ENVIRONMENTAL FACTORS AFFECTING CONCEPTION RATES

Sandy Johnson, PhD
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2019 WRM series

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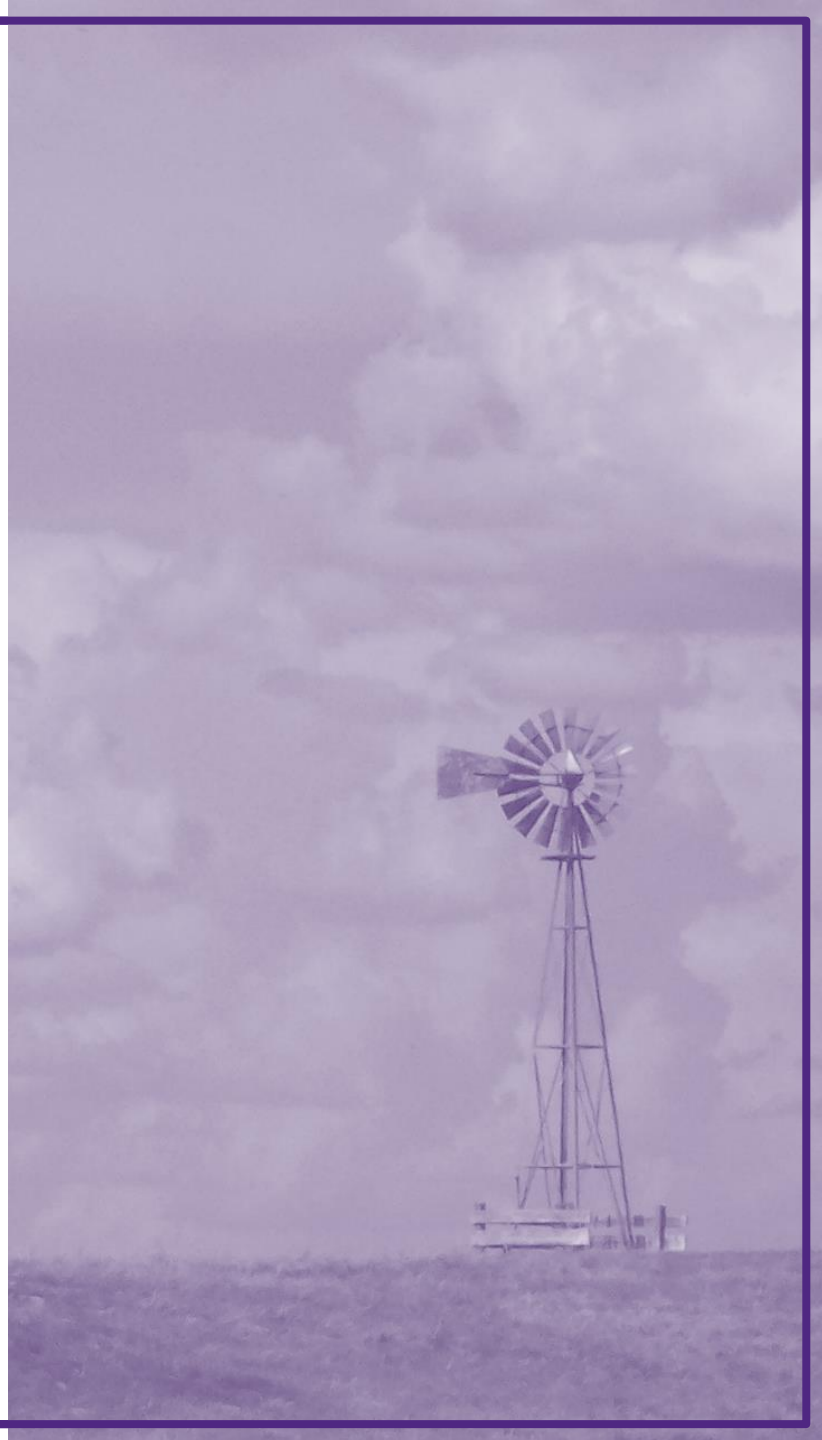
Research and Extension



STRESSORS

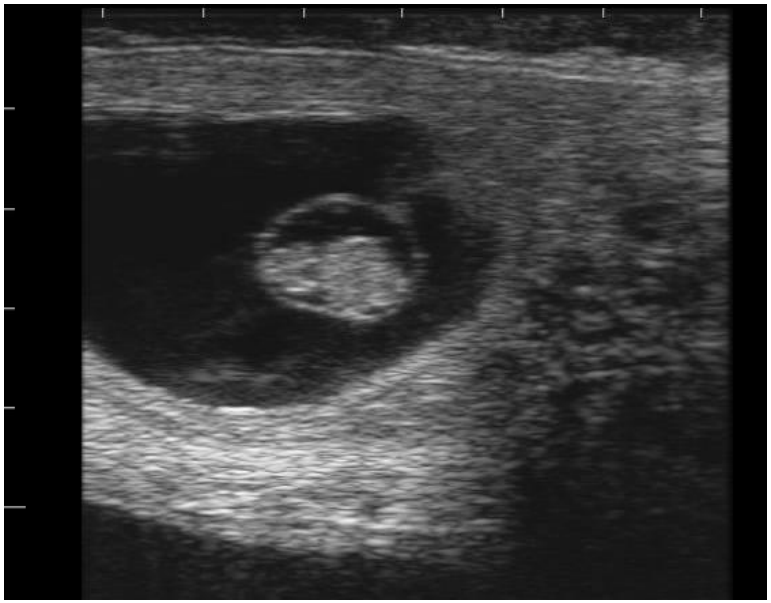
Temperature

Nutrition

Temperament

Transportation / relocation

Disease and inflammation



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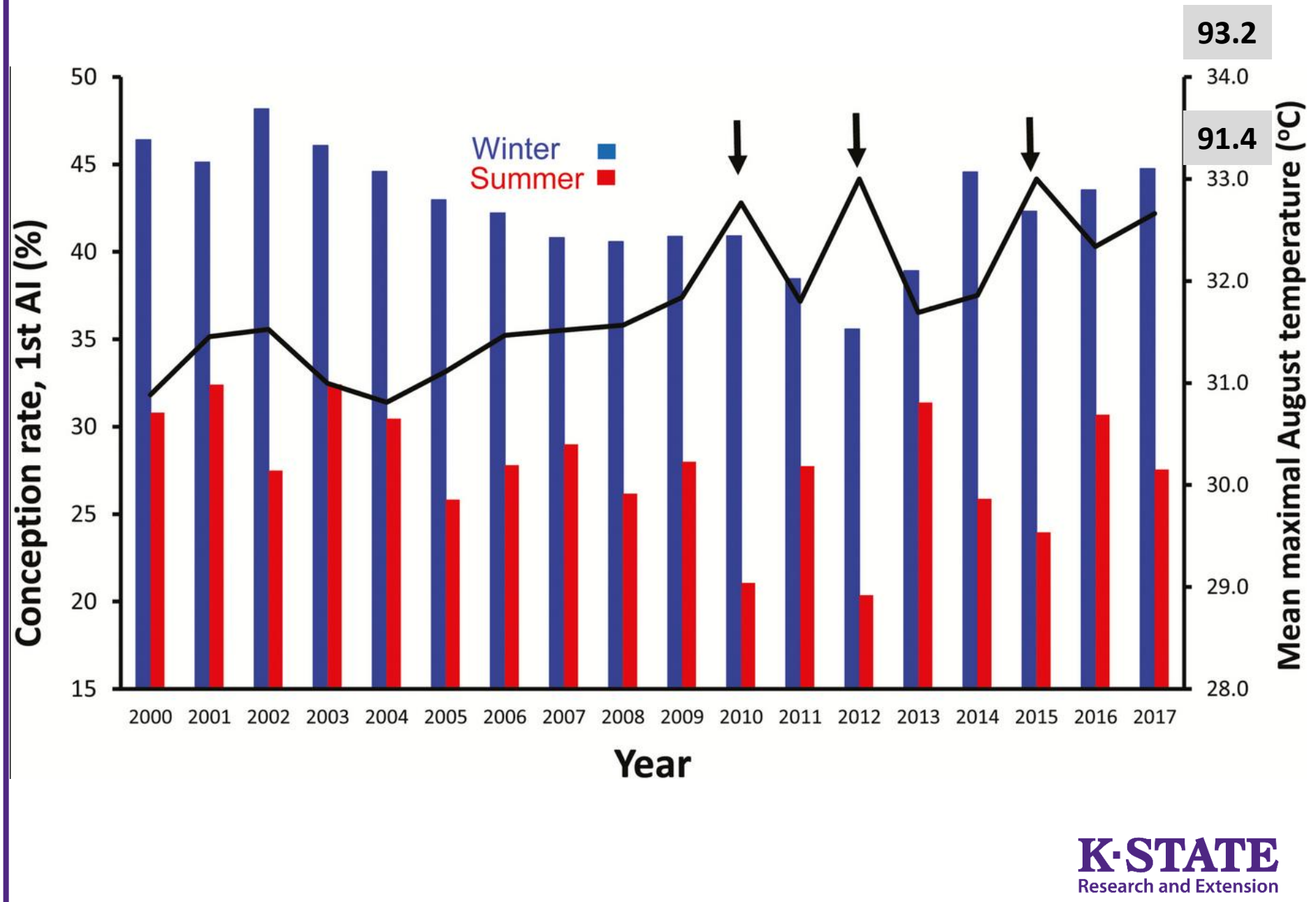

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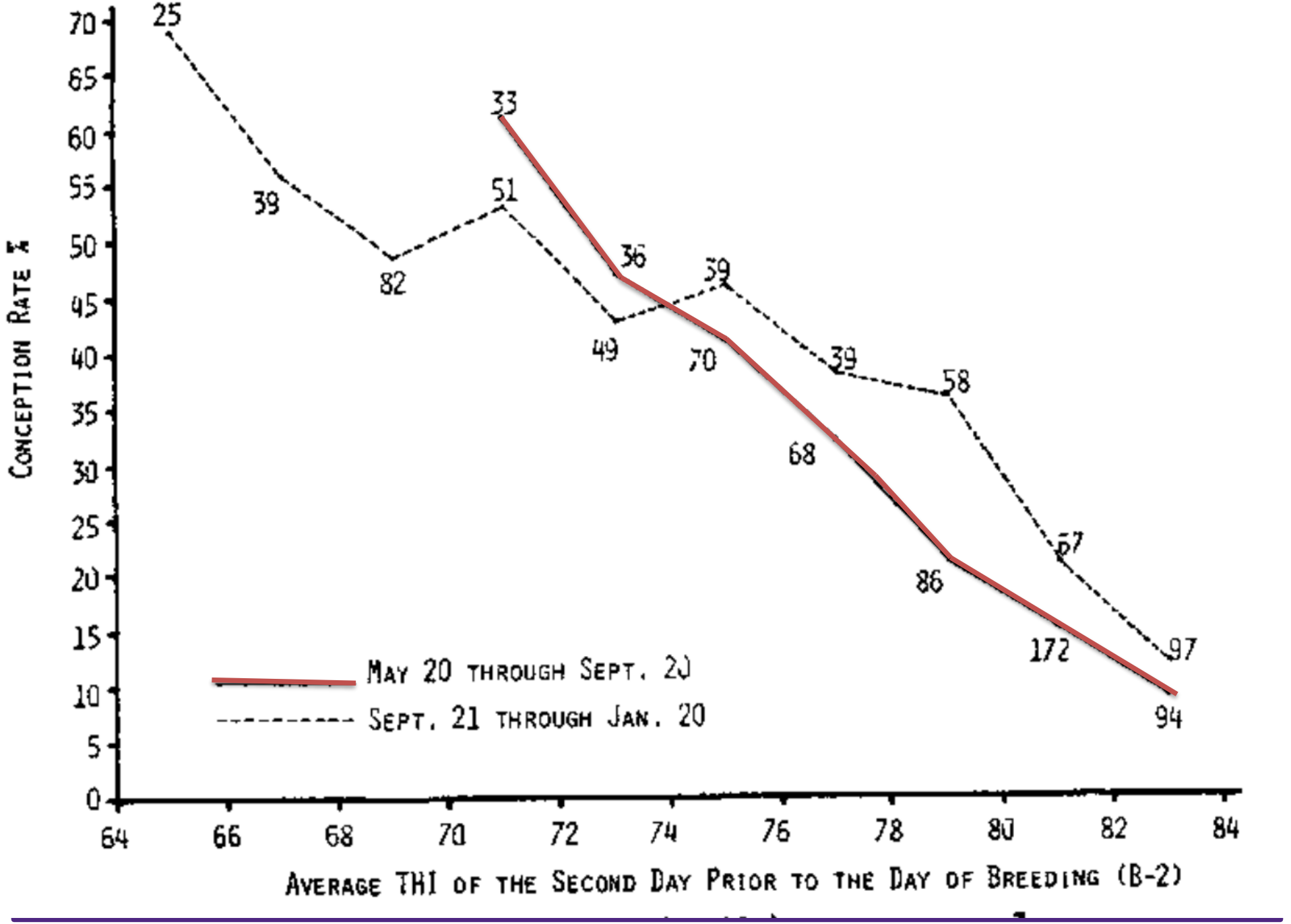
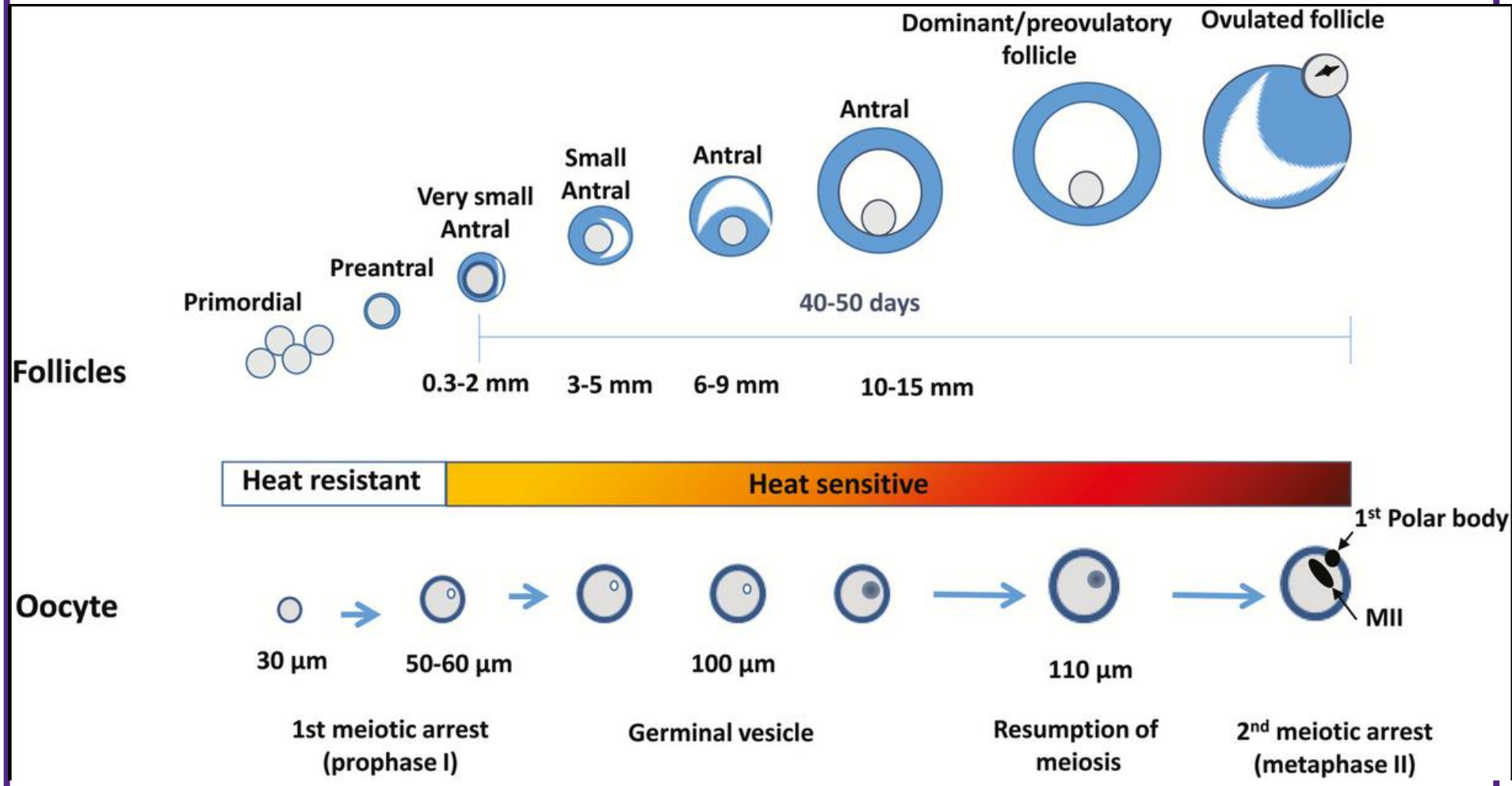

CONCEPTION RATE %
70
65
60
55
50
45
40
35
30
25
20
15
10
5
0
25
39
82
51
49
33
36
70
59
39
68
58
86
97
172
94
MAY 20 THROUGH SEPT. 20
SEPT. 21 THROUGH JAN. 20
64
66
68
70
72
74
76
78
80
82
84
AVERAGE THI OF THE SECOND DAY PRIOR TO THE DAY OF BREEDING (B-2)



Wolfenson & Roth, 2019

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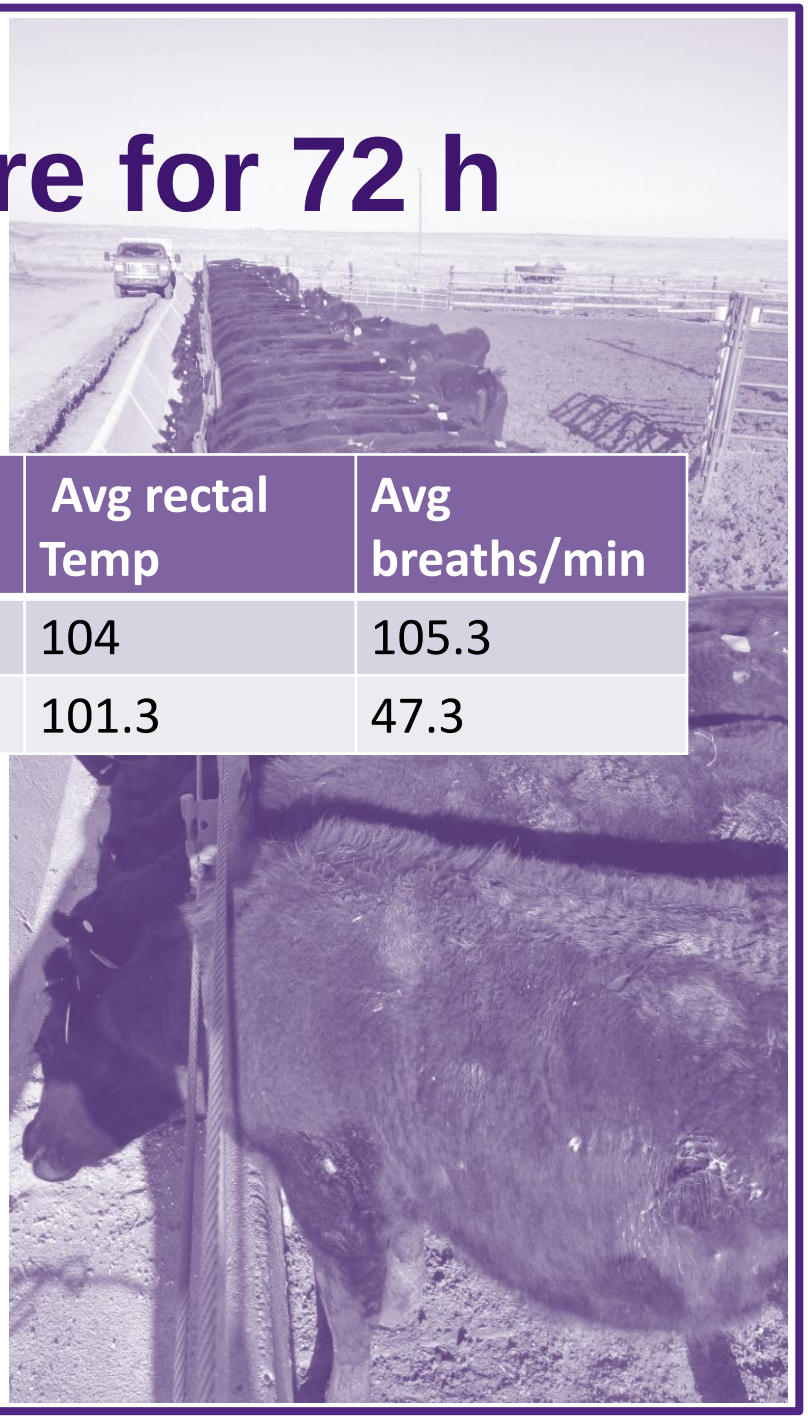
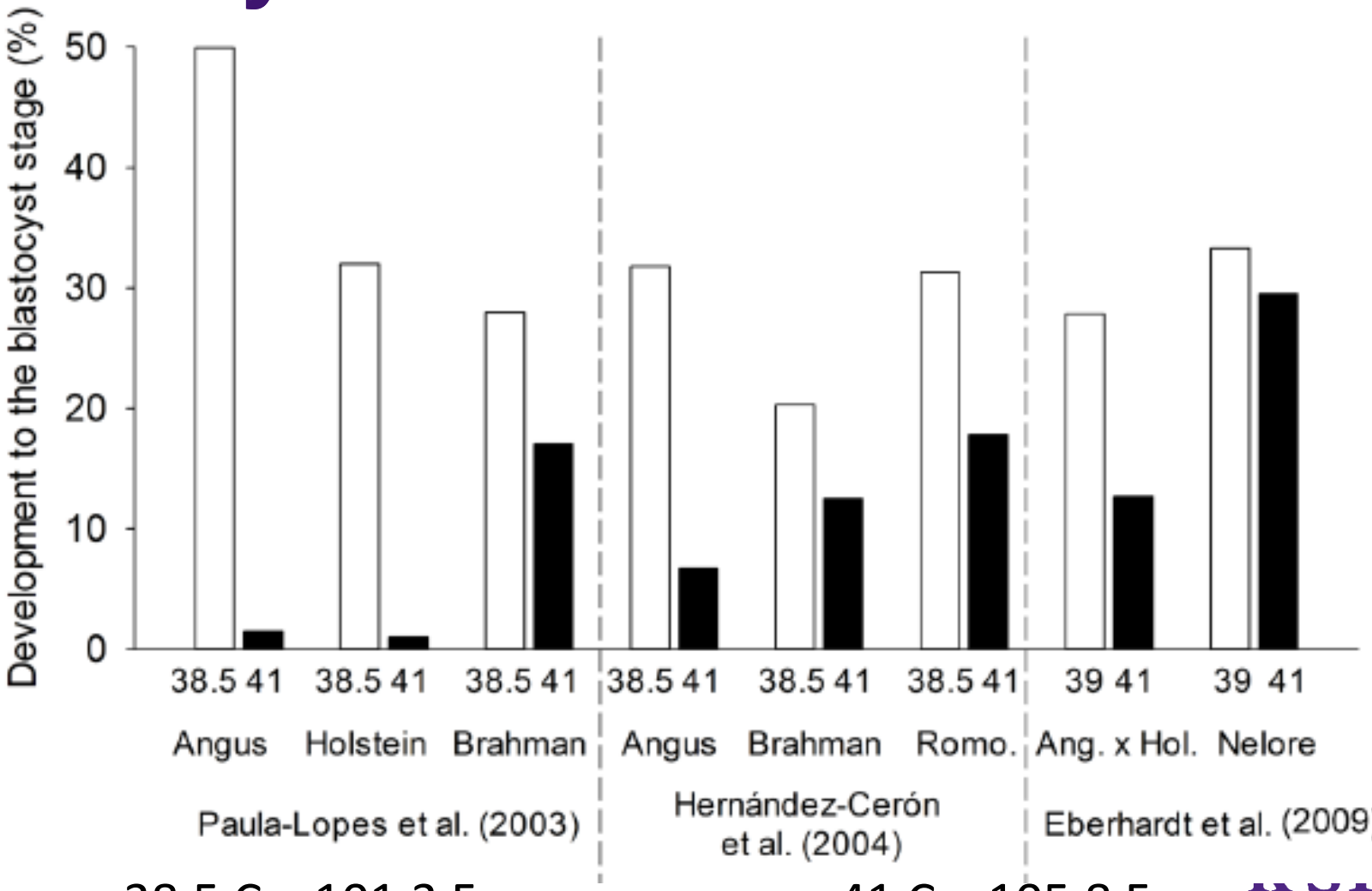
Effect of temperature for 72 h post insemination



Chamber Temperature	No. Hfrs	No. conceiving	Avg rectal Temp	Avg breaths/min
90	23	0	104	105.3
70	25	12	101.3	47.3

Dunlap and Vincent, 1971

Effect of heat shock on d 4 or 5 embryos



38.5 C = 101.3 F

41 C = 105.8 F

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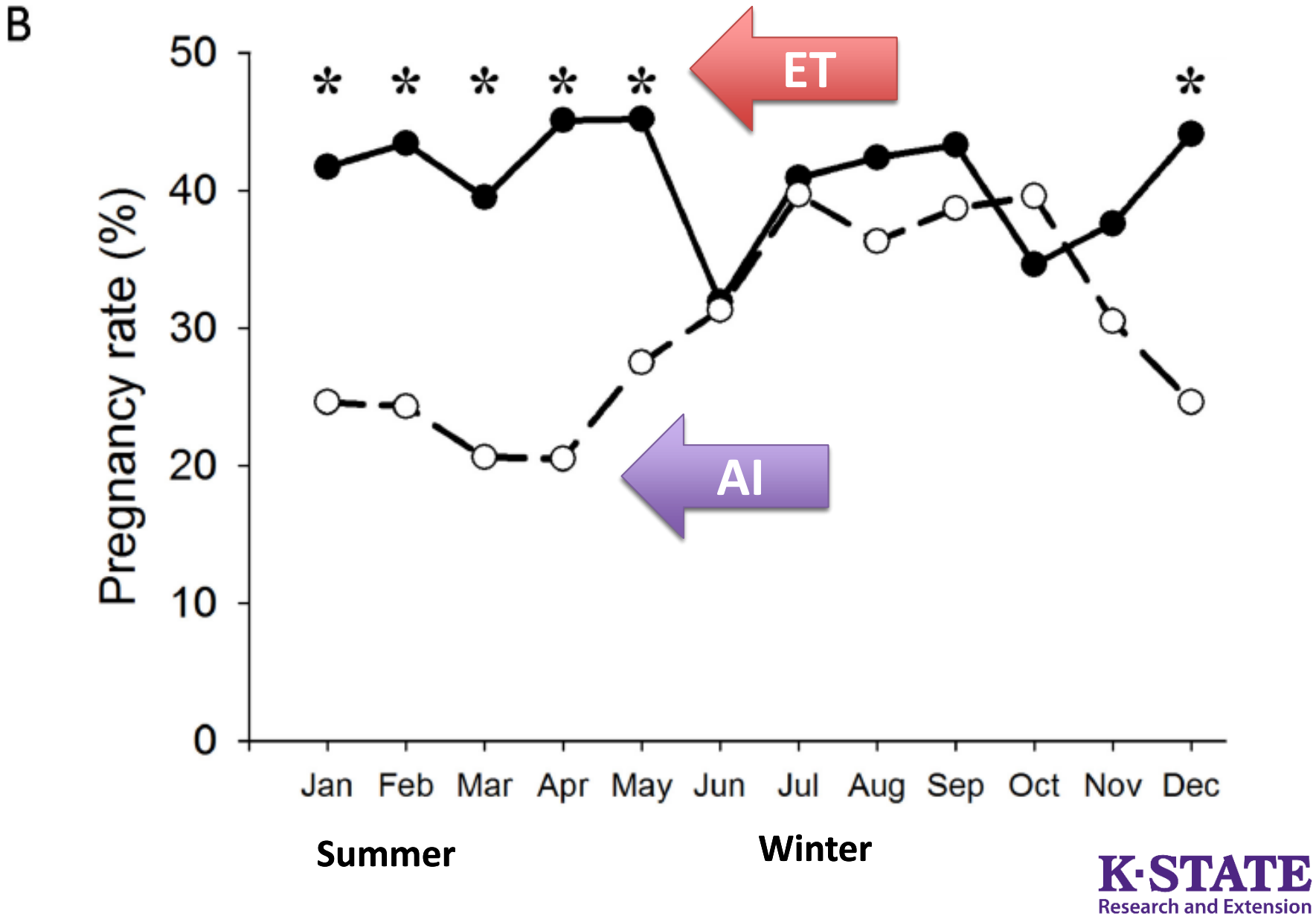
Commercial Dairy in Brazil



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Mean environmental conditions relative to beginning of breeding season

	Day -30	Day 21	Day 42	Day 60
Avg. Temp	58.6	66.4	70.2	72
Min. Temp	47.5	55.6	59	60.8
Max. Temp	70	77.2	81.3	82.9
RH, %	68.9	72.1	71.6	72.7
THI	58.4	64.9	68.1	69.7
Solar Radiation	494.7	531.5	578.0	590.7
Accum. precipitation	4.1	3.4	6.9	9.7
Wind speed	4.5	3.9	3.7	3.5
Pregnancy rate		54.2	75.8	83.0

Amundson et al., 2006

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Summary Points

- *Lower night time temperatures – greater coping ability for hot days*
- *THI threshold above which PR is negative was 73, close to the avg temp on days on days 42 and 60*
- *Optimum conditions change with changing environment*

Amundson et al., 2006

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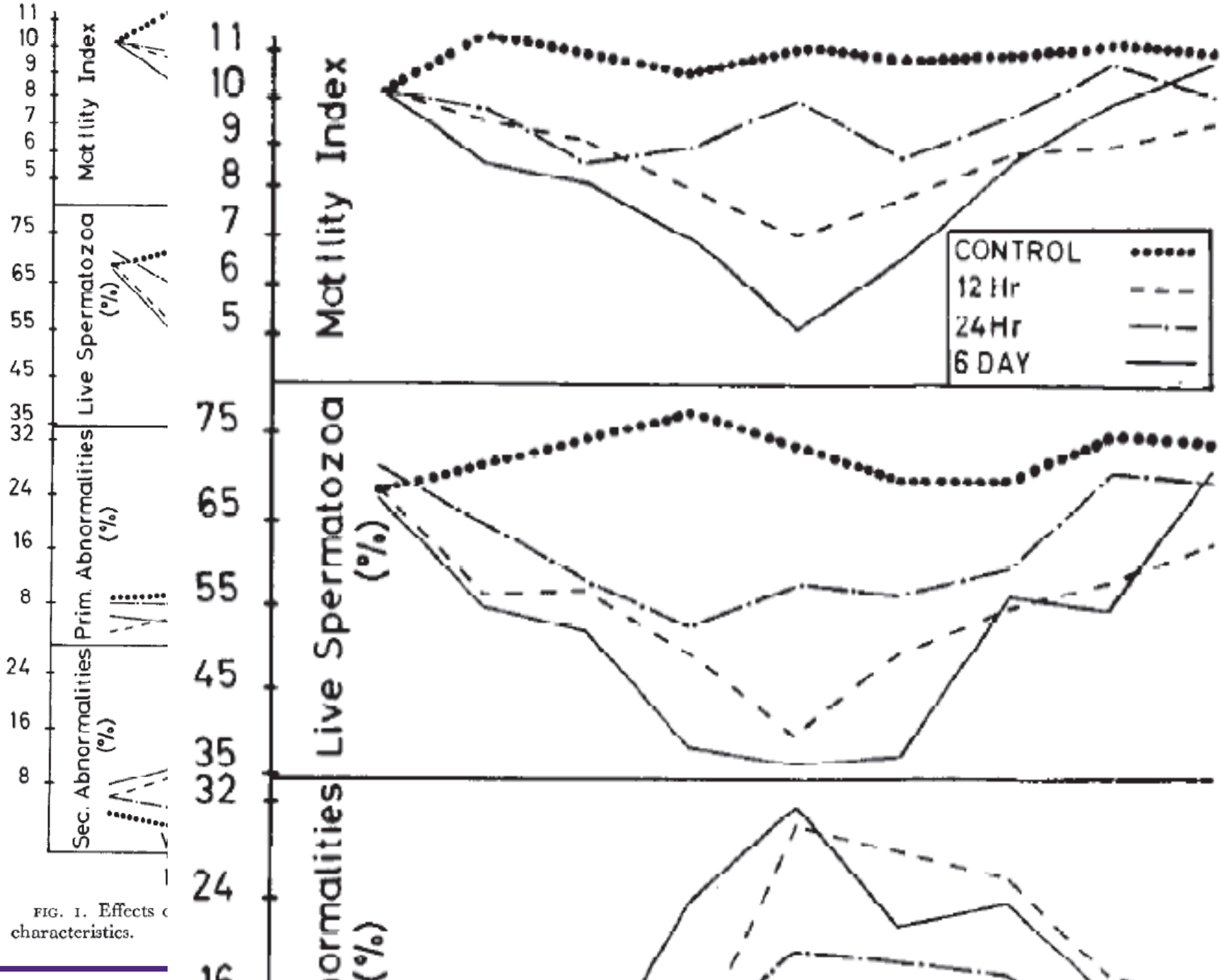


FIG. 1. Effects c
characteristics.

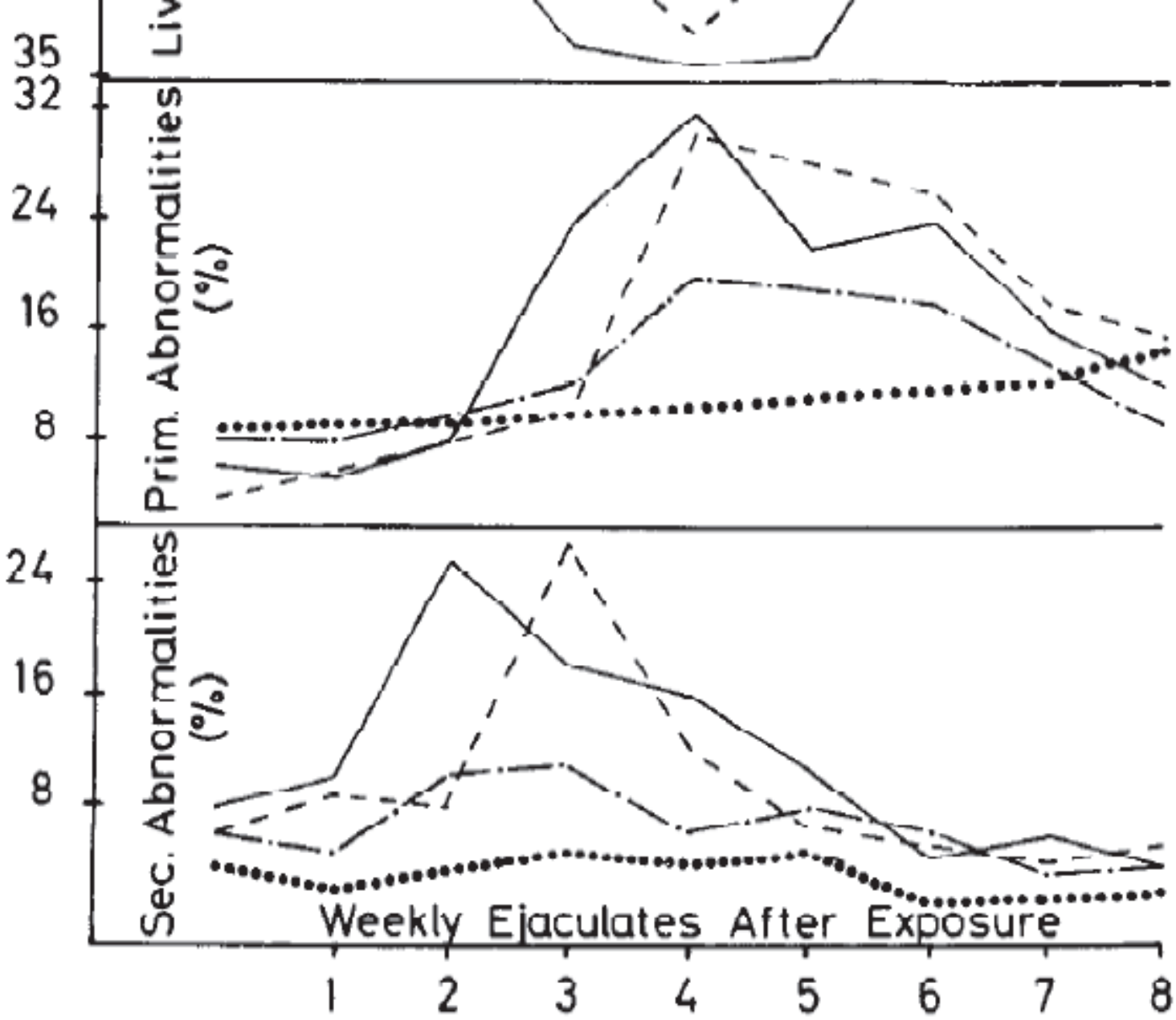
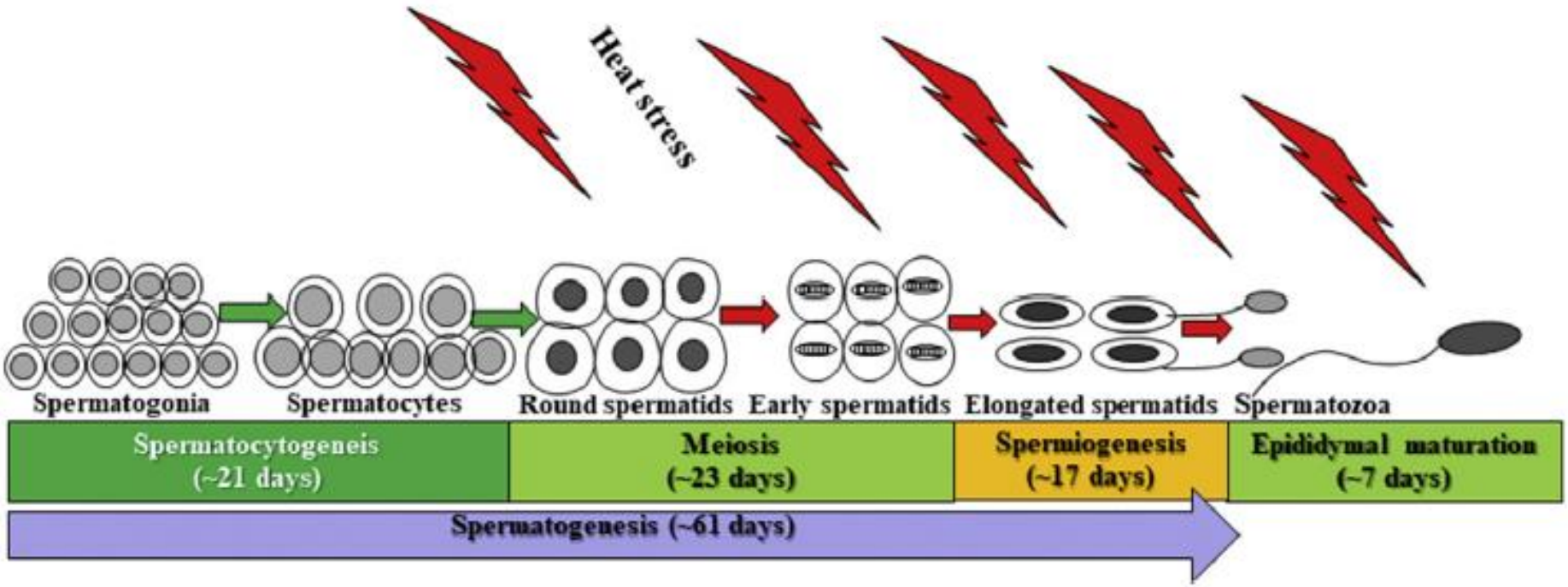


FIG. 1. Effects of exposure to 40 C upon various spermatozoal characteristics.

M.B. Rahman et al. / Theriogenology 113 (2018) 102–112



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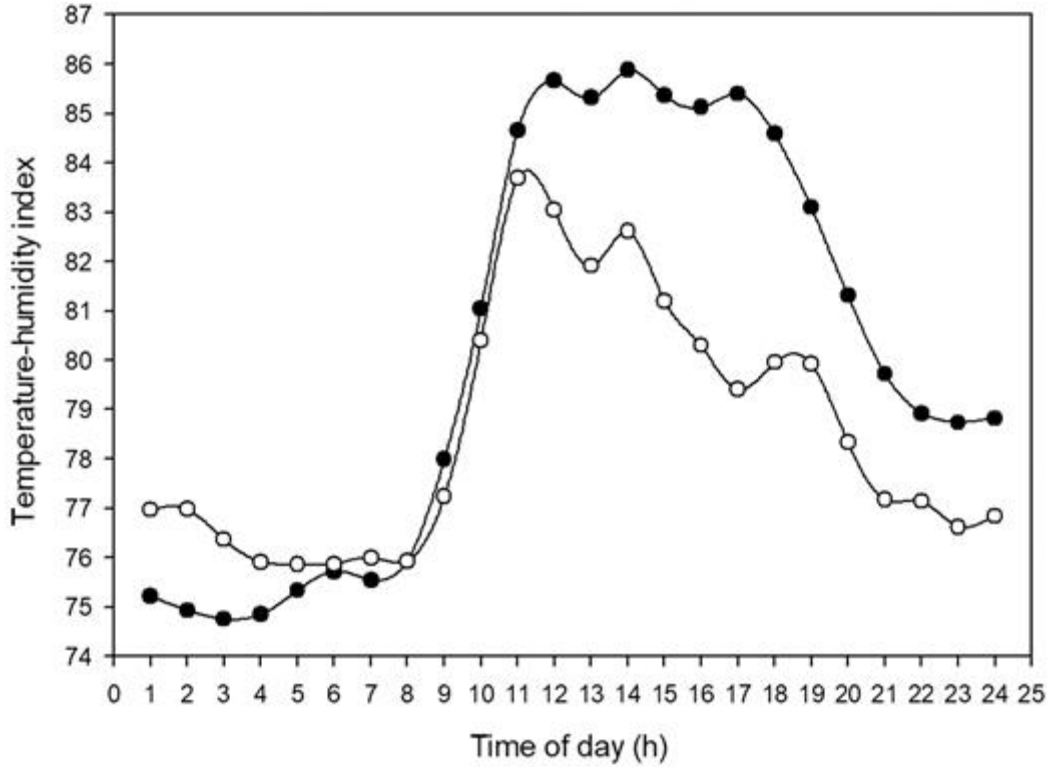

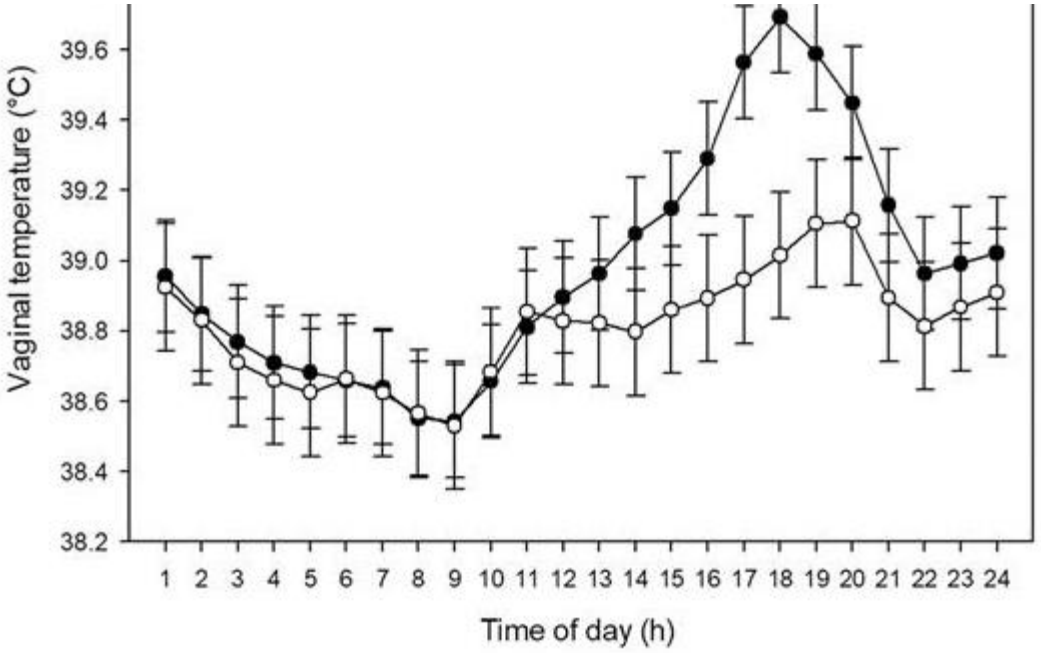

- THI > 80 for 11 hr and > 85 for 6 hr
  - THI > 80 for 7 hr and non over 85

Vaginal temperature peak lags the peak in THI

Hamblen et al., 2018

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Dealing with heat stress

If peak environmental temperature is at 4:00 pm

6:00 pm – Peak animal core temperature

12:00 am – recovery from heat load

Heat production from feed intake peaks 4-6 hr post feeding

Biting flies cause animals to bunch up, decreasing cooling

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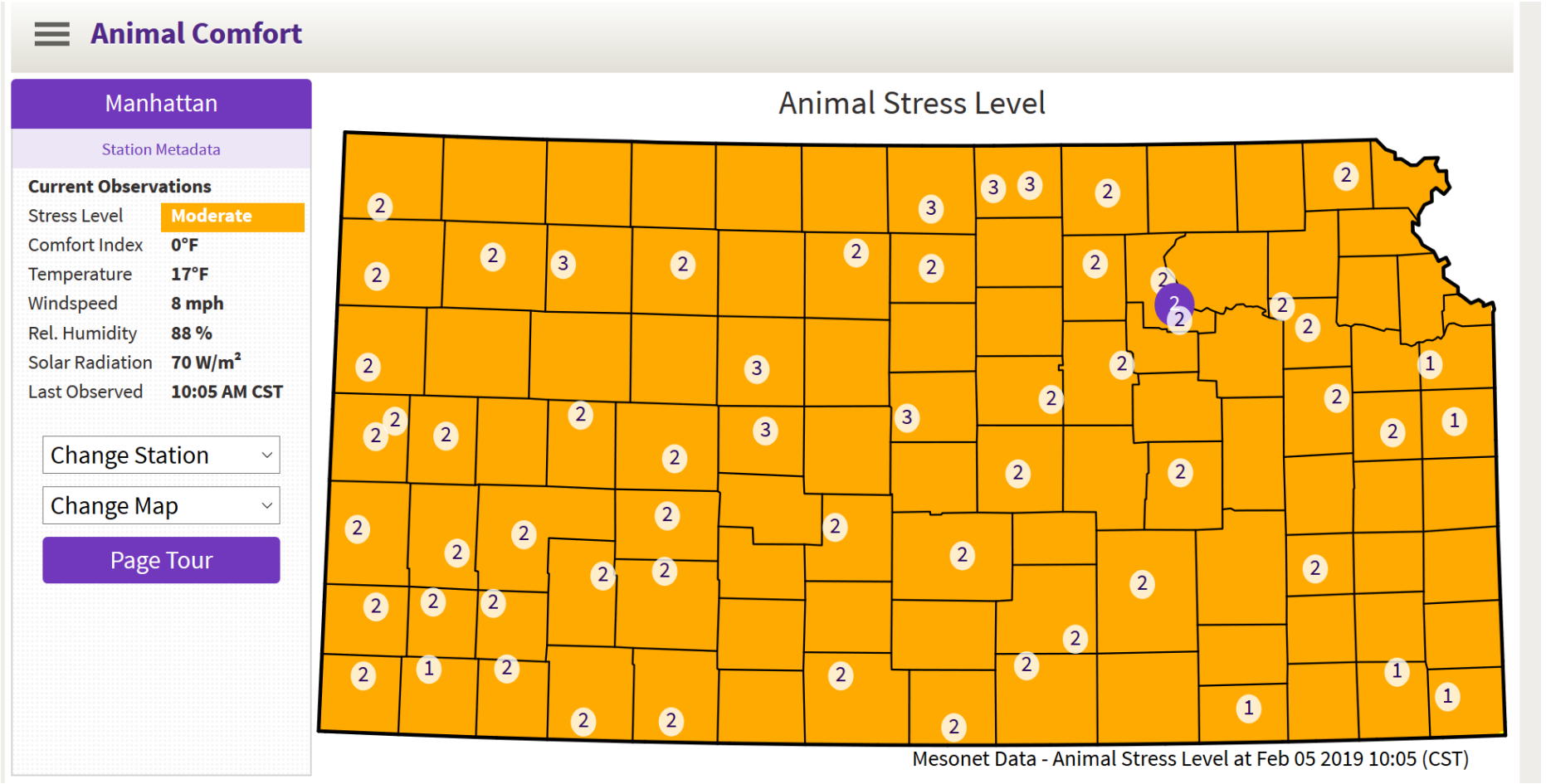
http://mesonet.k-state.edu/

Comfort Index includes
temperature, relative humidity, wind speed and solar radiation



STRESSORS

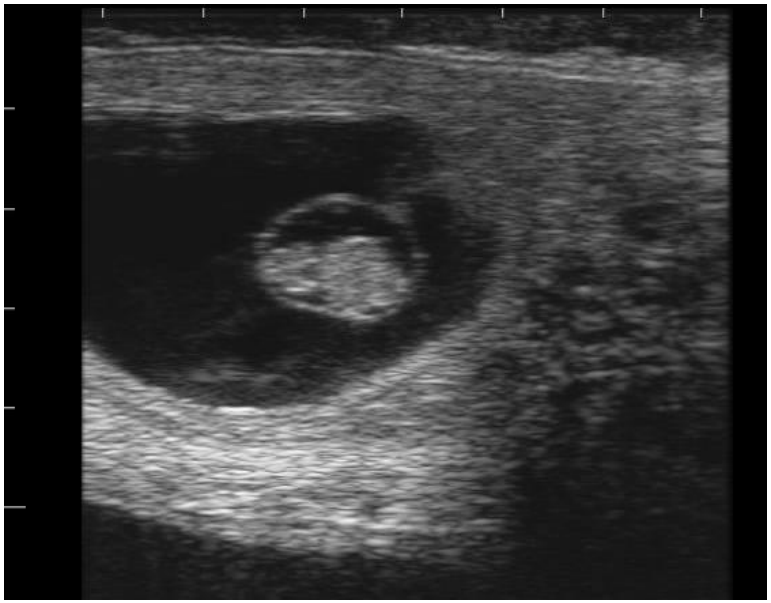
Temperature

Nutrition

Transportation / relocation

Temperament

Disease and inflammation



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Effect of pre-breeding and post-breeding nutrition

	L-L	L-H	H-H	H-L
Total heifers	66	65	60	56
Total Pregnant	46	46	39	21
Embryo Survival rate	0.70	0.71	0.65	0.38

Pasture allowance:
L=.8 maintenance energy requirements
H= 2x maintenance energy requirements

10 days prebreeding
14 days post insemination – Embryo recovery
30 days post insemination - US

Dunne et al., 1999

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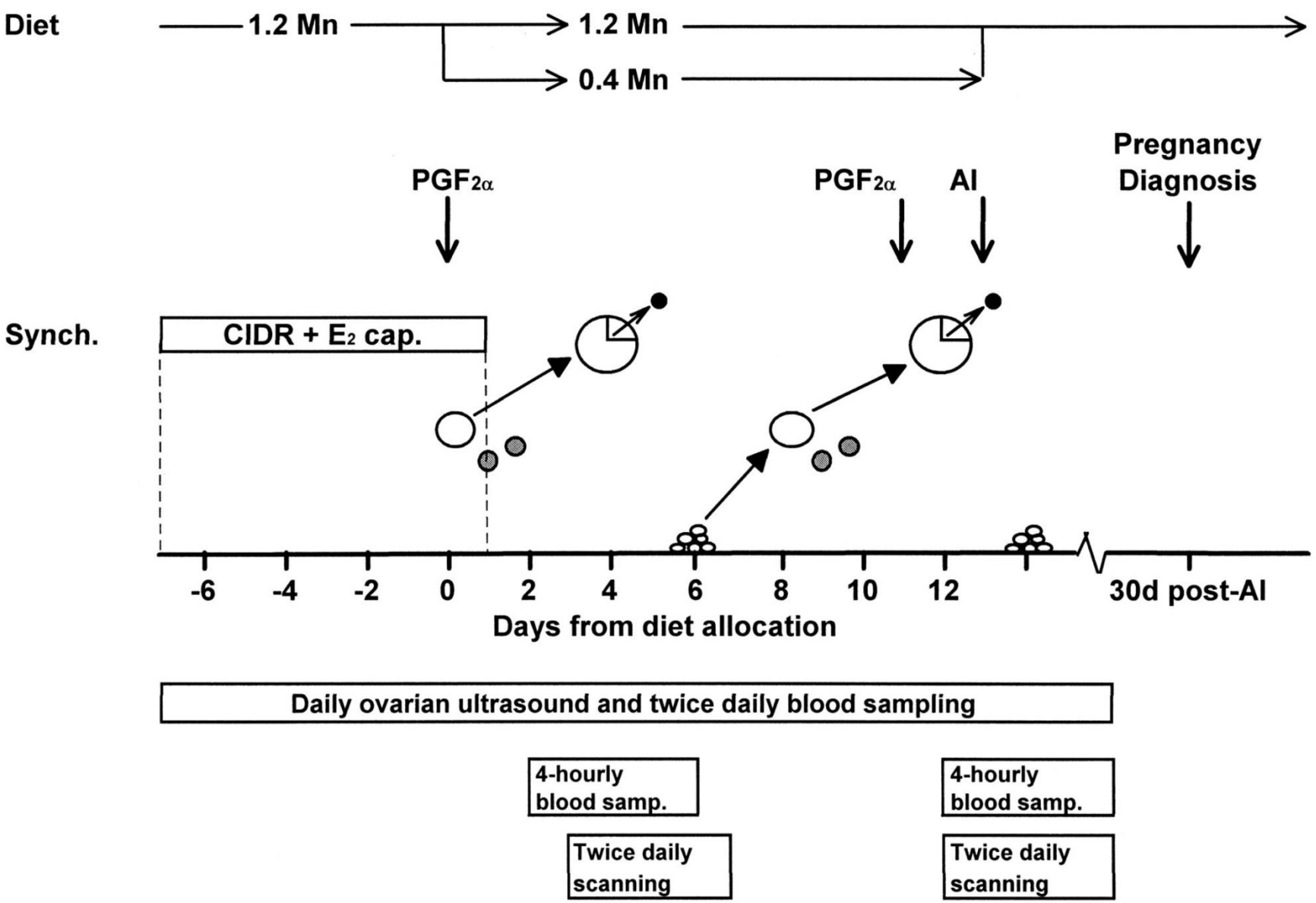
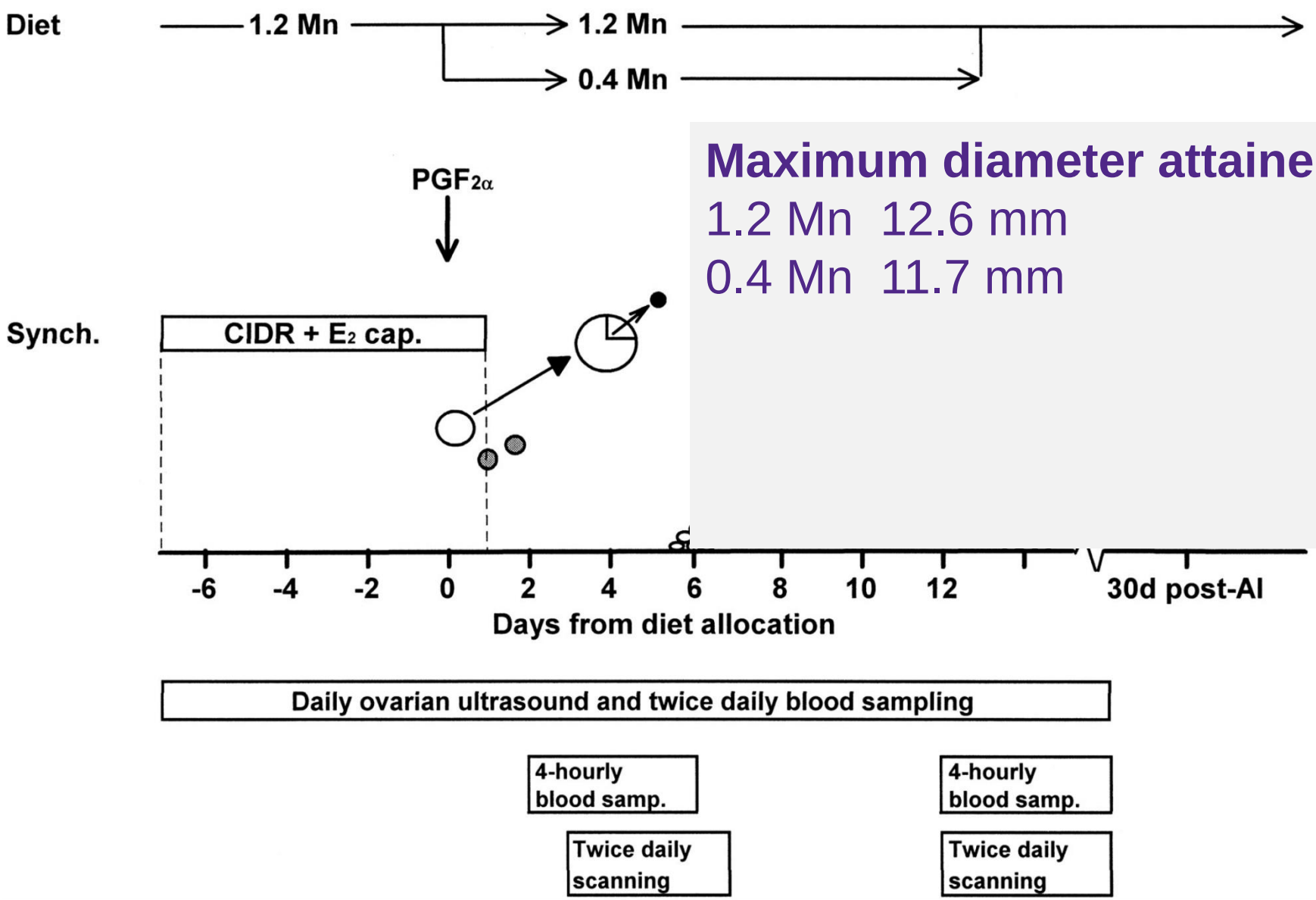


Effect of Acute Nutritional Restriction on Incidence of Anovulation and Periovulatory Estradiol and Gonadotropin Concentrations in Beef Heifers[1]

Biol Reprod. 1999;61(6):1601-1607. doi:10.1095/biolreprod61.6.1601

Mackey et al., 1999



Maximum diameter attained

1.2 Mn 12.6 mm

0.4 Mn 11.7 mm

Effect of Acute Nutritional Restriction on Incidence of Anovulation and Periovulatory Estradiol and Gonadotropin Concentrations in Beef Heifers[1]

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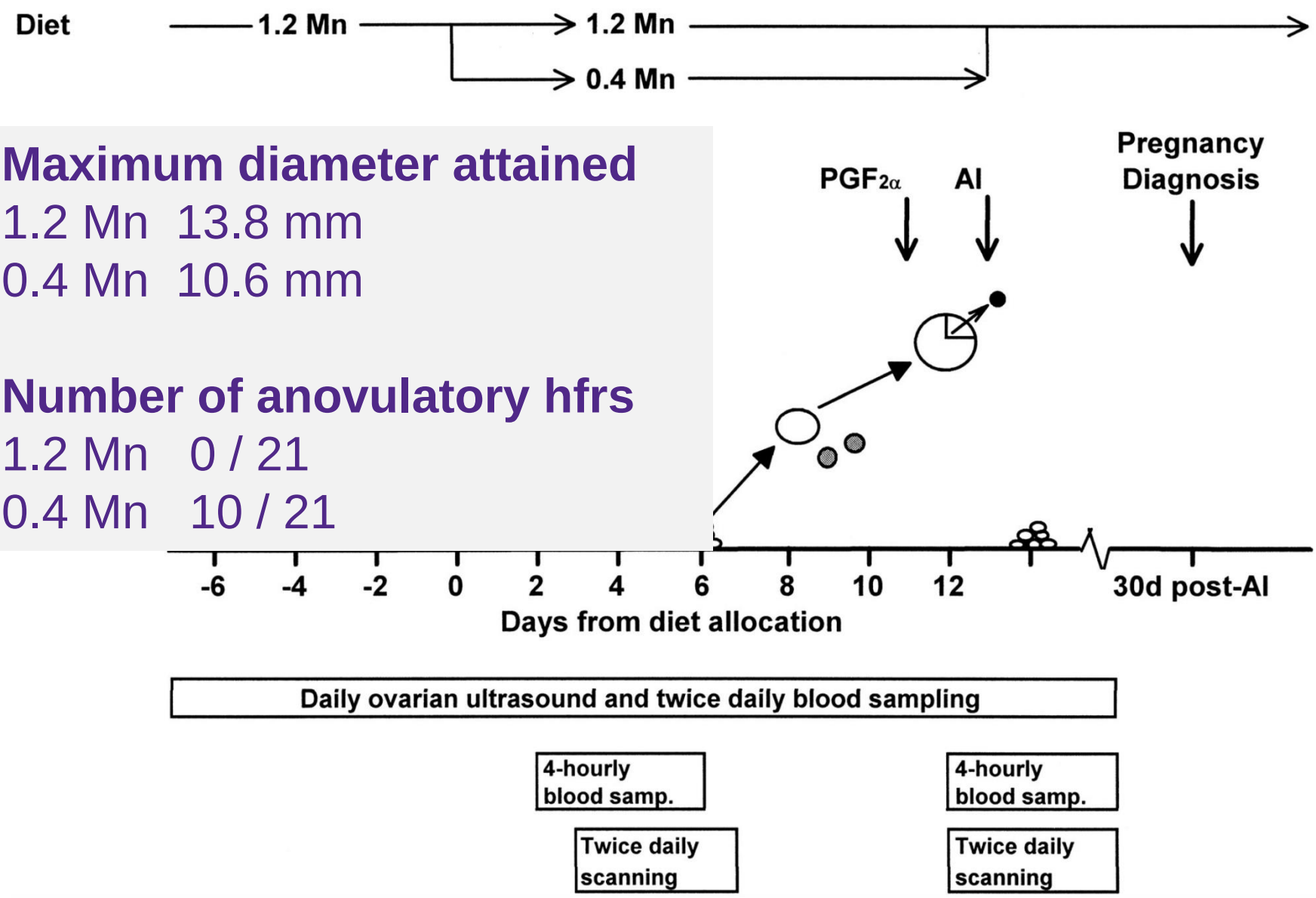

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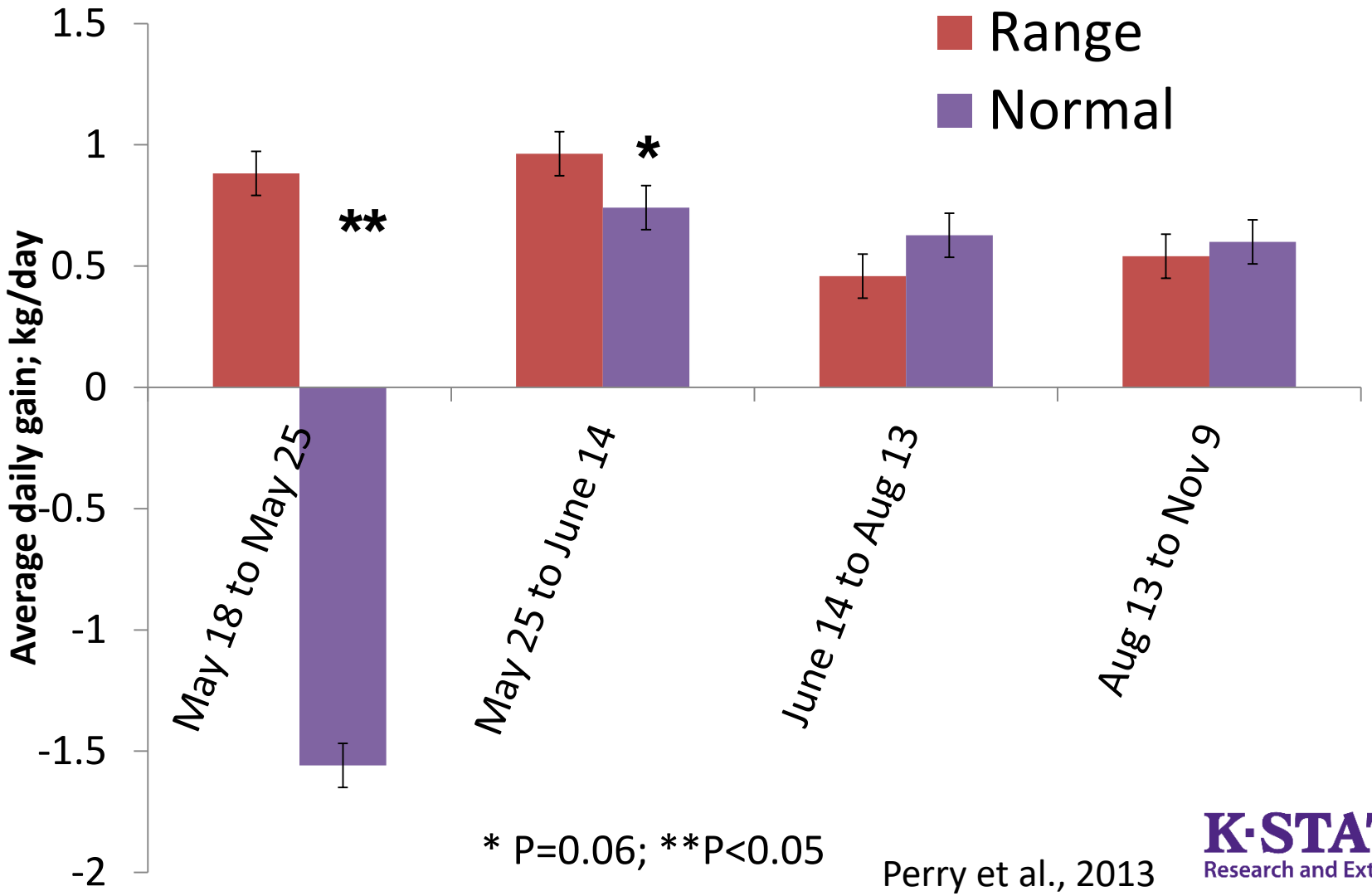
Mackey et al., 1999

Forage vs Drylot (normal) Development



* P=0.06; **P<0.05

Perry et al., 2013

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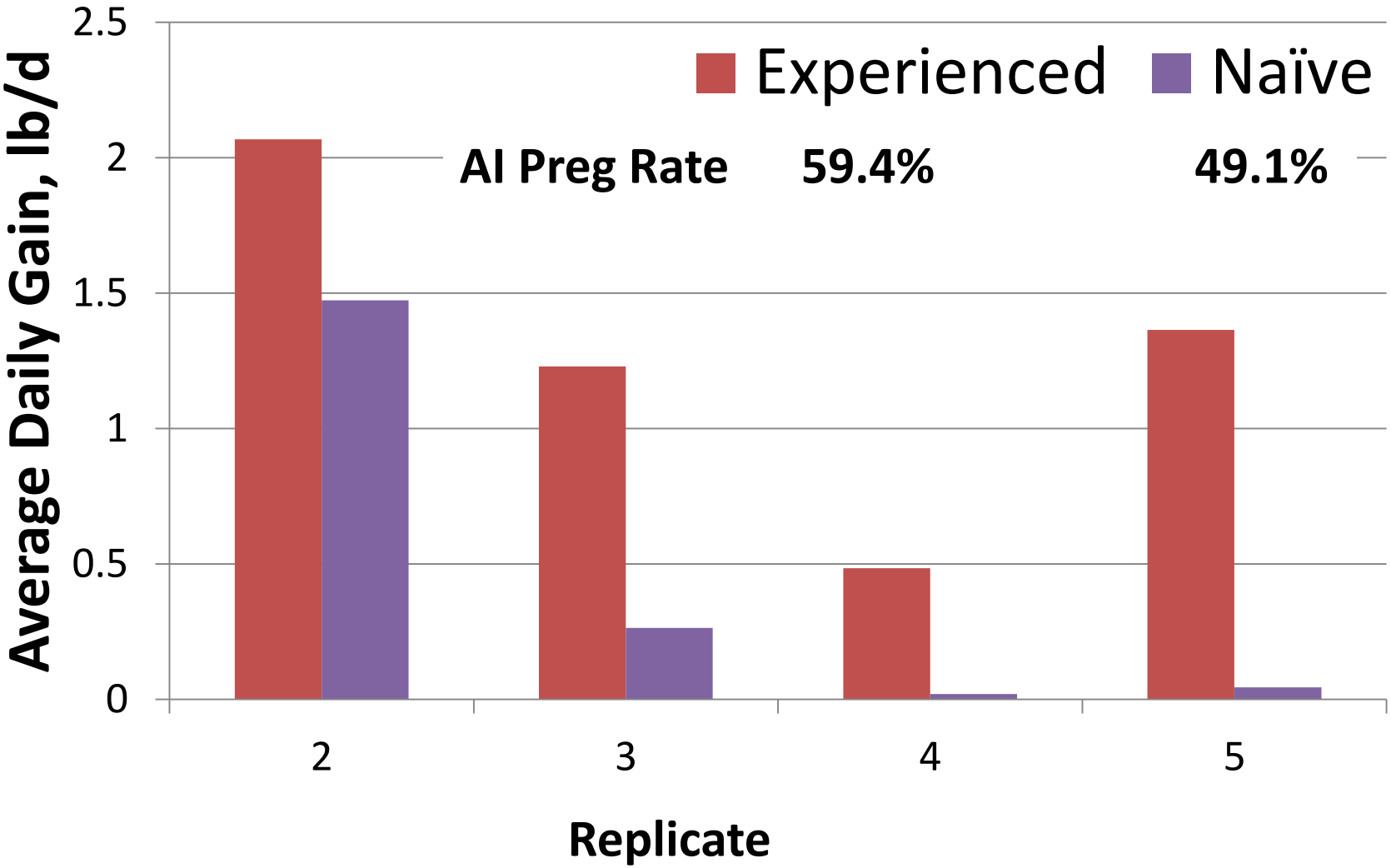

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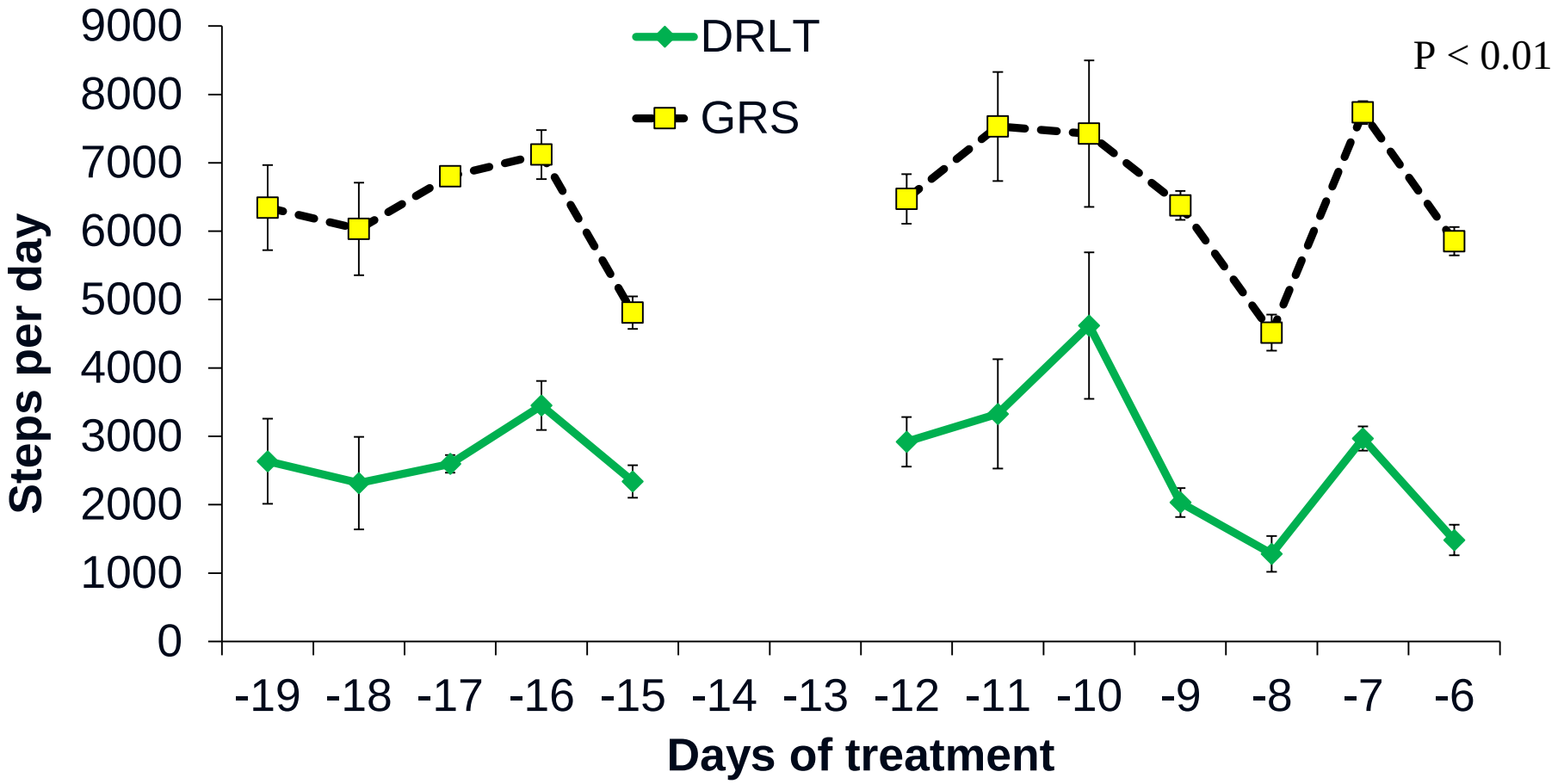
Grazing Behavior Prior to Movement



Perry et al., 2015 Prof Anim Sci 31:264-269

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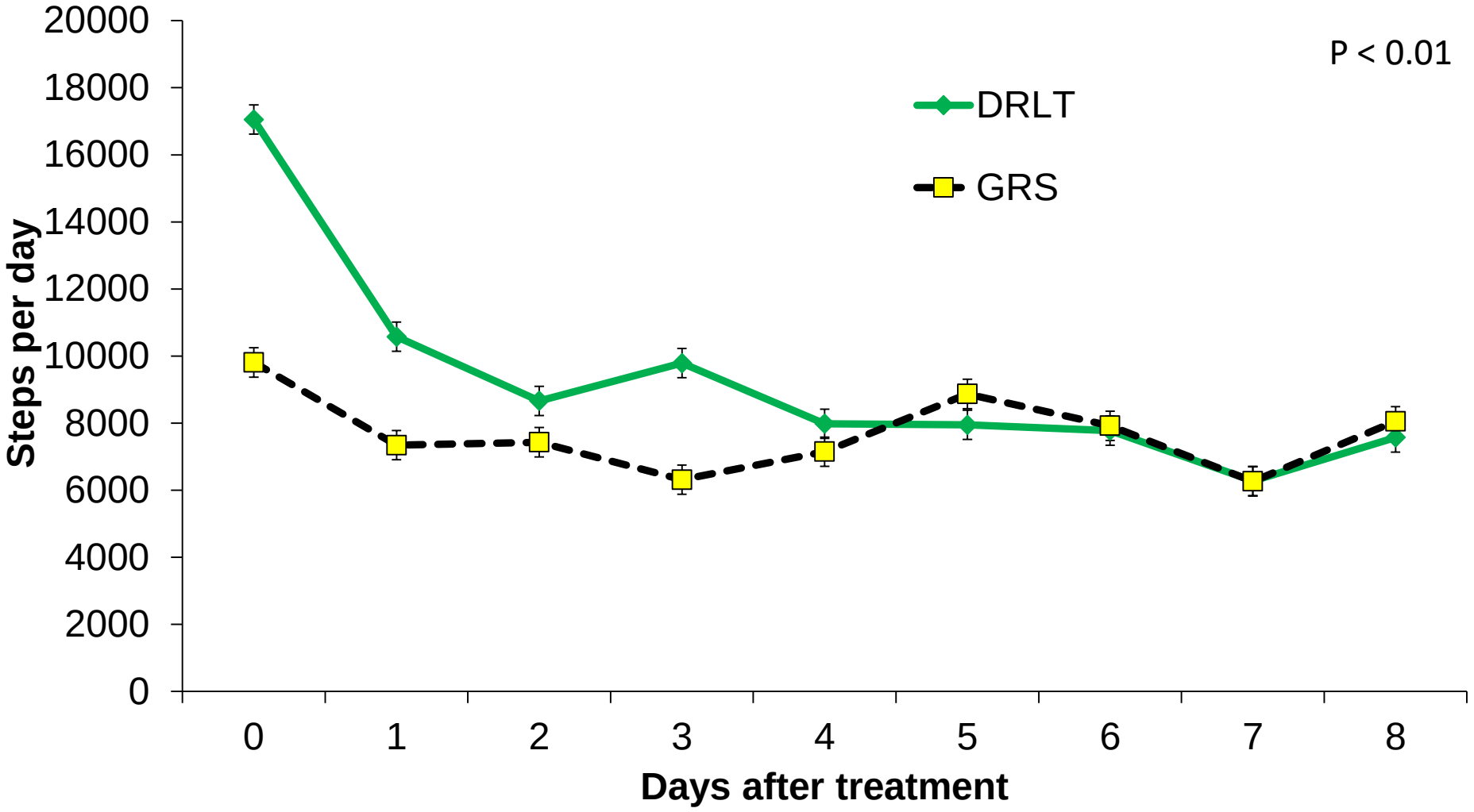
Grazing Behavior after Movement



Perry et al., 2015 Prof Anim Sci 31:264-269

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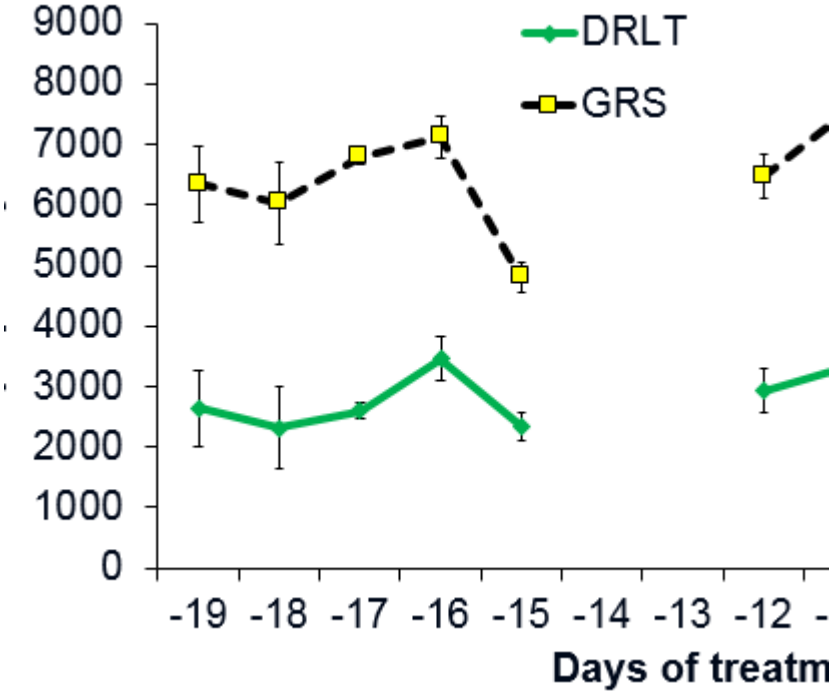
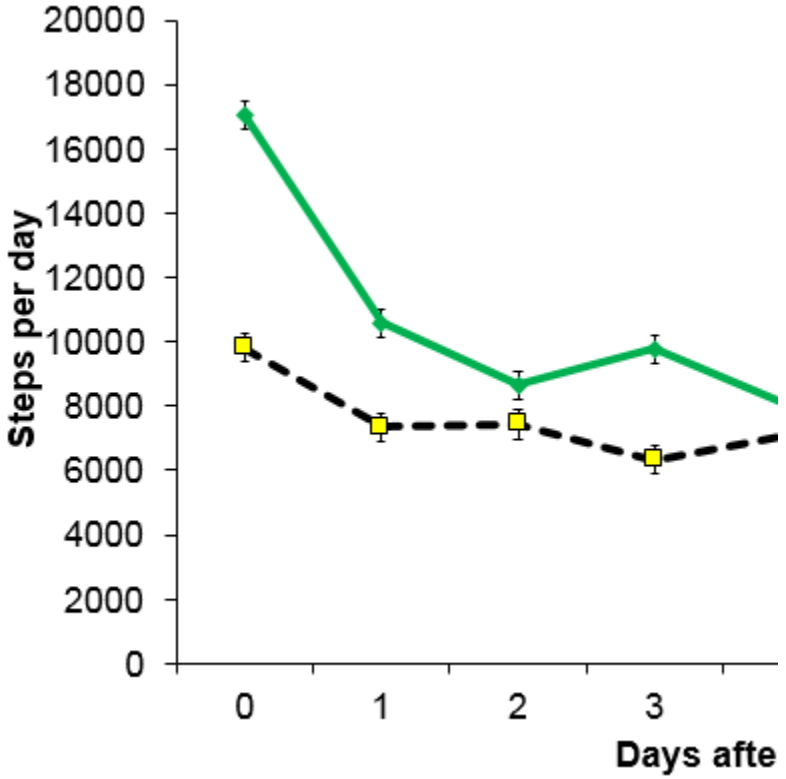
Note scale difference





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Transportation stress

	1-4	8 to 12	29 - 33
n	143	143	144
Synchronized pregnancy rate	74[a]	62[b]	65[b]
Breeding season pregnancy rate	95	94	94
Mean day of conception	9.6[a]	13.4[b]	13.6[b]

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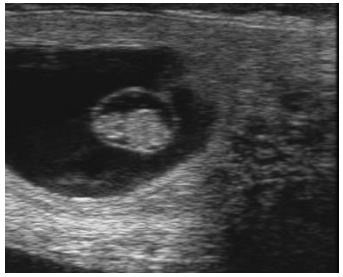
If heifers must be moved after AI, then transportation should be within 3-4 days of breeding or after 42 days.

	1-4	8 to 12	29 - 33
n	143	143	144
Synchronized pregnancy rate	74[a]	62[b]	65[b]
Breeding season pregnancy rate	95	94	94
Mean day of conception	9.6[a]	13.4[b]	13.6[b]



Event	Day
Estrus	0
Fertilization	1
Migration to uterus	5 - 6
Maternal recognition of pregnancy	15-17
Adhesion to uterus	21-22
Placentation	25
Definitive attachment of embryo to uterus	42

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STRESSORS

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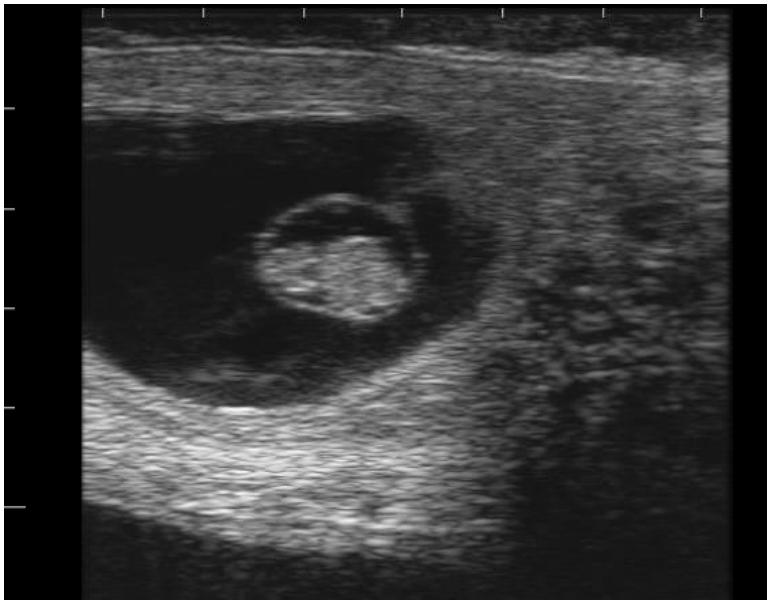
Disease and inflammation



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Effect of temperament

Item	Adequate	Excitable	P Value
n	324	109	
Plasma Cortisol, ng/ml	17.8	22.7	<0.01
Pregnancy rate, %	94.6	88.7	0.03
Calving rate, %	91.8	85	0.04
Weaning rate, %	89.9	83.9	0.09
Calf weaning BW, lbs	545	543	0.71
Lbs calf weaned/cow exposed	490	455	0.08

Cooke et al., 2012

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Effect of acclimatization

Item	Acclimated	Non-Acclimated	P Value
n	44	44	
Plasma Cortisol, ng/ml	26.1	32.8	0.01
Pubertal by 12 months	59.6	37.8	0.01

Cooke et al., 2012

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TEMPERAMENT

Acclimated to handling

- Lower cortisol, higher [LH] and LH pulse frequency
- Earlier puberty, earlier pregnant heifers

Probability of pregnancy is higher when cortisol is lower

Adequate temperament score (≤ 3) higher AI preg rate than Excitable Nelore cows

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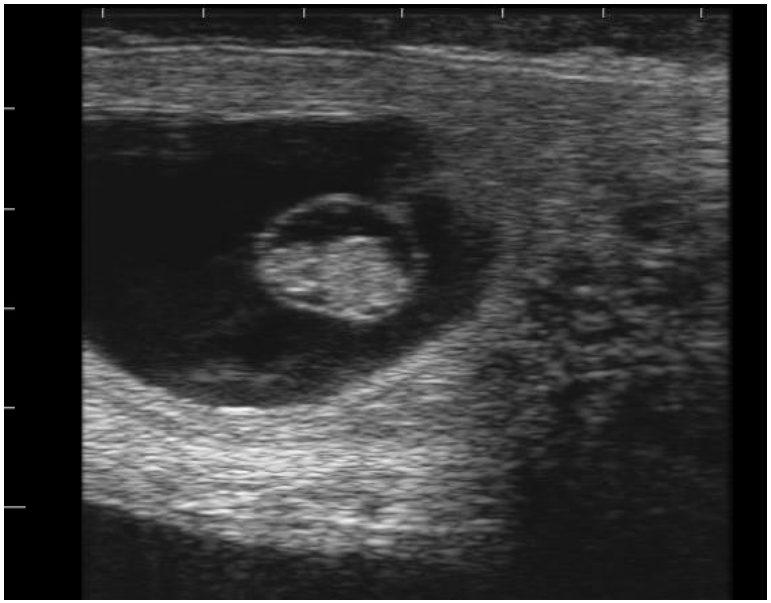
STRESSORS



Temperature

Nutrition

Transportation / relocation

Temperament

Disease and inflammation

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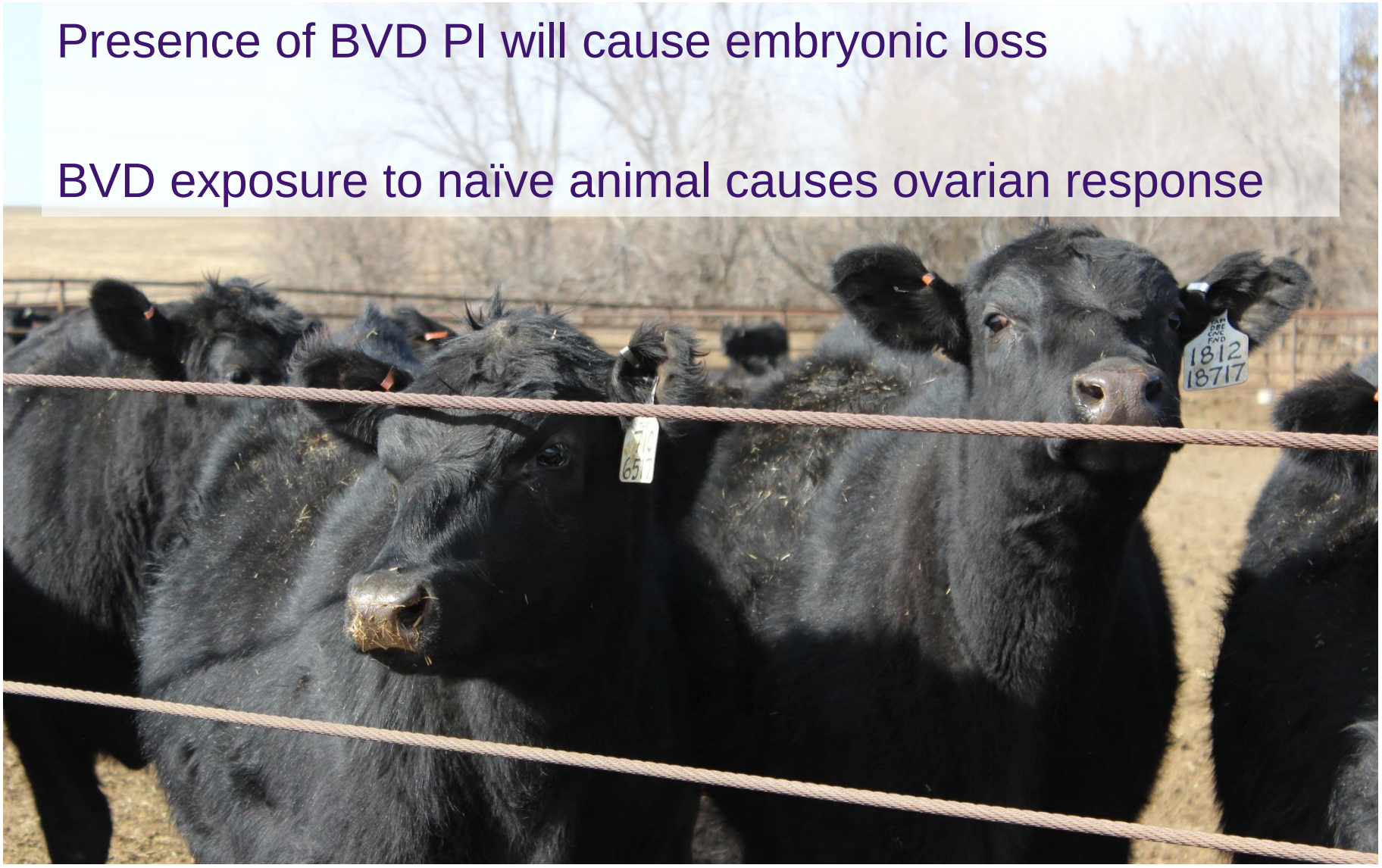
Disease Issues

Presence of BVD PI will cause embryonic loss

BVD exposure to naïve animal causes ovarian response



As production levels (e.g., rate of gain, milk production per day, eggs per day) increase, the sensitivity and tolerance to stress increases and, when coupled with an adverse environment, the animal is at greater risk. Collier et la., 2019

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How to assess temperament

Chute Score

behavior while restrained in chute

Scale

1. *Calm, no movement*
2. *Restless movement*
3. *Frequent movement with vocalization*
4. *Constant movement, vocalization, shaking of chute*
5. *Violent and continuous struggling*

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HOW TO ASSESS TEMPERAMENT

Exit Velocity or Score

Speed of animal after it leaves chute

Measurement

Electronic – Classify on feet/second

Visual

1=walks away from chute

2=trots away from chute

3=runs away from chute

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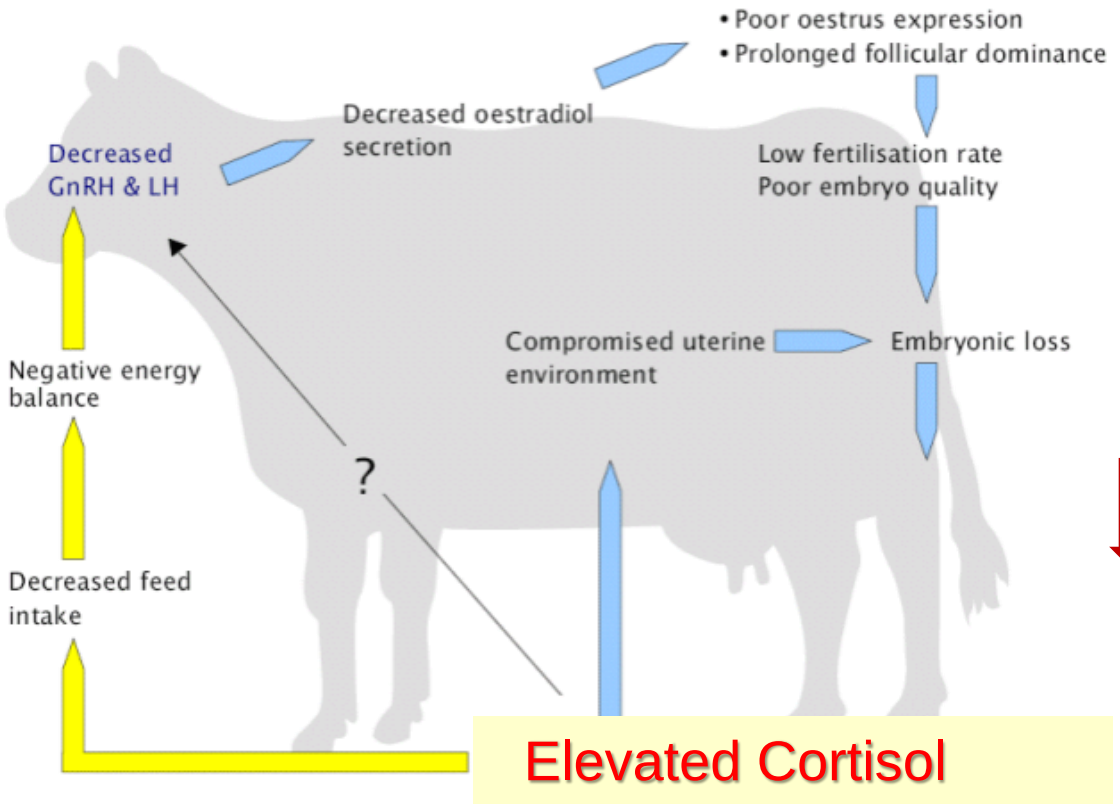
Stress and reproduction



Ovulation success

+

Luteal development

+

Pregnancy maintenance

=

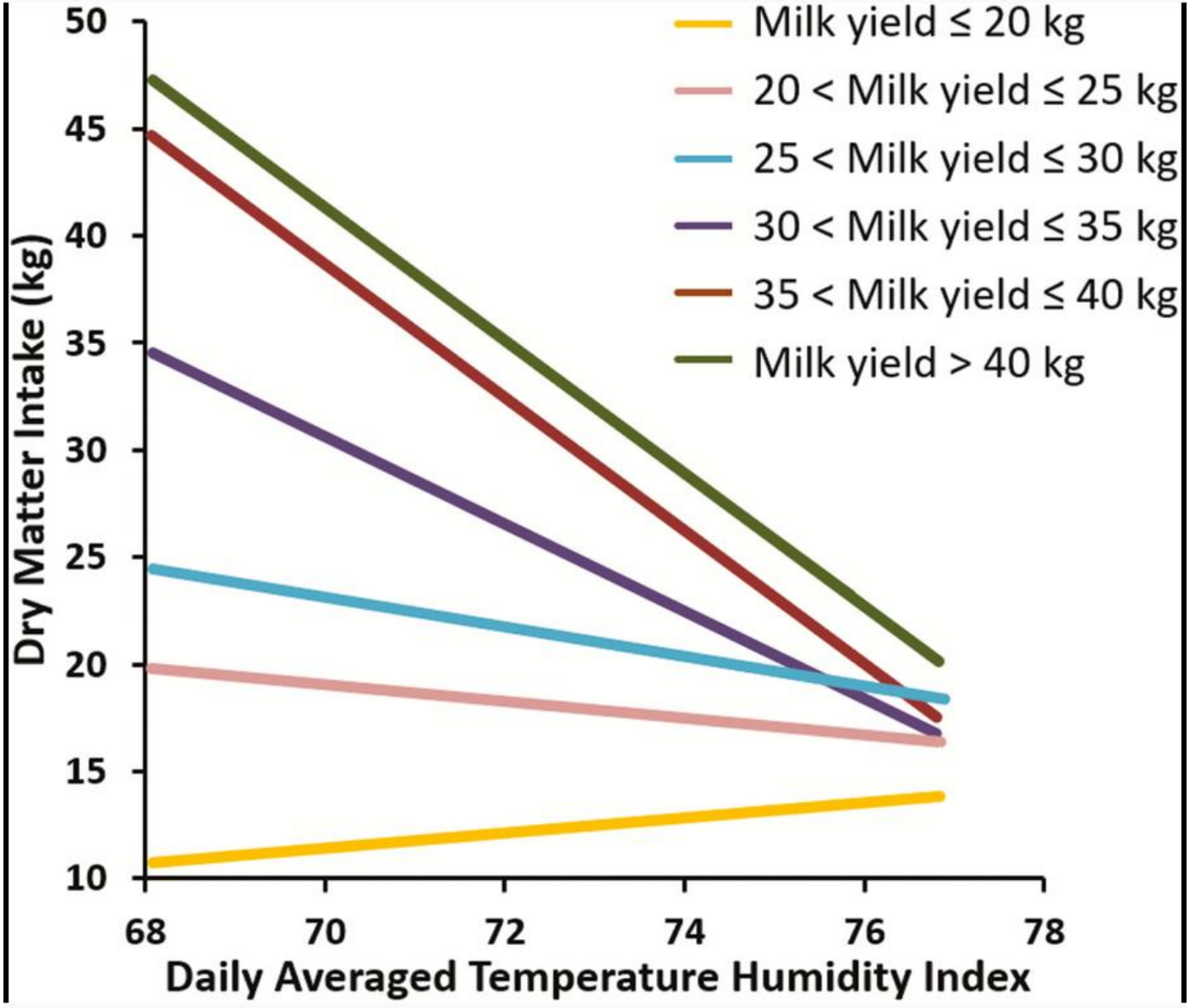
Reproductive failure

Less heat stress (vaginal temp & sweating rate)

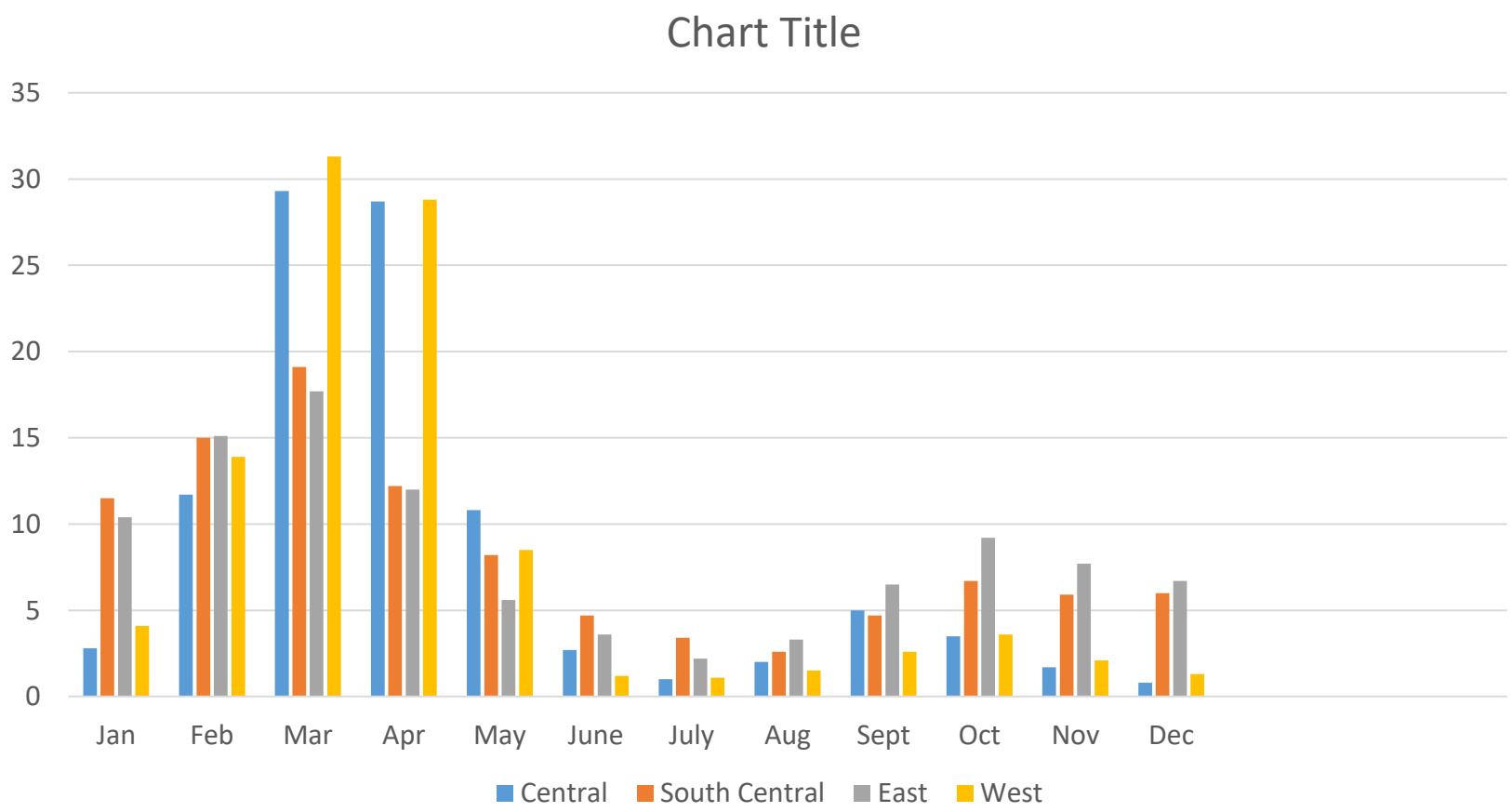
- heifers that were calm in the chute
- Shorter, smoother hair coats

Hamblen et al., 2018

- Night-time cooling
- THI
- Aclimitization


Milk yield ≤ 20 kg
20 < Milk yield ≤ 25 kg
25 < Milk yield ≤ 30 kg
30 < Milk yield ≤ 35 kg
35 < Milk yield ≤ 40 kg
Milk yield > 40 kg
Dry Matter Intake (kg)
50
45
40
35
30
25
20
15
10
68
70
72
74
76
78
Daily Averaged Temperature Humidity Index

Percentage of Calves born by month, NAHMS 2007-2008

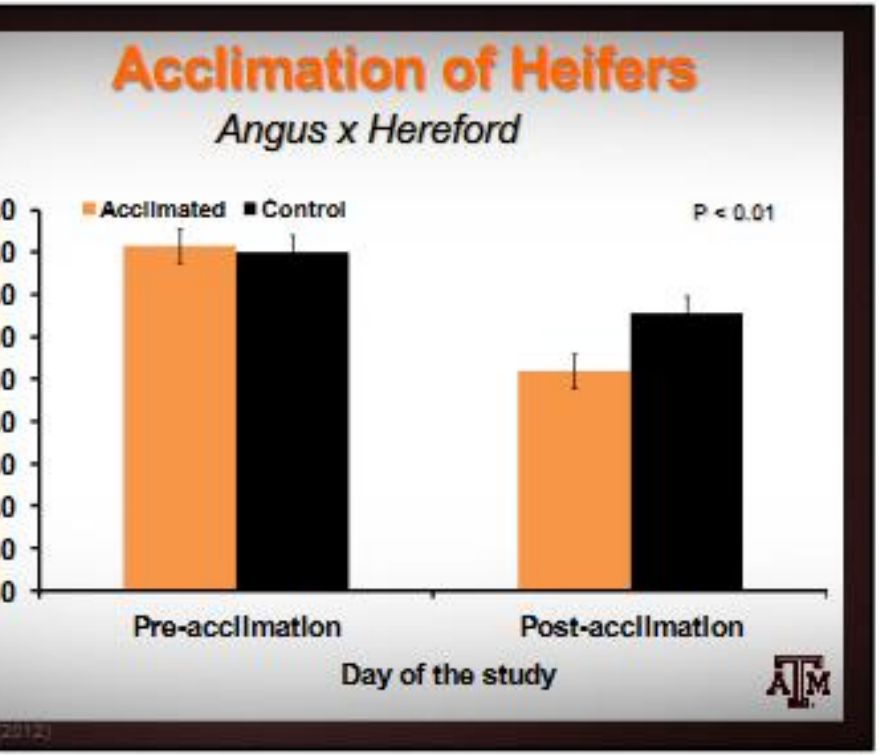


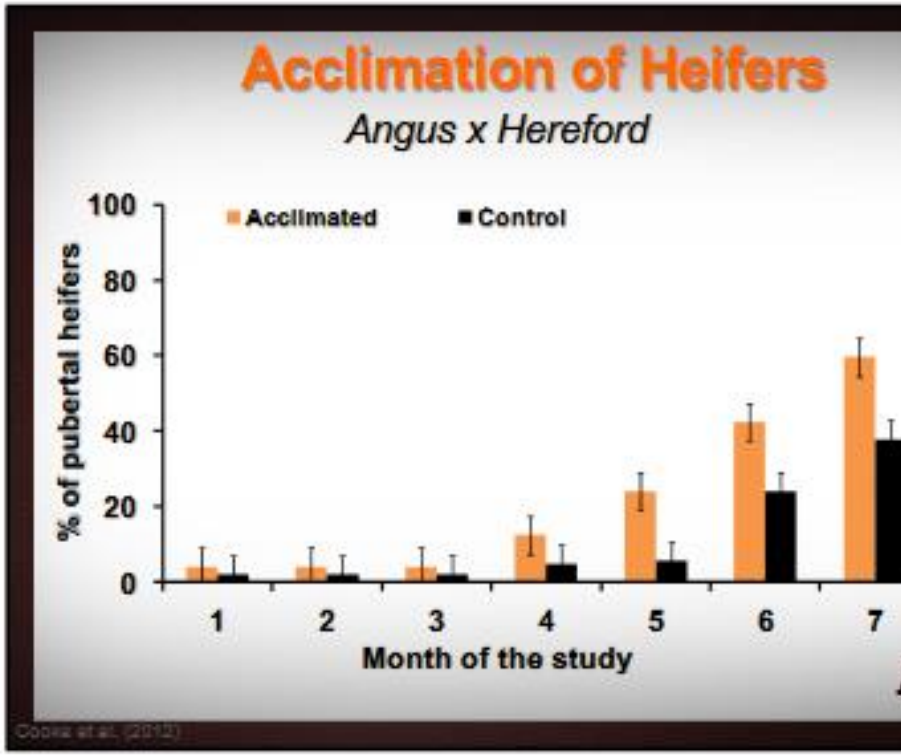
Temperament x Reproduction

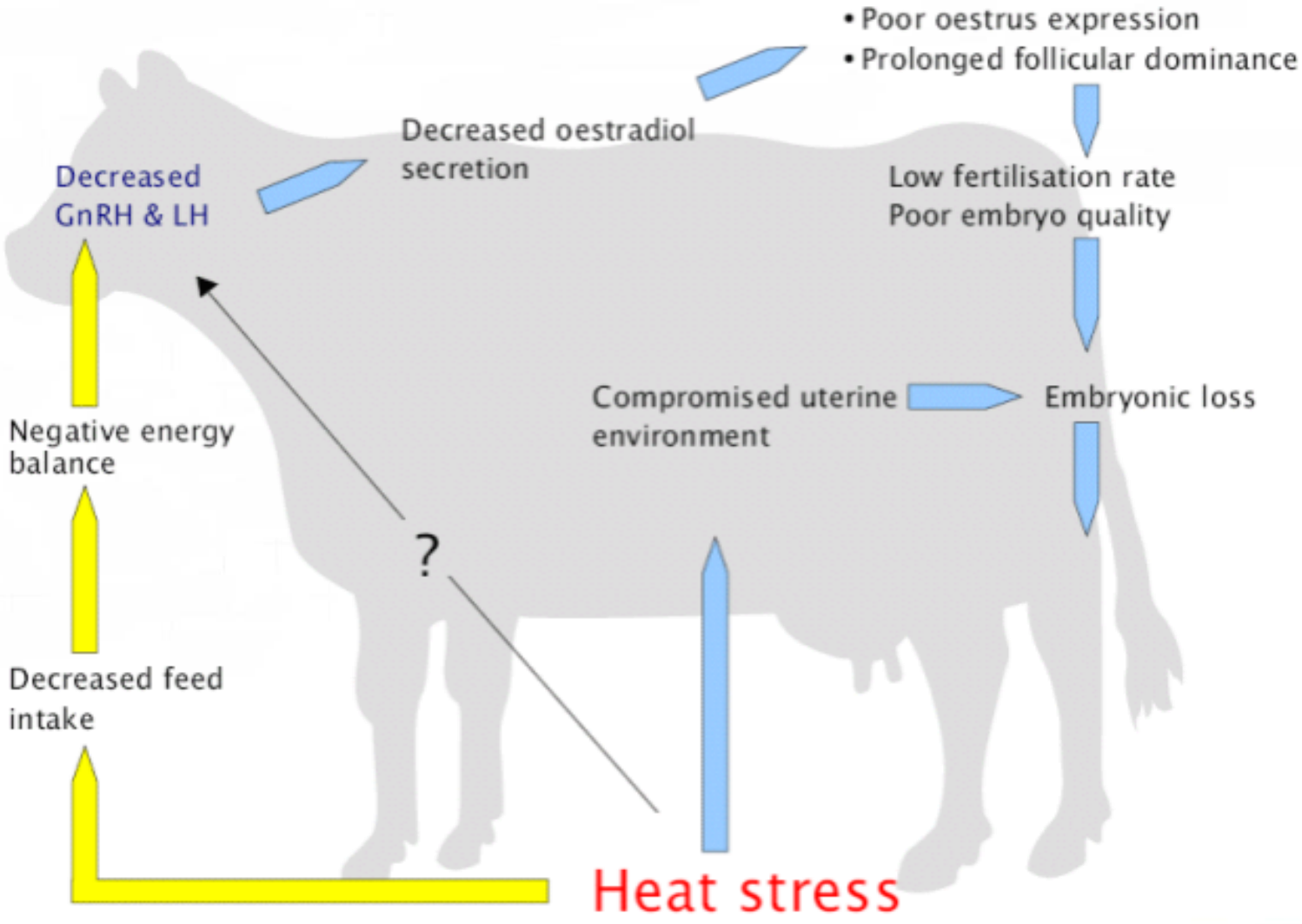
Angus x Hereford cows

Item	EXC	ADQ	SEM	P=
Breeding season	n = 109	n = 324	-	-
Plasma cortisol at AI, ng/mL	22.7	17.8	0.8	< 0.01
Pregnancy rates, %	88.7	94.6	1.9	0.03
Pregnancy loss, %	3.8	2.8	1.3	0.63
Calving rate, %	85.0	91.8	2.2	0.04
Weaning results				
Calf weaning BW, lbs	543	545	5	0.71
Weaning rate, %	83.9	89.9	2.4	0.09
Calf BW/cow exposed, lbs	455	490	6	0.08
Weaning return/cow, $	820	882	12	0.01

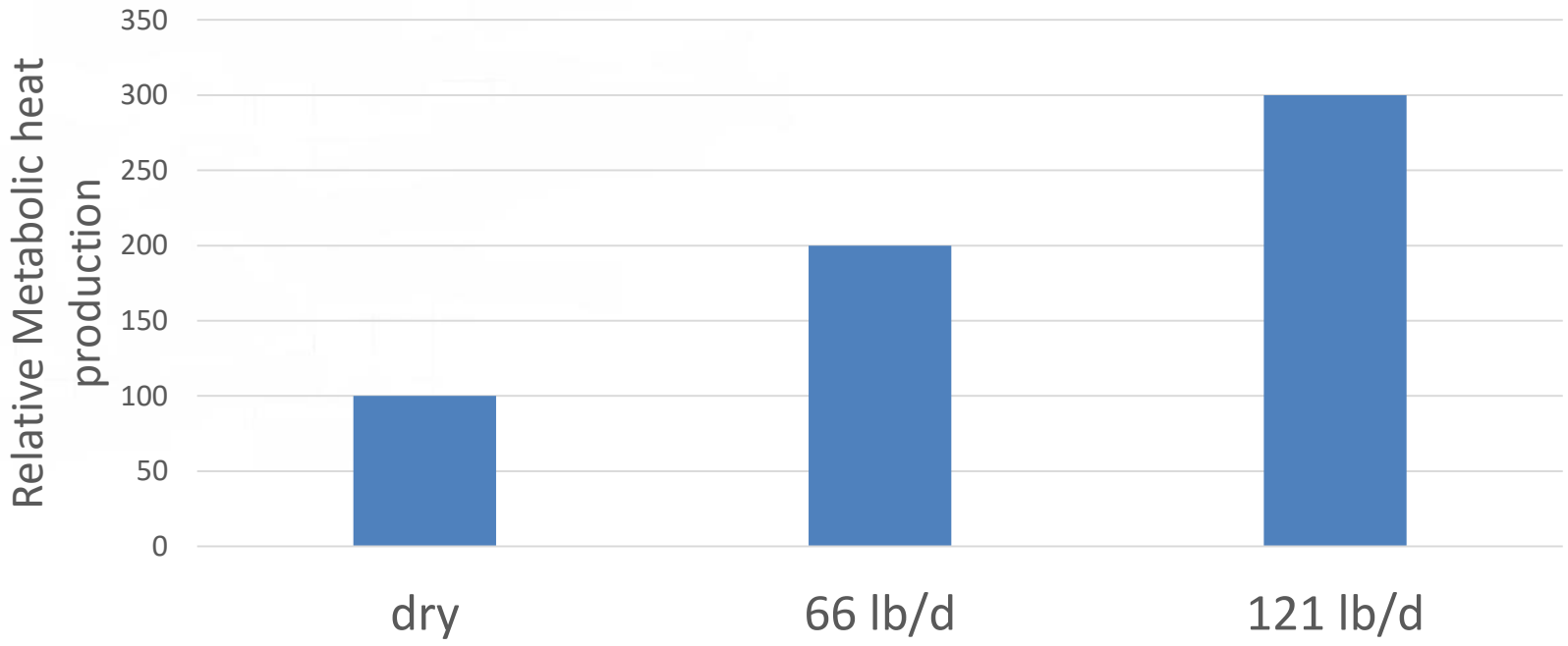
Cooke et al. (2012)

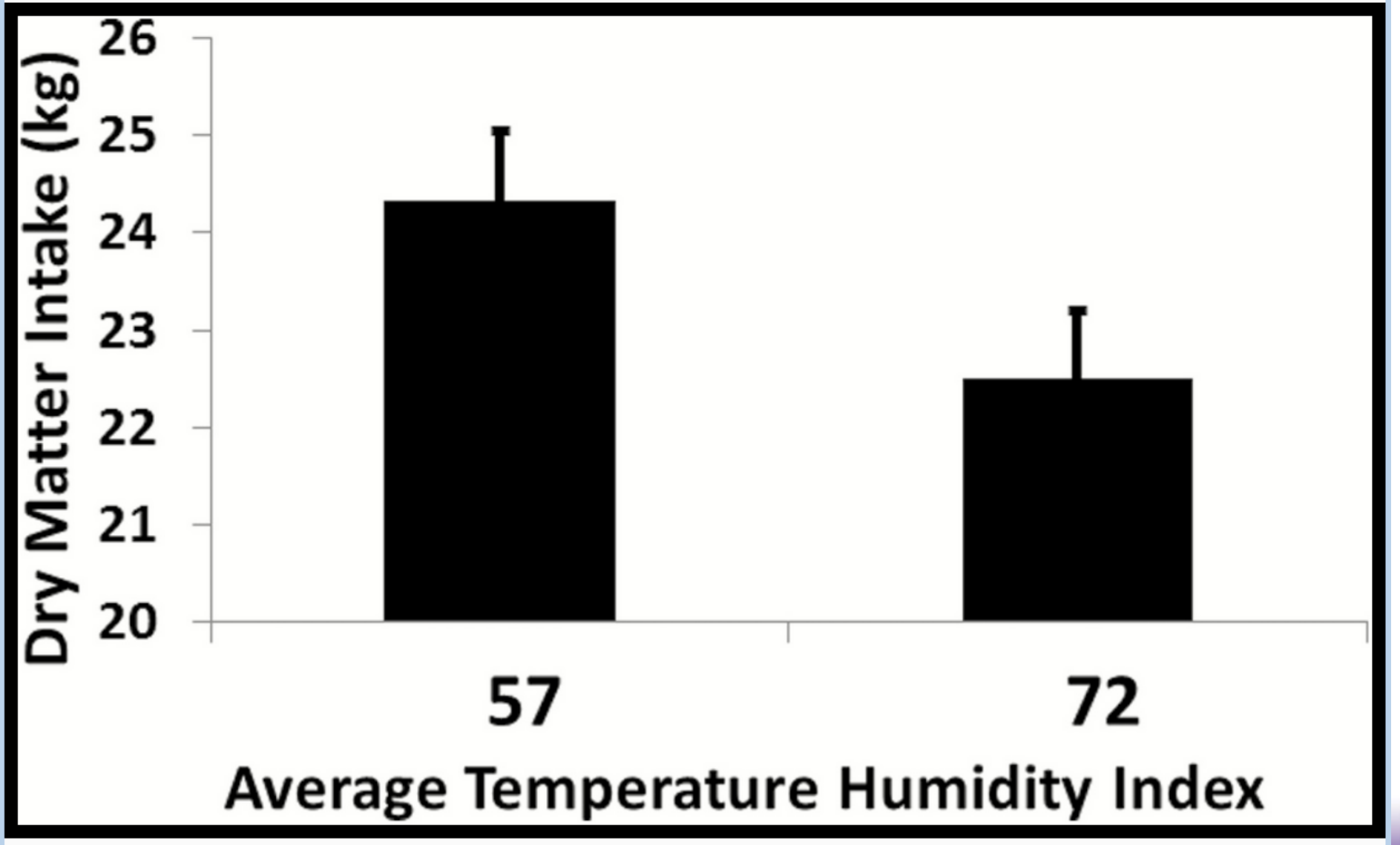

Acclimation of Heifers
Angus x Hereford
Acclimated
Control
P < 0.01
Pre-acclimation
Post-acclimation
Day of the study


Acclimation of Heifers
Angus x Hereford
Acclimated
Control
% of pubertal heifers
100
80
60
40
20
0
1
2
3
4
5
6
7
Month of the study


• Poor oestrus expression
• Prolonged follicular dominance
Decreased oestradiol secretion
Decreased GnRH & LH
Low fertilisation rate
Poor embryo quality
Compromised uterine environment
Embryonic loss
Negative energy balance
?
Decreased feed intake
Heat stress

Effect of milk production on metabolic heat production




Dry Matter Intake (kg)
26
25
24
23
22
21
20
57
72
Average Temperature Humidity Index