Coping with repro challenges during heat stress

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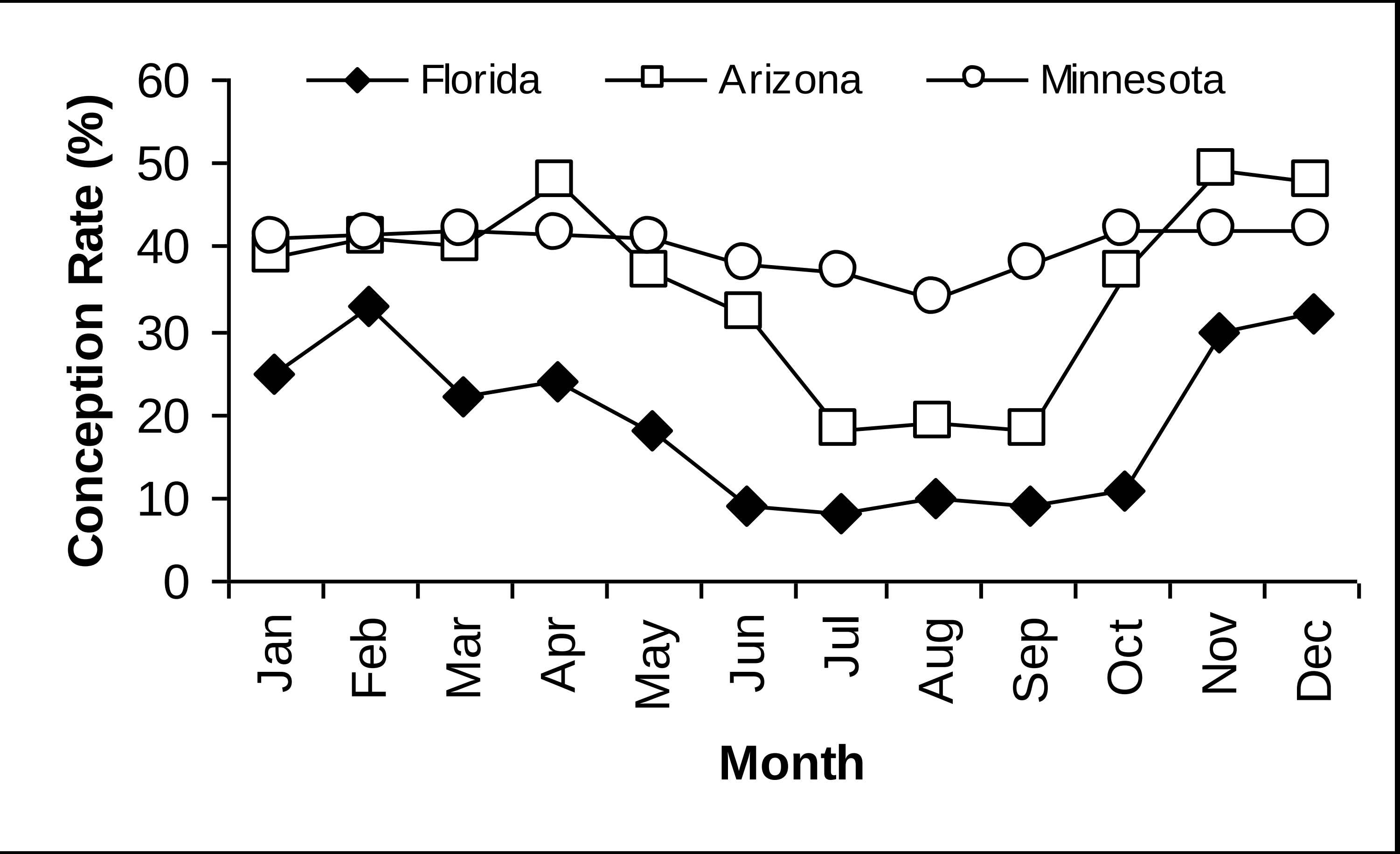
Conception Rate in United States Dairy Cows



Adapted from Hansen (1997)

Ambient temperature and pregnancy rate

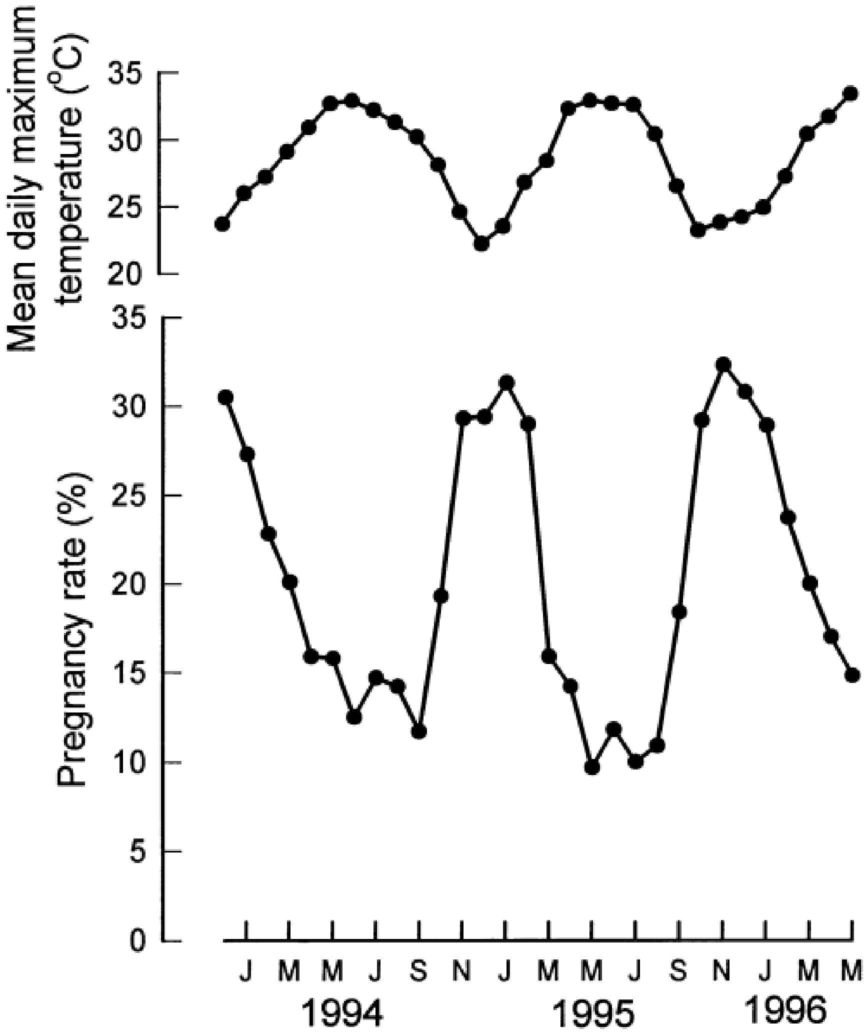
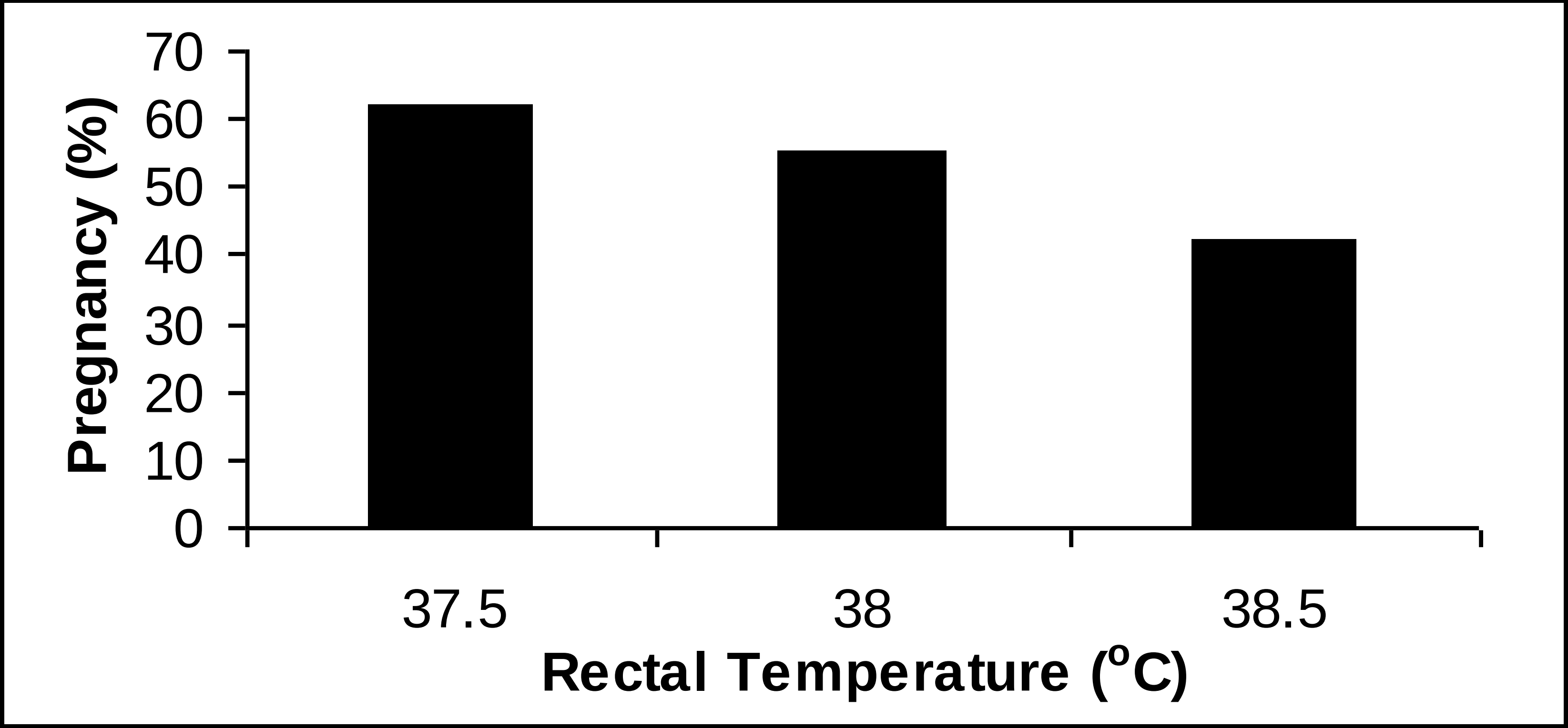


Figure 1. Seasonal variation in pregnancy rate (percentage of inseminations in which pregnancy was established) on a commercial dairy in South Florida in which cows were maintained in a facility with shade, fans, and sprinklers.

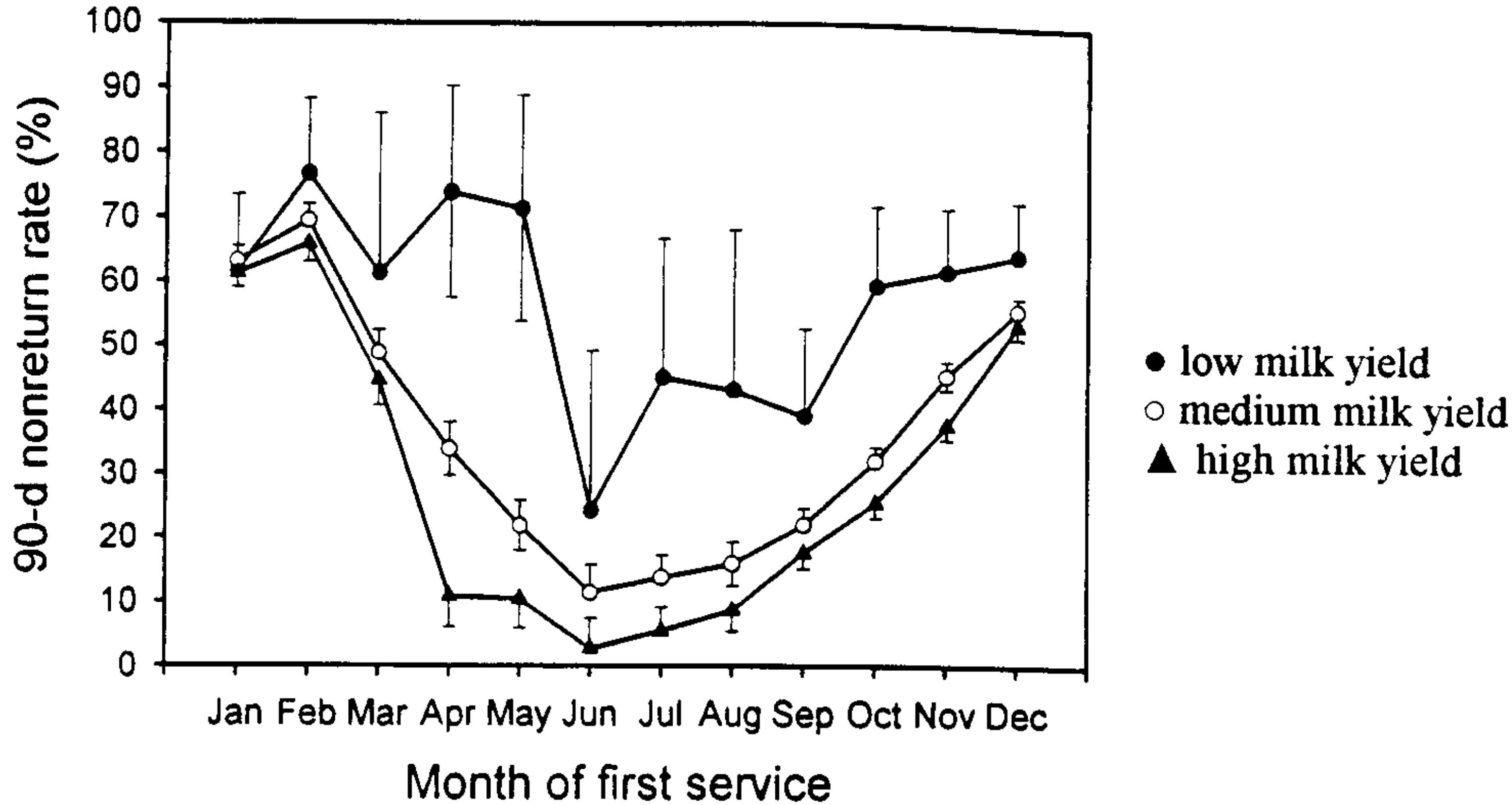
Hansen and Aréchiga, 1999

Pregnancy rates for cattle with different rectal temperatures at the time of breeding



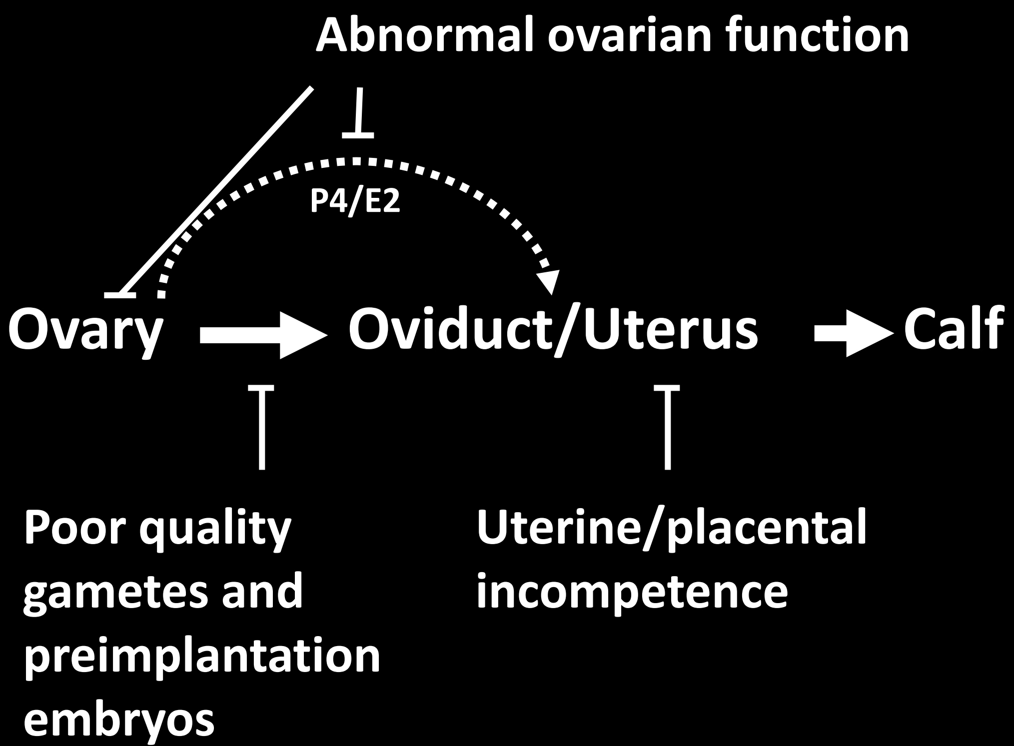
Ulberg and Burfening (1967)

Seasonal Influence of Milk Production on Reproduction

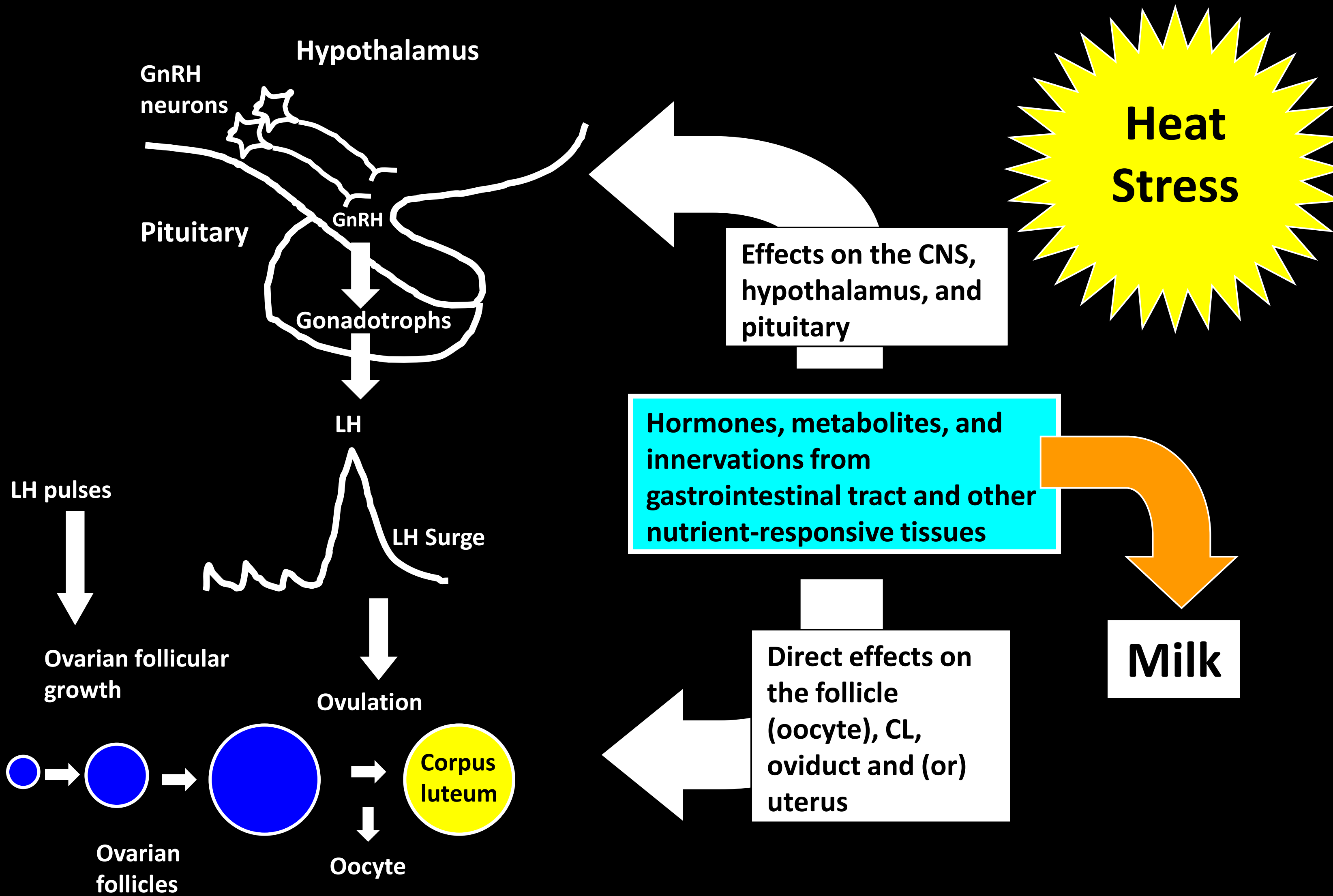


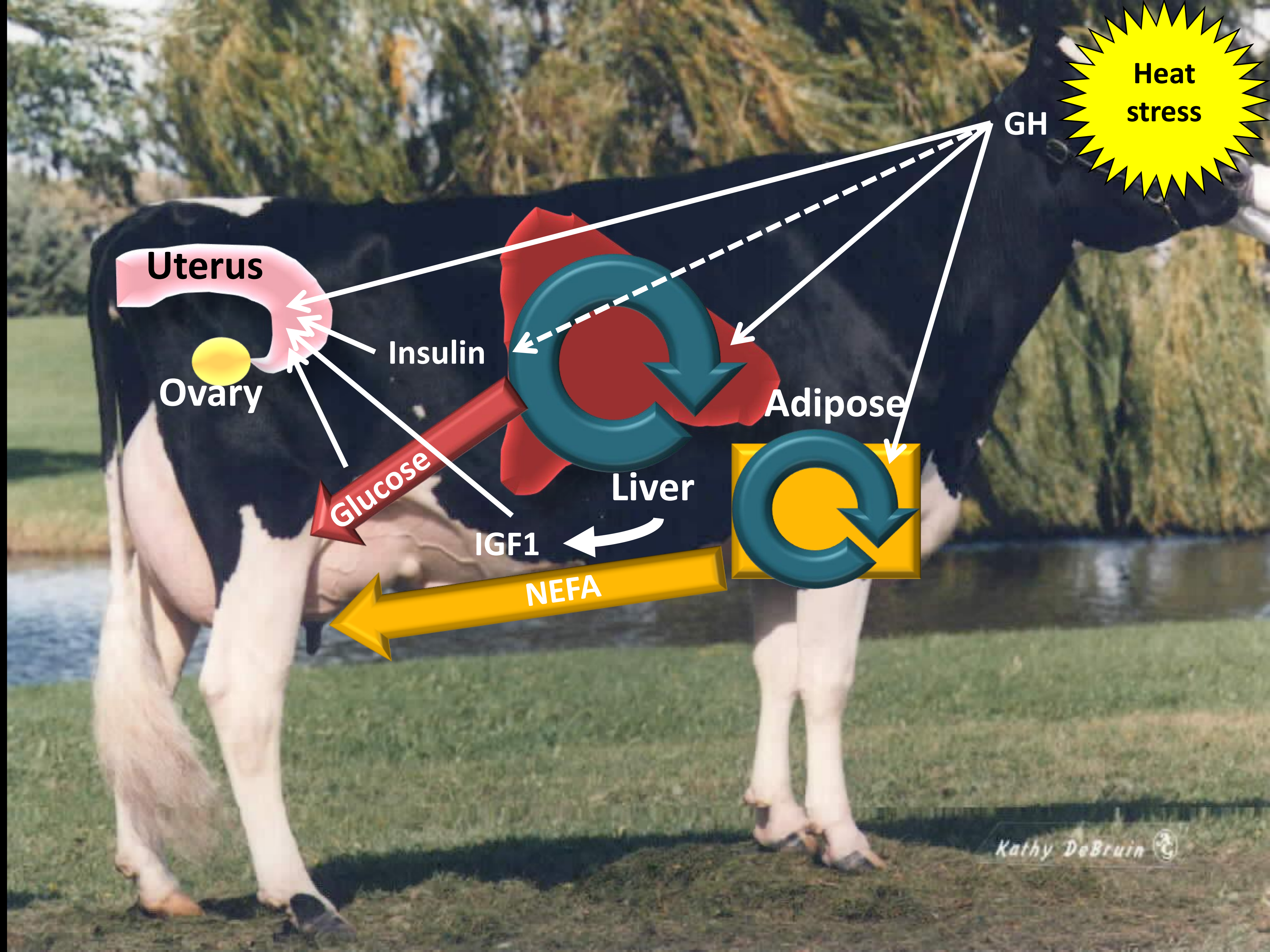
Al-Katanani et al. (1999)

Dairy cow fertility

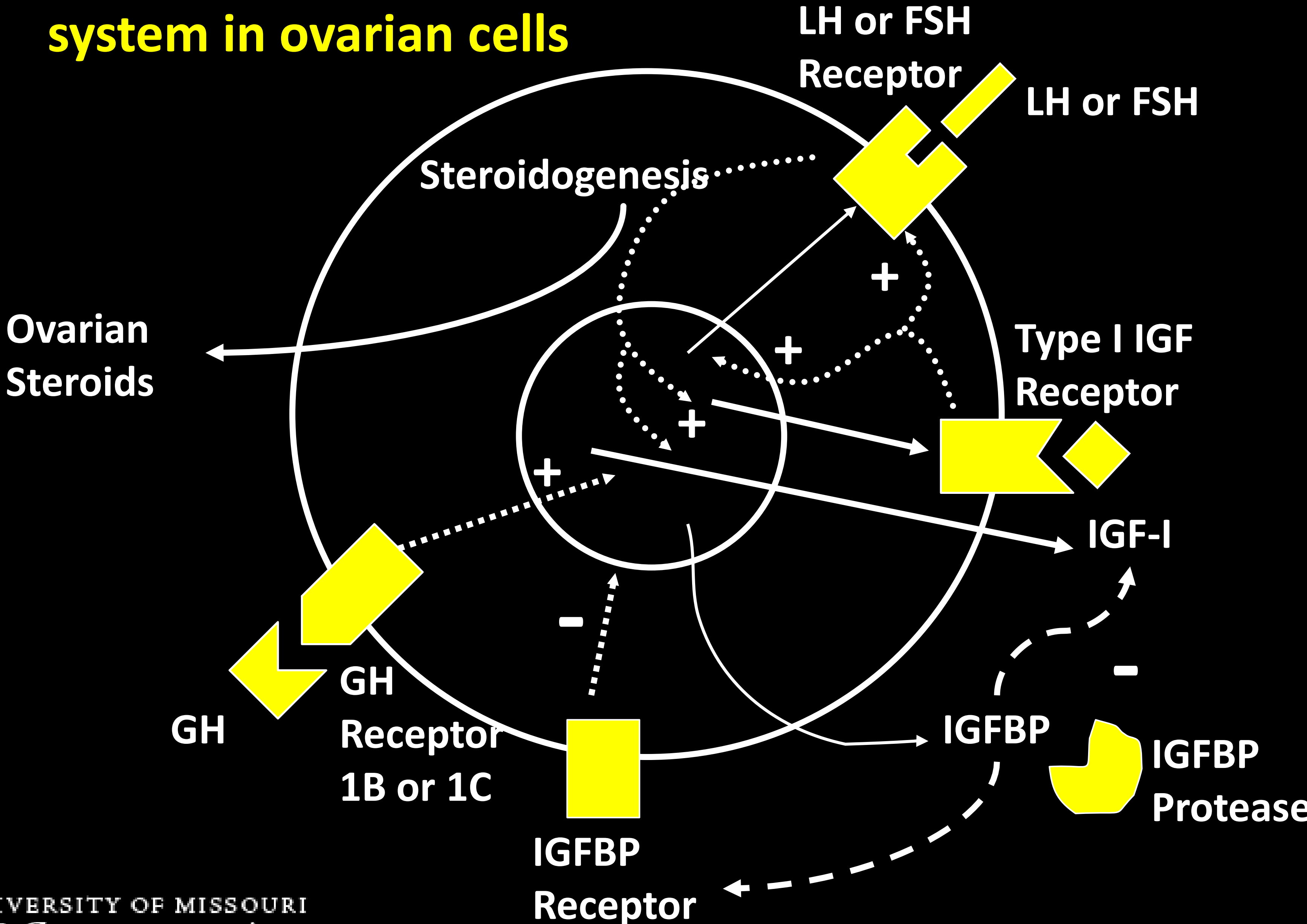


Nutrition/reproduction/heat stress model

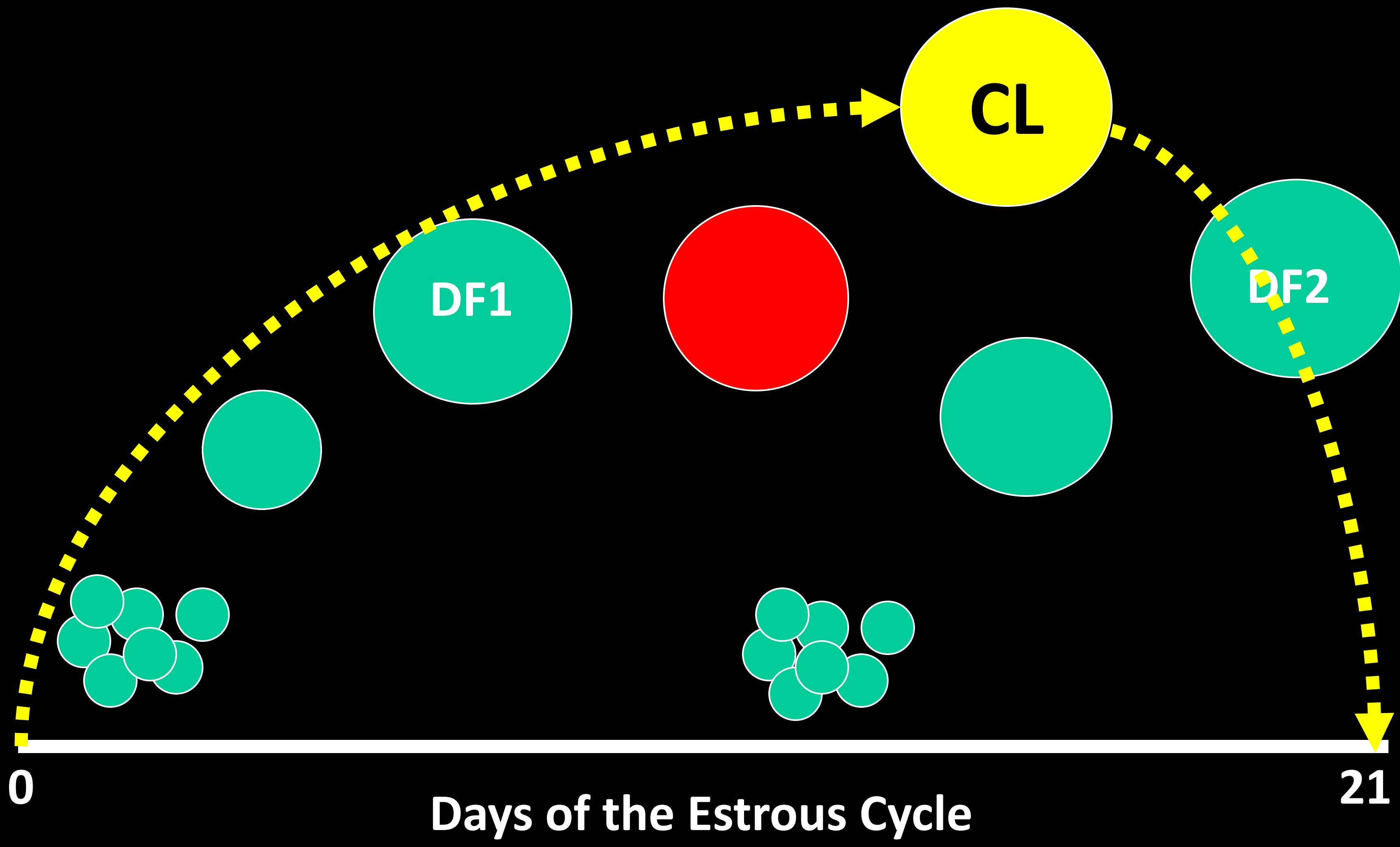



Heat stress
GH
Uterus
Insulin
Ovary
Adipose
Glucose
Liver
IGF1
NEFA
Kathy DeBruin

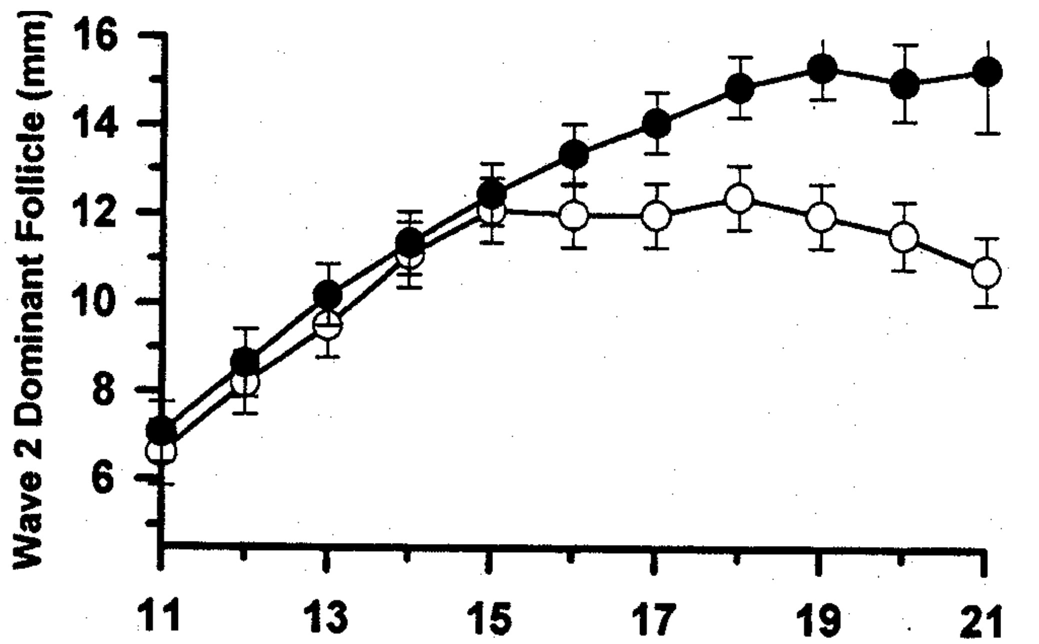
Gonadotropins and the IGF system in ovarian cells



The estrous cycle of cattle



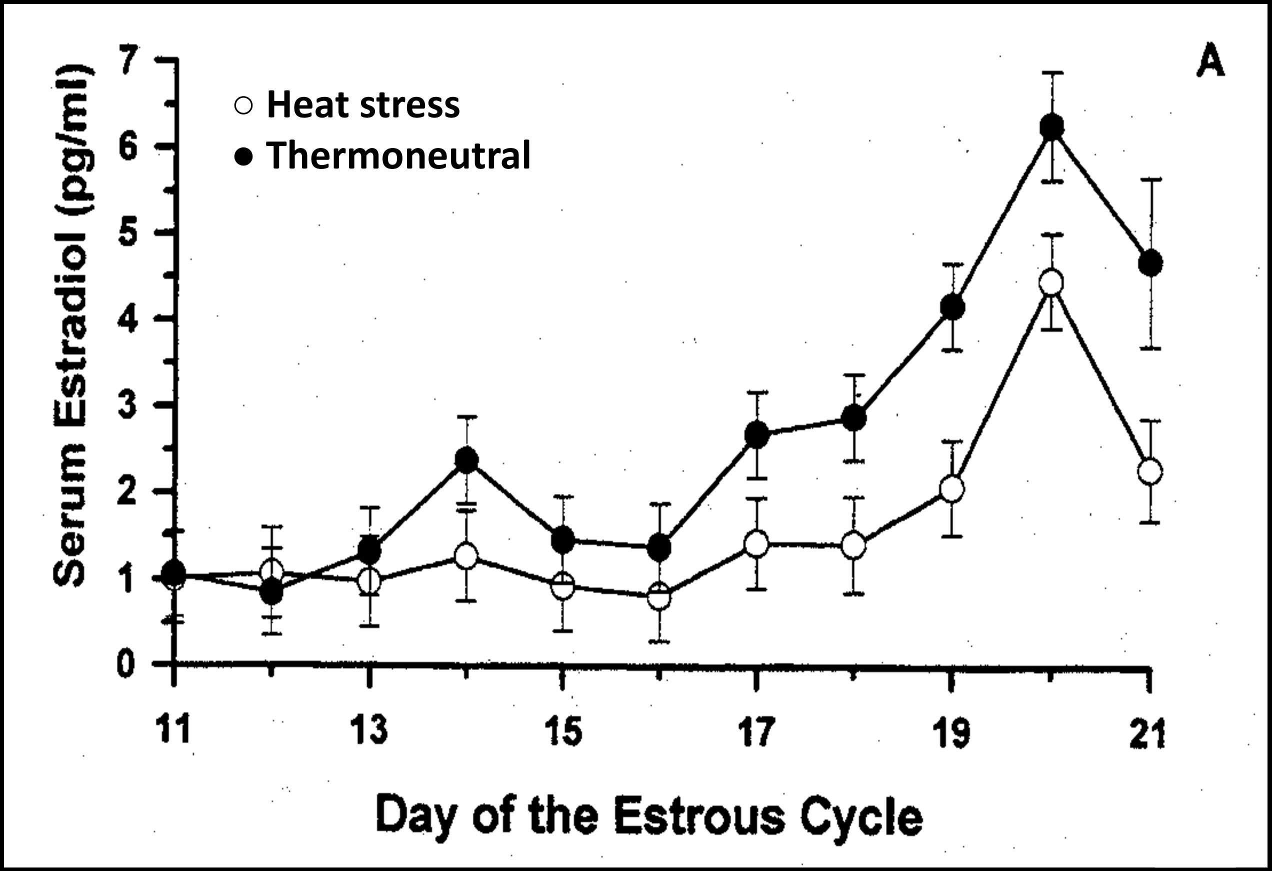
Dominant follicle diameter in heat-stressed heifers



○ Heat stress
● Thermoneutral

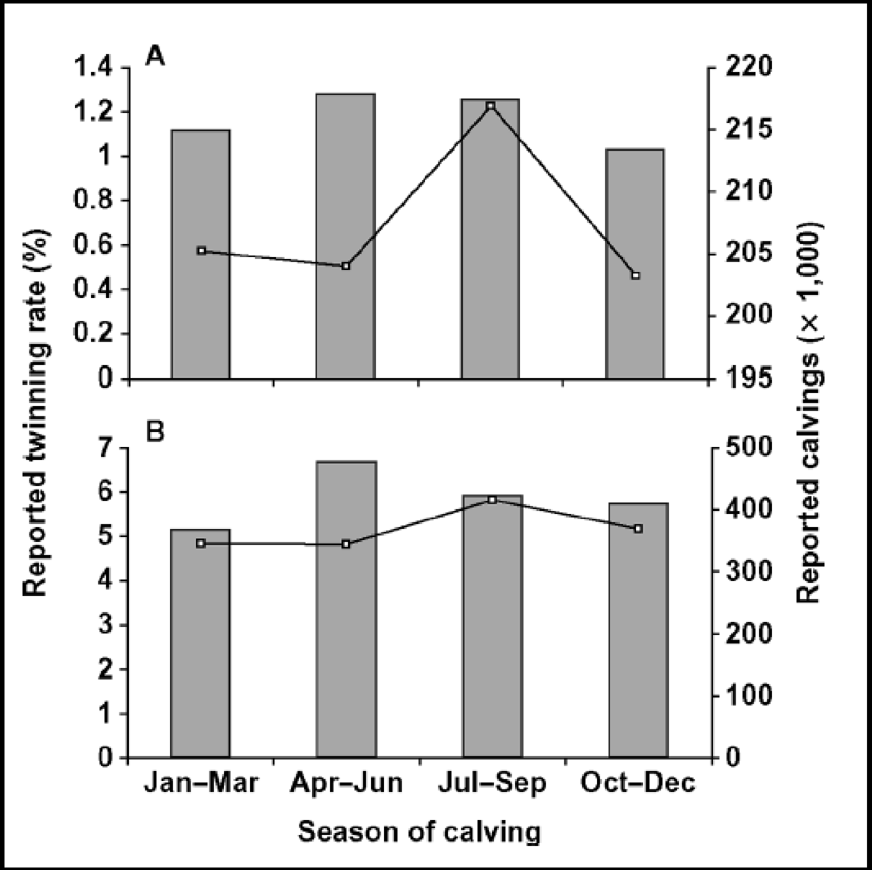
Wilson et al. (1998) J Dairy Sci. 81:2132-2138.

Serum estradiol in heat-stressed heifers



Wilson et al. (1998) J Dairy Sci. 81:2132-2138.

Twinning



August to October conception
OR = 1.2

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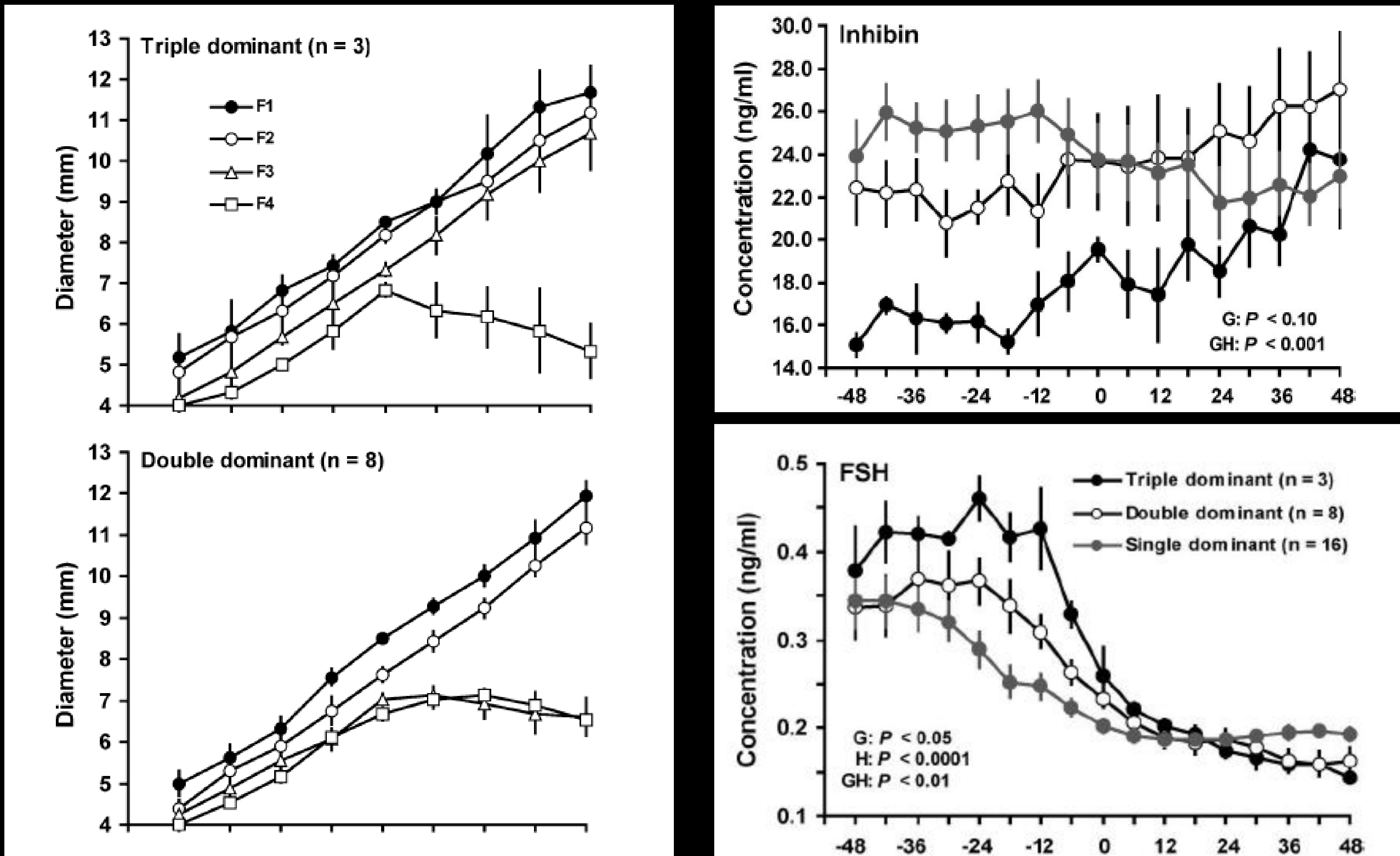
Silva del Rio et al. (2007) J. Dairy Sci. 90:1255-1264.

Multiple ovulation (twinning)



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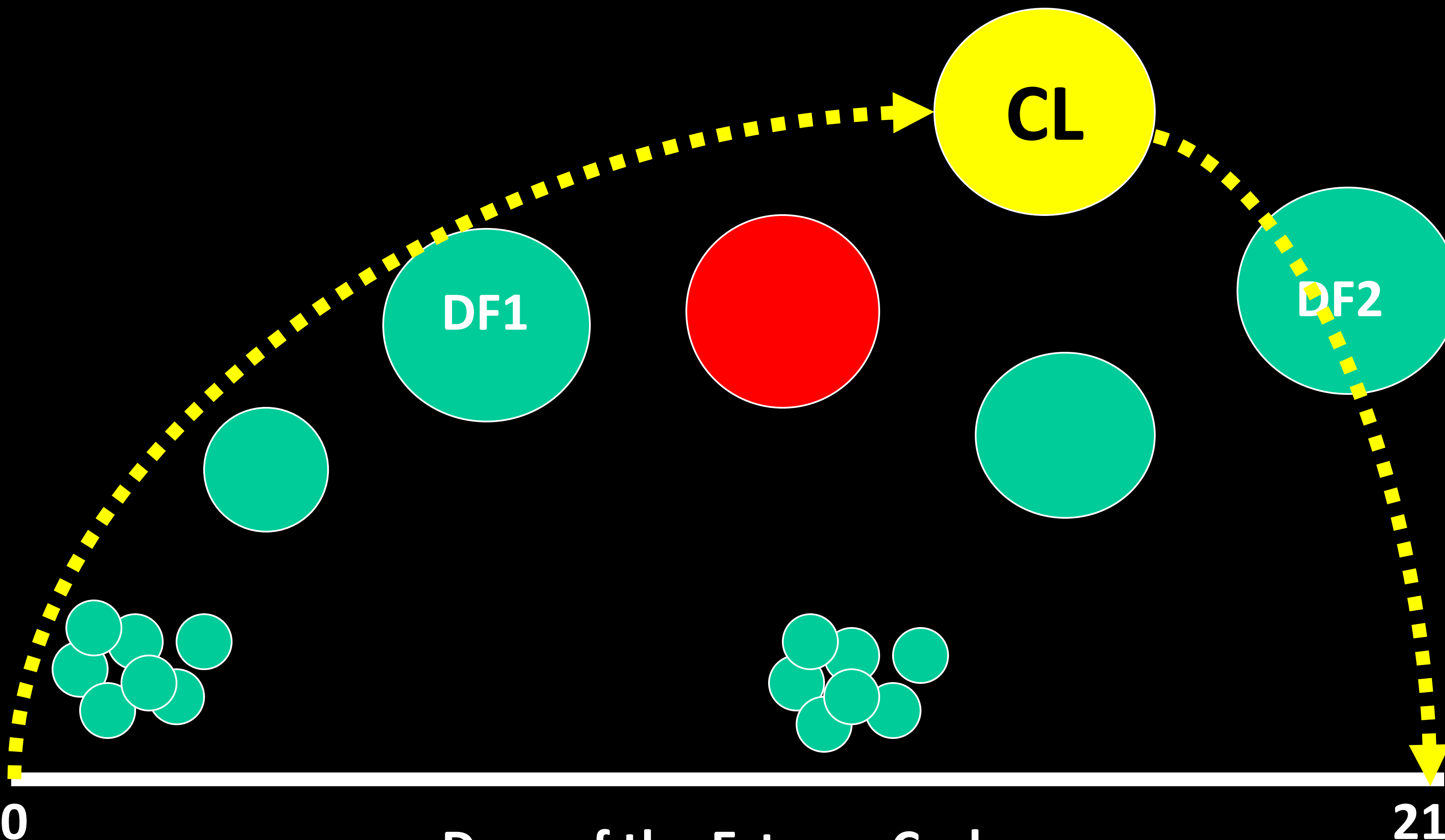
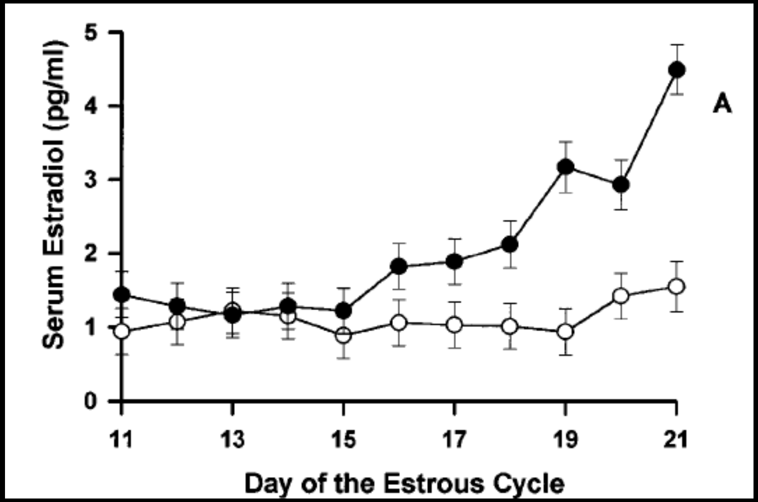
Lopez et al. (2005) Biol. Reprod. 72:788-795.

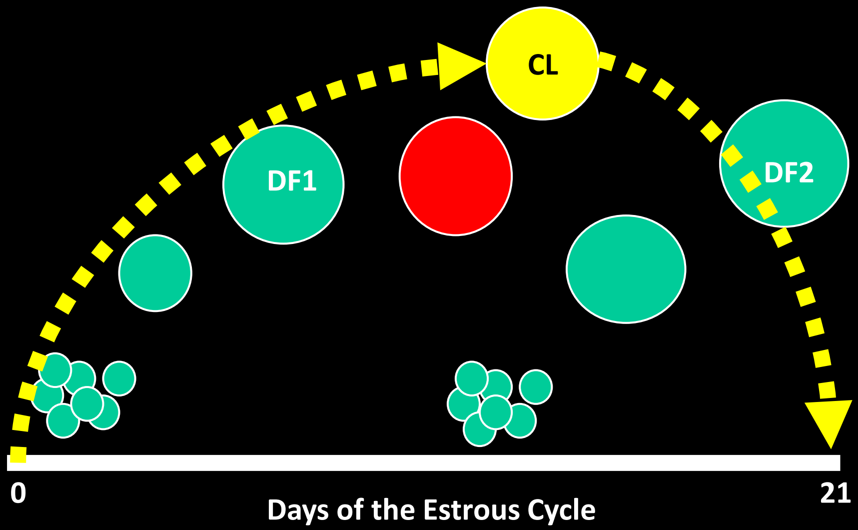
Effects of heat stress on the corpus luteum

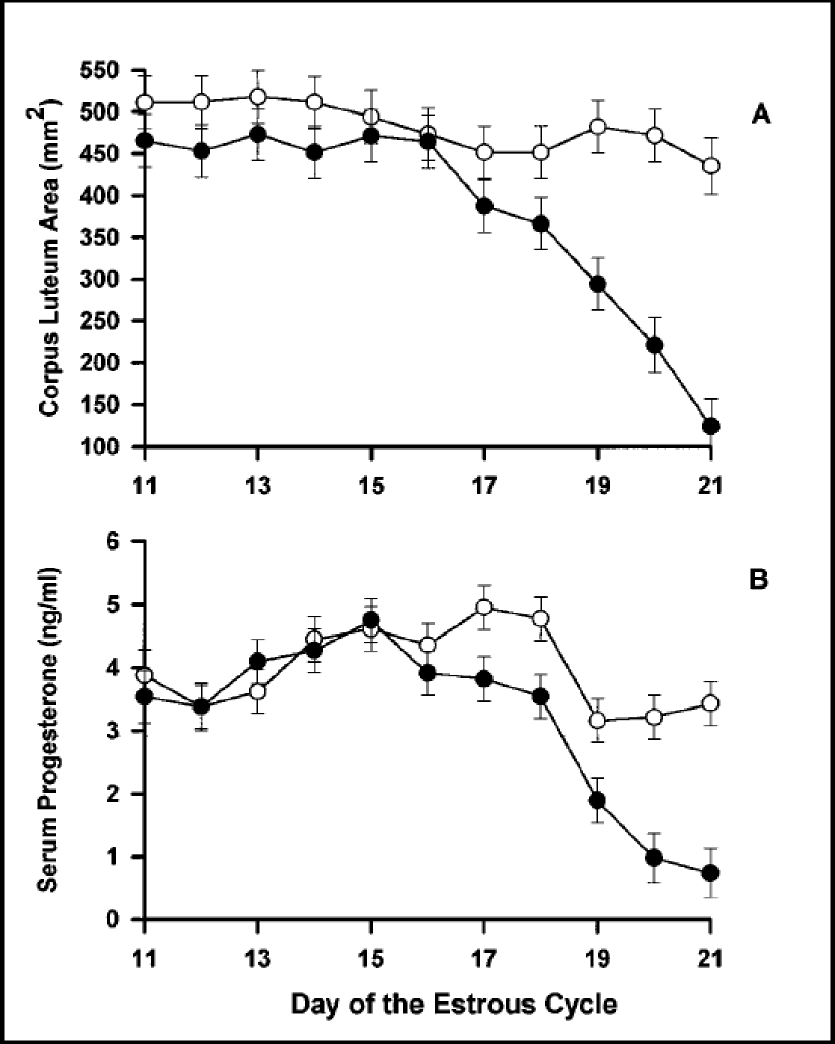


Days of the Estrous Cycle

Corpus luteum regression in heat-stressed dairy cows







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Wilson et al. (1998) J Dairy Sci. 81:2124-2131.

Persistent follicles

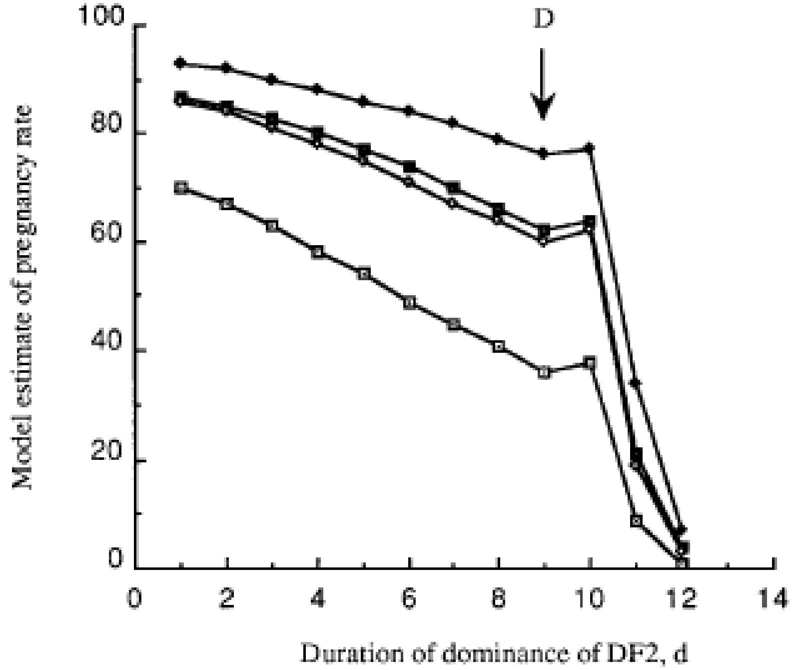
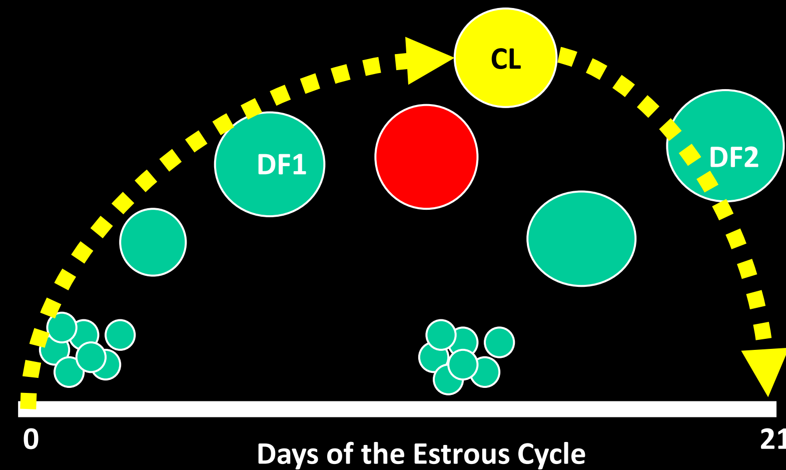


Figure 3. Estimate of pregnancy rate as duration of dominance of the preovulatory follicle increases, established when a logistical model was fitted to data from Exp. 1; yr 1 (—♦—) and yr 2 (—◊—) and from data previously published by Mihm et al. (1994a) Exp. 1 (—□—) and Exp. 2 (—■—). Different model equations were used to estimate pregnancy rate before and after D, the day of change in the trend in pregnancy rate.



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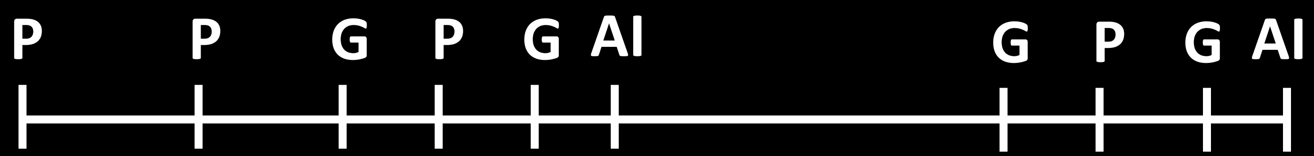
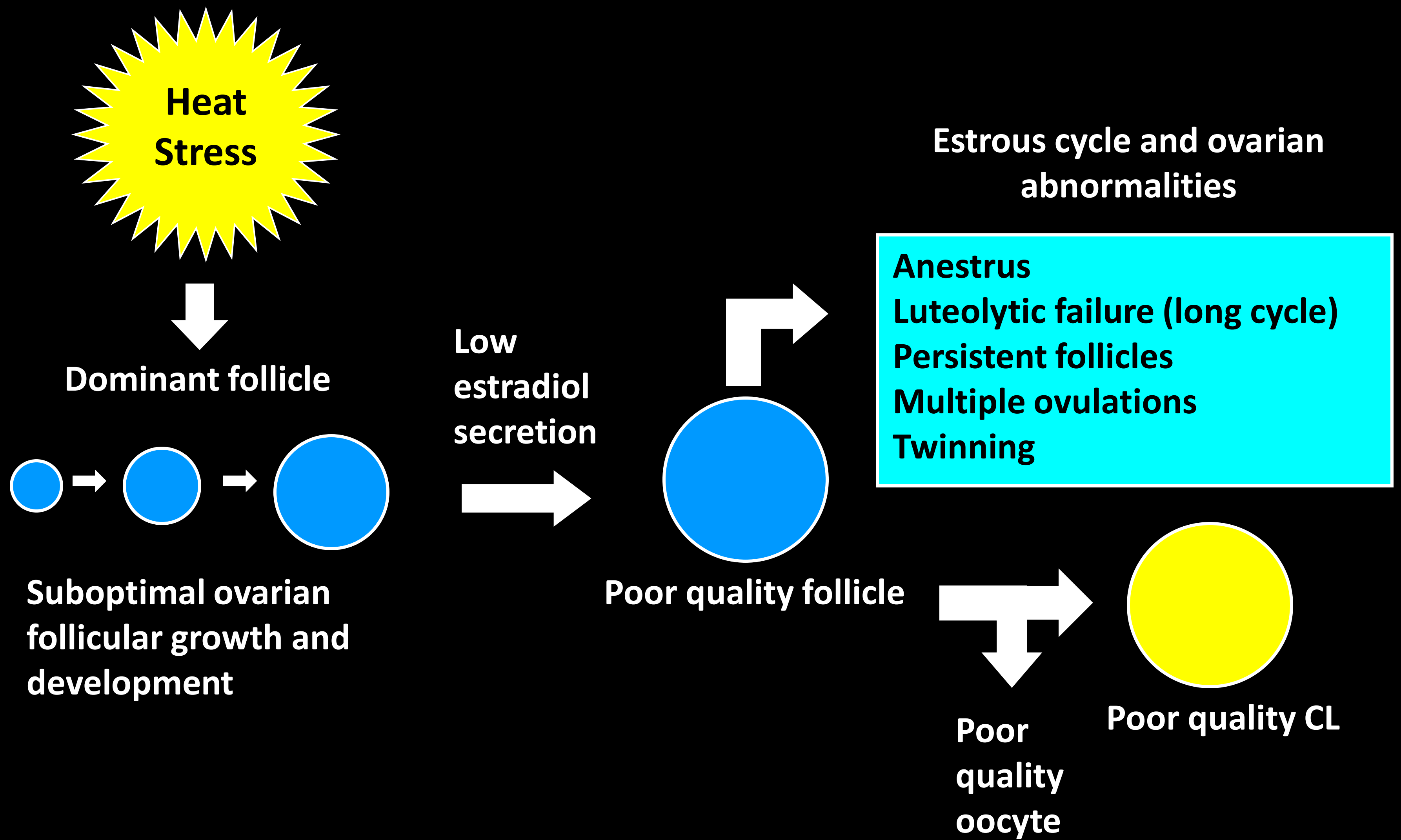
Austin et al. (1999) J. Anim. Sci. 77:2219-2276

Visual observation for estrus



Presynch-Ovsynch-Resynch

Heat stress and follicular health



Embryos collected from superovulated donor cows that were either thermoneutral or heat stress between estrus and insemination (before ovulation)

	Thermoneutral	Heat Stress
Embryo		
< 16 cells	23.5%	85.0%
Morula	70.6%	10.0%
Blastocyst	5.8%	5.0%
Quality		
Good to excellent	47.4%	4.0%
Poor to fair	42.1%	76.0%
Unfertilized	10.5%	20.0%

Putney et al. (1989)

Solutions

- Maximize cow comfort (shades and cooling)
- Timed AI (aggressive program for synchronization, early pregnancy detection and resynchronization of non-pregnant cows)
- Embryo transfer
- Clear damaged follicles from the ovary

Conception rates during heat stress for lactating dairy cows that were either cooled or not cooled (heat stress)

		Conception rate (%)		
Experiment	Site	Heat stress	Cooled	Adv. for cooled
Stott et al. (1972)	Arizona	35	58	+23
Thatcher et al. (1974)	Florida	28	39	+11
Stott and Wiersma (1976)	Arizona	22	30	+8
Roman-Ponce et al. (1977)	Florida	25	44	+19
Wolfenson et al. (1988)	Israel	20	57	+37
Her et al. (1988)	Israel	36	31	-5
Wise et al. (1988)	Arizona	17	29	+12
Ealy et al. (1994)	Florida	6	16	+10

Adapted from Hansen, 1997

Breed on estrus or TAI

Table 1. Effectiveness of timed insemination protocols for increasing pregnancy rates of lactating Holsteins when implemented during periods of heat stress in Florida[a]

Exp. and treatment[b]	n	Interval from calving to first service (d)	Pregnancy rates		
			At first service	At d 90 postpartum	At d 120 postpartum
1					
BOE	184	82.4 ± 1.0	12.5 ± 2.5	9.8 ± 2.5	30.4 ± 3.5
TAI	169	72.4 ± 1.0***	13.6 ± 2.6	16.6 ± 2.6*	32.7 ± 3.6
2					
BOE	35	58.1 ± 1.7	8.6 ± 5.1	14.3 ± 7.2	37.1 ± 8.3
TAI	35	51.7 ± 1.7*	11.4 ± 5.1	34.3 ± 7.1†	62.9 ± 8.3*
3					
PGF	156	91.0 ± 1.9	4.8 ± 2.5		16.5 ± 3.5
TAI	148	58.7 ± 2.1*	13.9 ± 2.6*		27.0 ± 3.6*

[a]Data represent least-squares means ± SEM.

[b]Experiments 1 and 2: Aréchiga et al., 1998a; Experiment 3: de la Sota et al., 1998. BOE = breeding at each observed estrus beginning at d 70 (Experiment 1) or d 50 (Experiment 2) postpartum; TAI = timed artificial insemination programmed for d 70 (Experiment 1), 50 (Experiment 2) or d 60 (Experiment 3) followed by breeding at all observed estrous periods thereafter; PGF = injection of PGF at d 57 postpartum and breeding at all detected estrous periods thereafter.

†$P < .10$ ($P = .055$).

*$P < .05$.

**$P < .01$.

***$P < .001$.

Hansen and Aréchiga, 1999

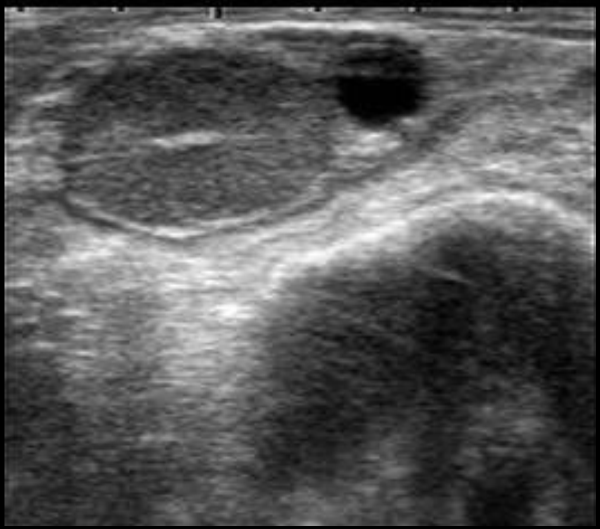
Embryo transfer or TAI

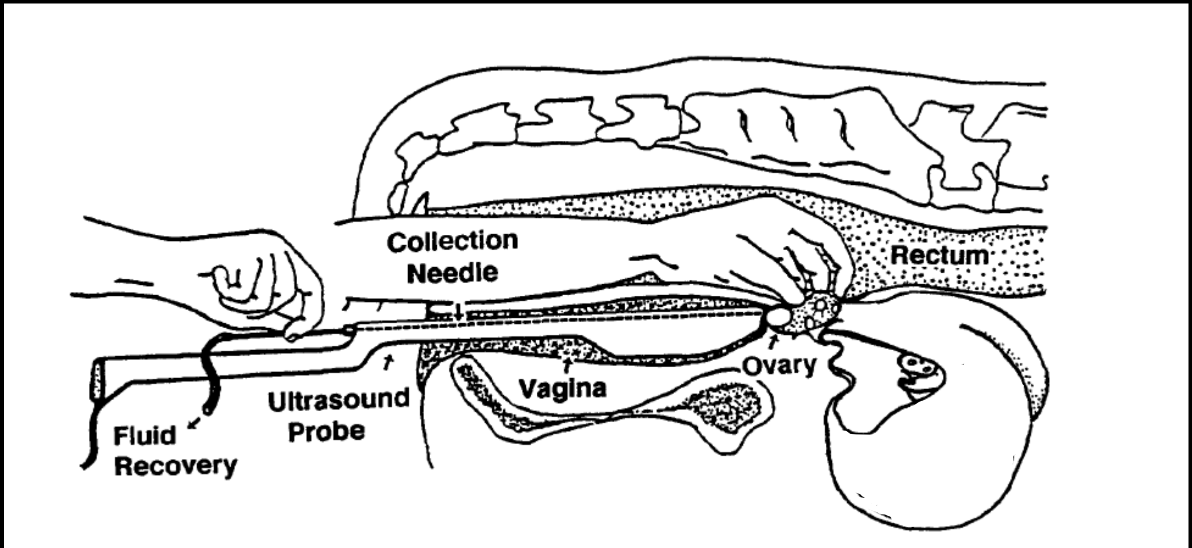
Table 2. Summary of pregnancy rates in lactating cows in Florida following artificial insemination or embryo transfer in the summer[a]

Experiment[b]	Treatment[c]	n	Pregnancy rate (%)[d]
1	AI	524	13.5[e]
	ET, SO, unfrozen embryo	113	29.2
2	AI	84	21.4[f]
	ET, SO, frozen embryo	48	35.4
	ET, IVF, frozen embryo	48	18.8
3	TAI	129	4.3[g]
	TET, IVF, unfrozen embryo	133	17.0
	TET, IVF, frozen embryo	142	7.1

Hansen and Aréchiga, 1999

Transvaginal follicle/oocyte aspiration

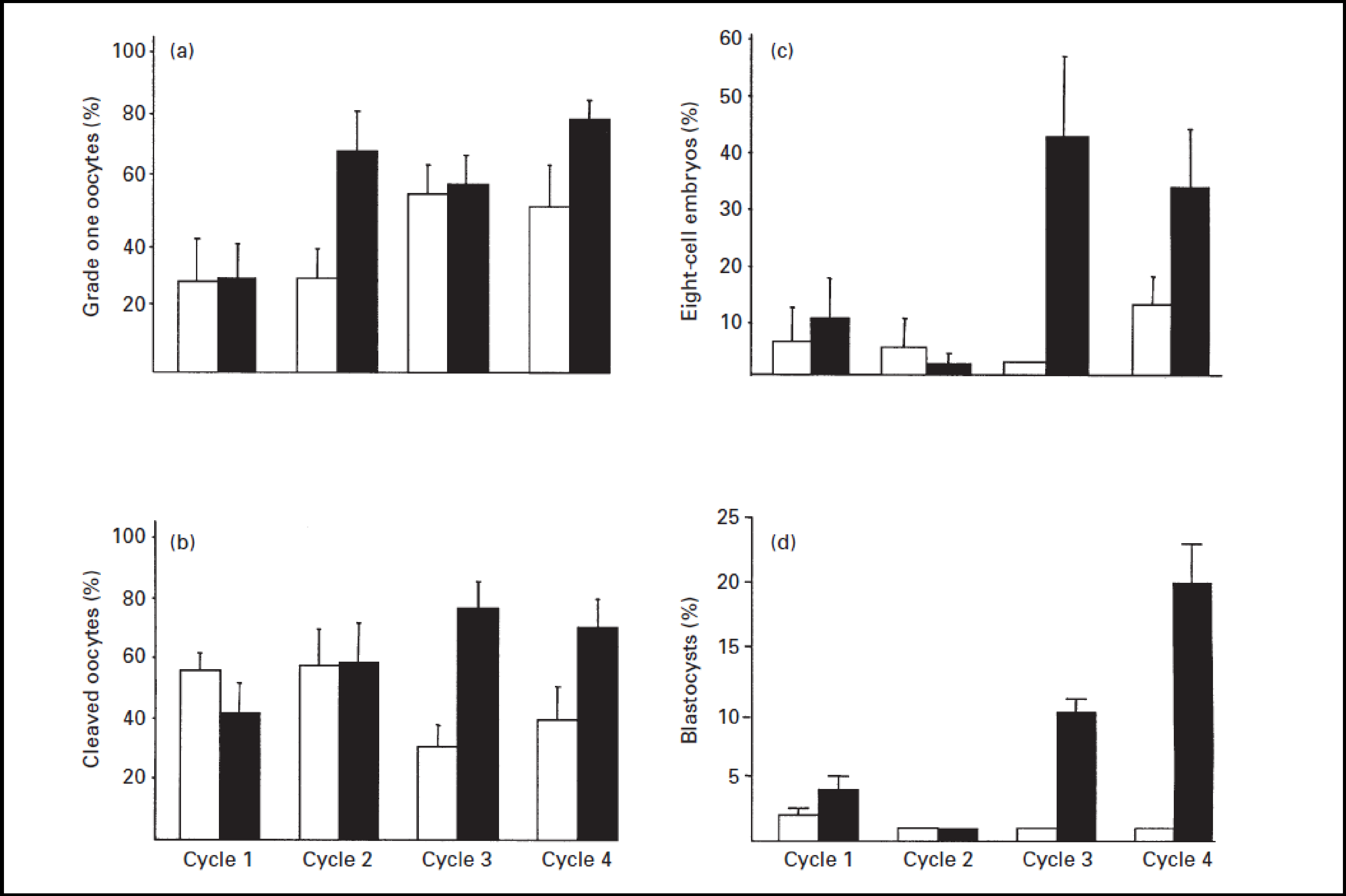




Meintjes et al. (1995) J. Anim. Sci. 73:967-974.

Repeated follicular aspirations

Roth et al. 2001



Control (open bar), aspirated on day 4
Treated (closed bar), aspirated on days 4, 7, 11, and 15

Roth et al. (2001) Reproduction 122:737-744.

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