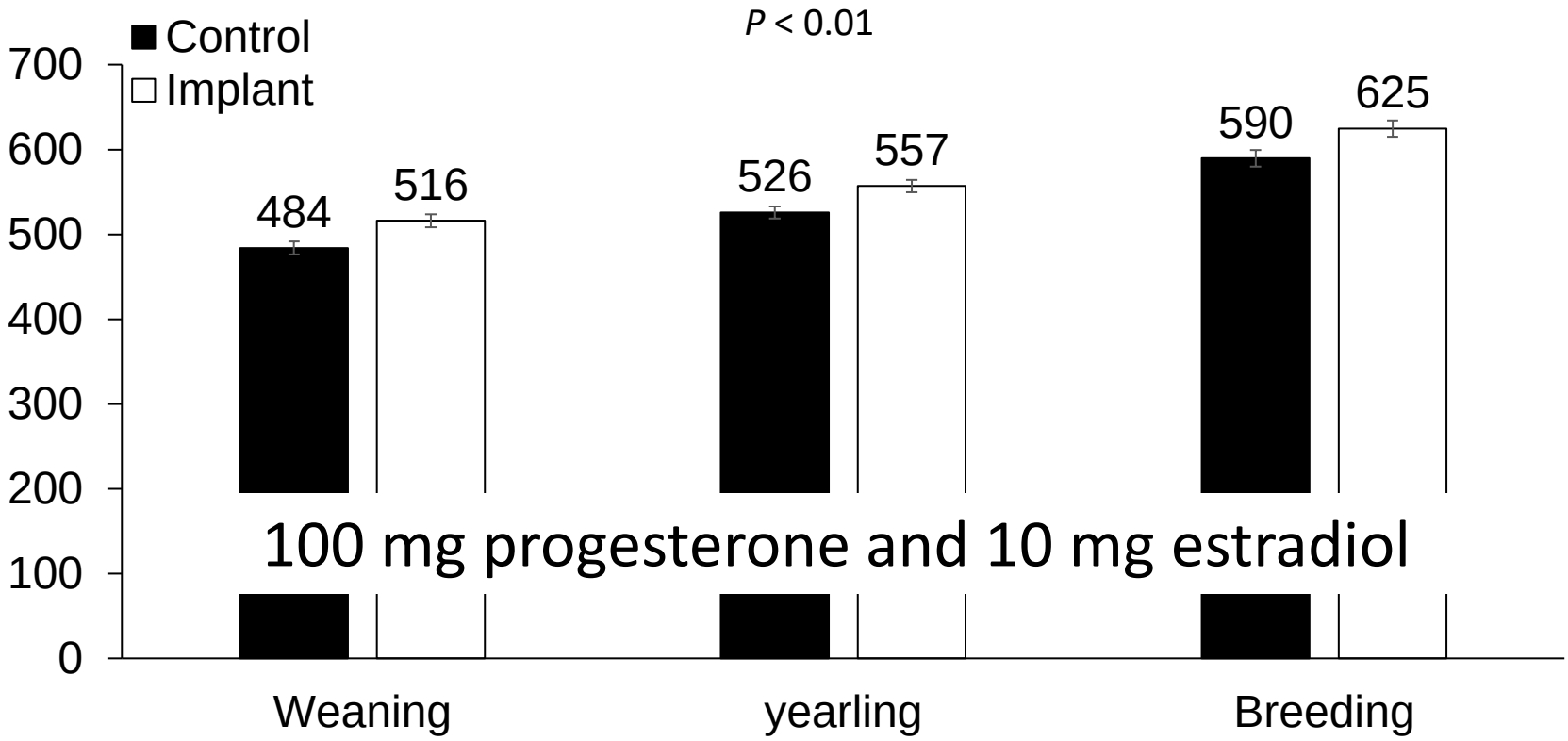
Experimental Design

- Treatments:
  - Constant gain drylot (CG-d)
  - Stair-step drylot (SS-d)
  - Constant gain native range (CG-r)
  - Stair-step native range (SS-r)
- 90-d development period
- Blood samples last 16 days to classify circulating progesterone profiles.
- Uterine biopsies



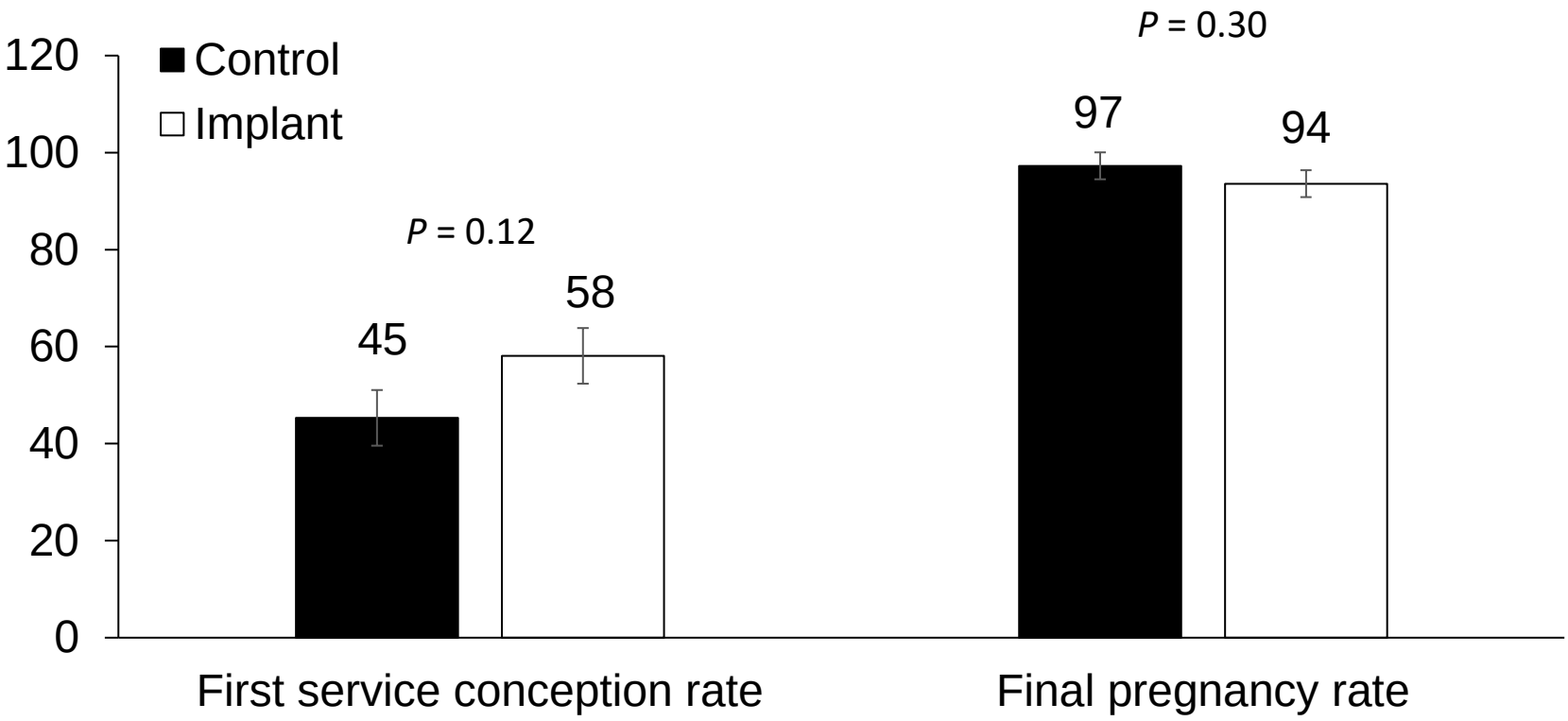

Can we add value or increase efficiency in our replacement heifer systems?

Can we use growth promoting implants in replacement heifers?



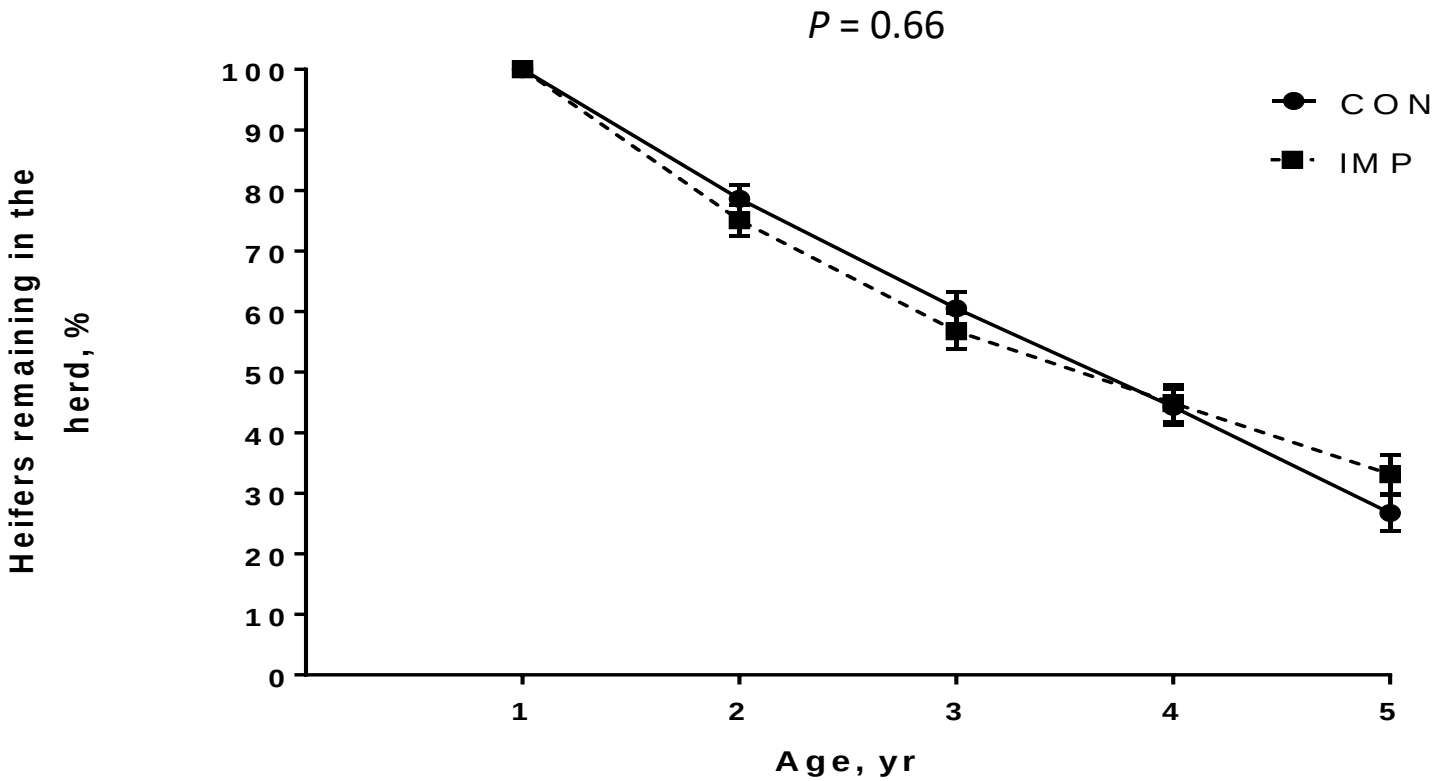
(Rosasco et al., 2018)

Effect of Synovex C implant administered at 3 mo of age on pregnancy rates



(Rosasco et al., 2018)

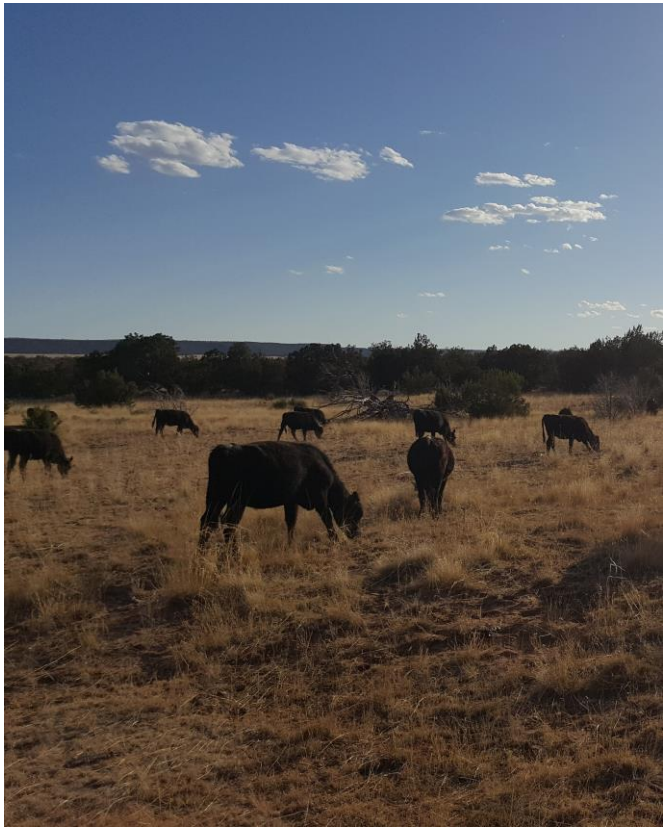
Effect of Synovex C implant administered at 3 mo of age on longevity



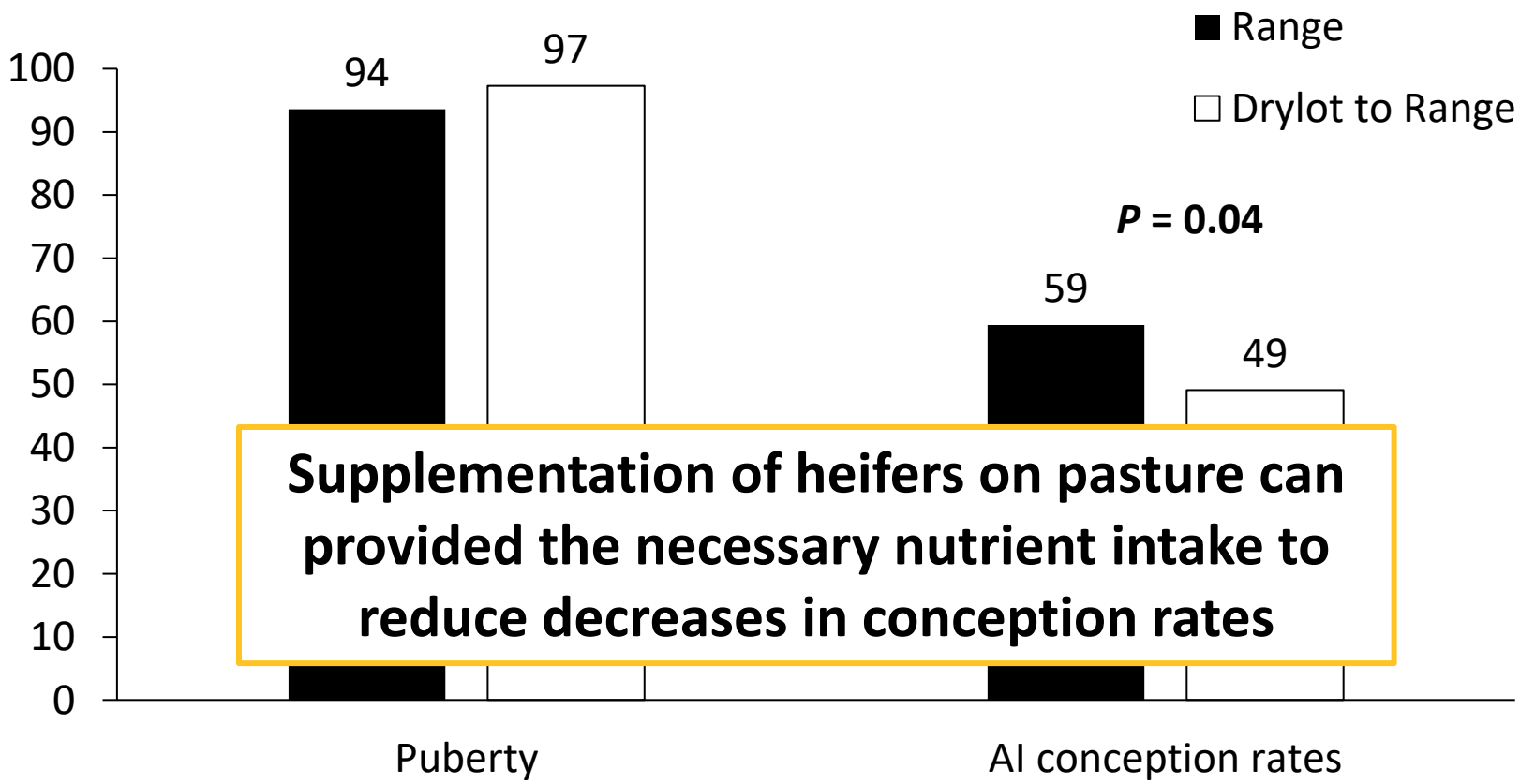
(Rosasco et al., 2018)

Post-breeding Nutritional Management

- Alterations in plane of nutrition post-breeding may alter conception rates and embryo quality (Perry et al., 2013; Kruse et al., 2017)



Post-AI Nutrition Influences Reproductive Success



Supplementation of heifers on pasture can provided the necessary nutrient intake to reduce decreases in conception rates

Perry et al., 2013

Long-term Implications of Heifer Management

- Effect of post-weaning heifer development systems on longevity is complex as it is influenced by both the environment and management practices.
- Longevity and reproduction have relatively low heritability
  - Management strategies and heifer development protocols can potentially impact cow retention

Take Home Message…

- Heifer selection and development is unique for each operation
- Decisions made regarding nutritional management of heifers can help program puberty attainment, fertility, and the ovarian reserve.
- Management decisions will affect overall productivity and longevity of the cow
  - Management of fertility and longevity is not a single stage event
  - Stair-step nutritional programming may allow for increased longevity
- Consistency between pre- and post-breeding nutritional management is key!

Thanks!!

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Beef Extension Website coming soon!!!