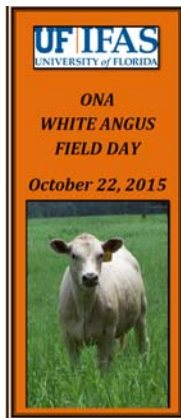


Effects of heat stress on reproduction in cattle

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Take Home Message #1

Heat stress affects most aspects of reproduction but especially fertility



Effects of Heat Stress on Reproduction

↓ ESTROUS BEHAVIOR



↓ FERTILITY

↓ FETAL GROWTH



Take Home Message #2

Best Estimates of Heat Stress Needed to Reduce Fertility is a Rectal Temperature of 102.2°F



Body Temperatures at Which Cows Experience Declines in Production and Reproduction

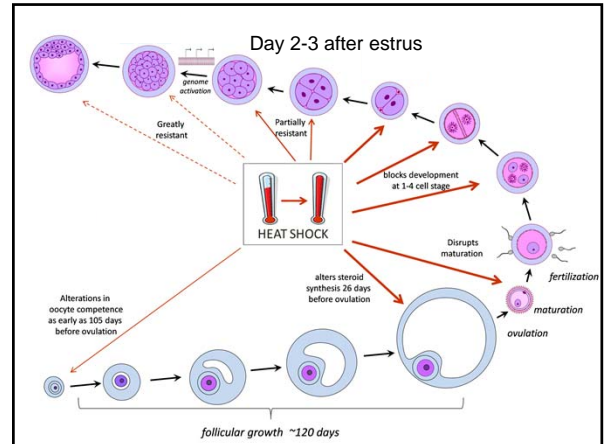
Conception rates decline as afternoon rectal temperatures > 102.2°F

normal rectal temp~ 101.3-101.5°F

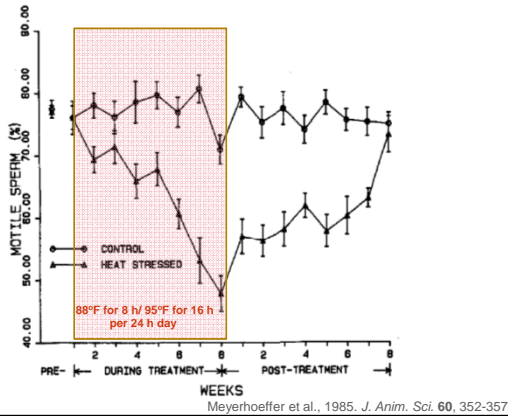
The critical vaginal temperatures are ~ 102.5°F in the PM

Take Home Message #3

Heat stress can compromise fertility many weeks later



Changes in Sperm Motility in Bull Semen During and After Heat Stress

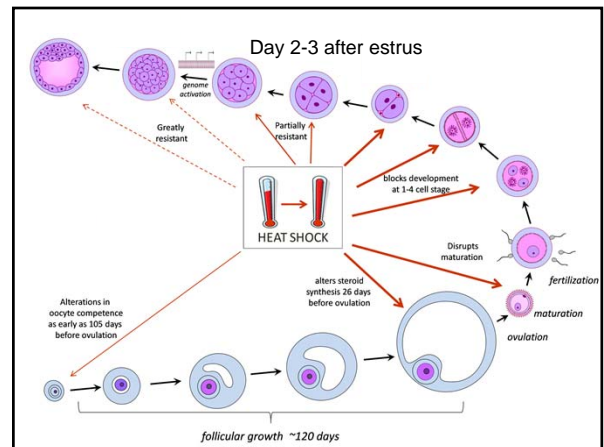
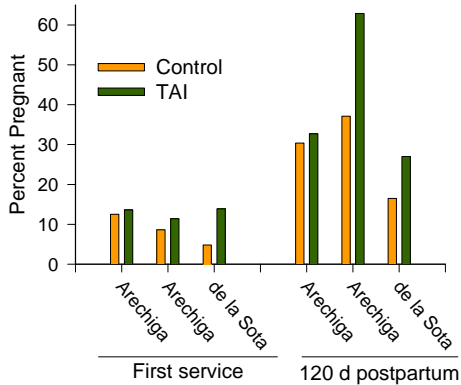


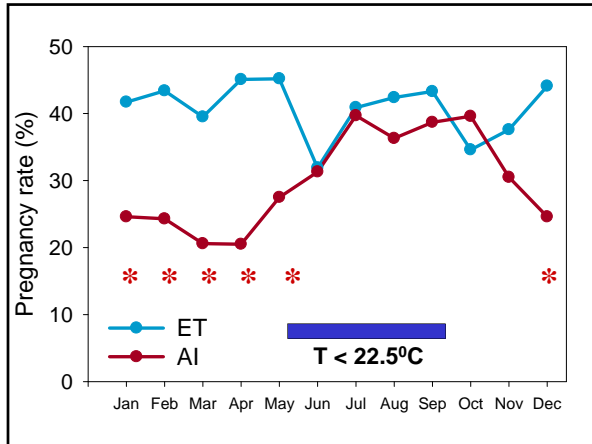
Take Home Message #4

The only reproductive technique known to increase fertility during heat stress is embryo transfer. It works very well!



Effectiveness of a single use of fixed time AI for first service on pregnancy rate during the summer in lactating Holsteins in Florida





Take Home Message #5

Reproduction of beef cattle can be affected by heat stress but it is much less of a problem than for dairy cows

Lactating Cows Burn as Much Energy as Human Athletes and Must Lose that Heat to Prevent Hyperthermia

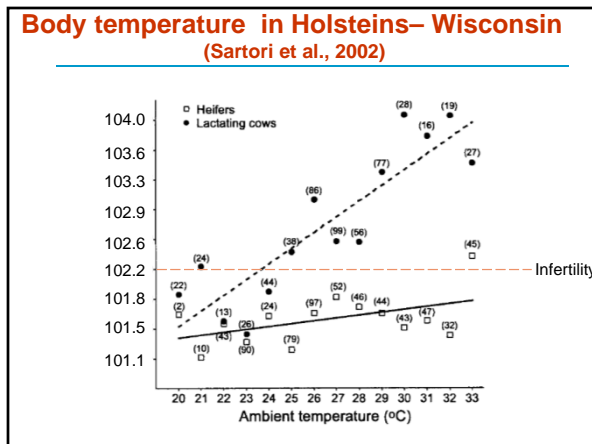
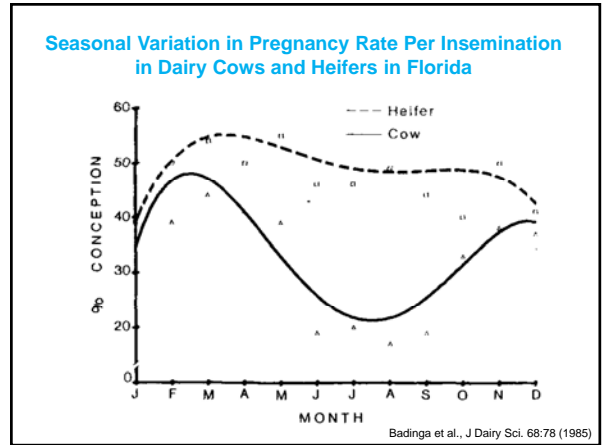
Human Athlete

- Typical human requires 2 Mcal/day
- Extreme aerobic exercise can increase caloric requirements by 6 to 8 Mcal/day (i.e., **3-4 times maintenance**)

Dairy Cow at Peak Lactation

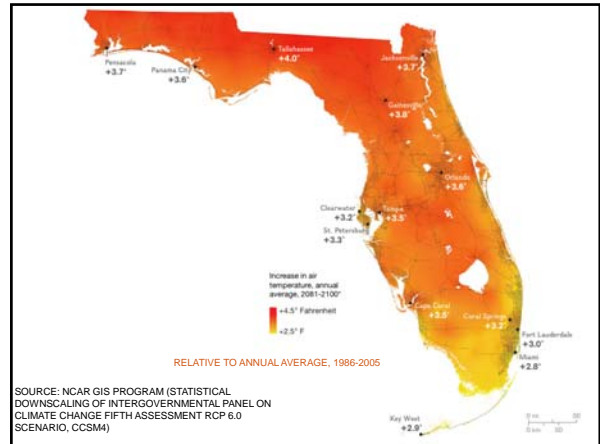
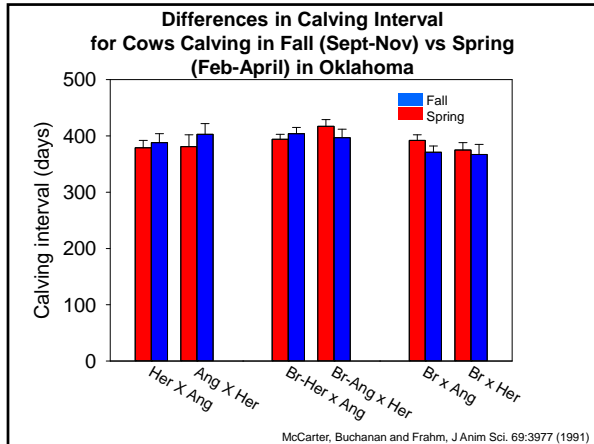
- Average dairy cow produces 99 lb/day at peak lactation
- Maintenance energy=15 Mcal ME/day
- Extra energy for milk=55 Mcal ME/day
- Total energy demands=70 Mcal ME/day
- At peak lactation, energy consumption increases to **4.7 times maintenance**

Santos et al. (2010). Reprod. Dom. Rum. VII:387-404



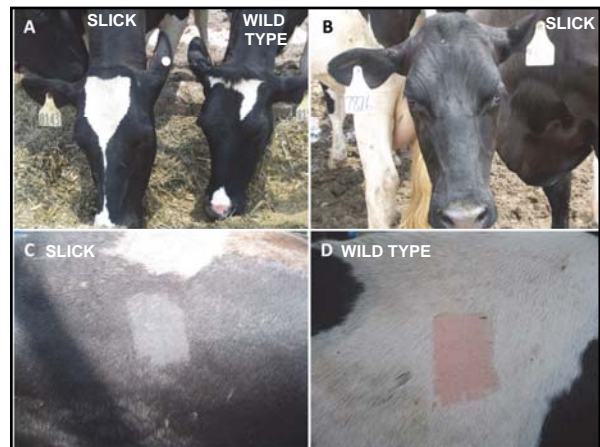
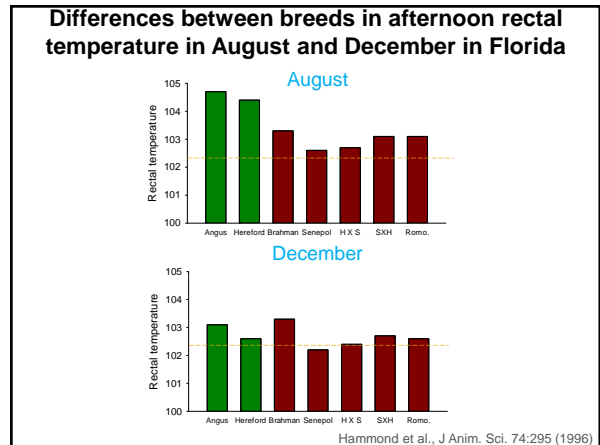
Heat Stress is Often Not a Major Problem for Beef Cattle Fertility Because:

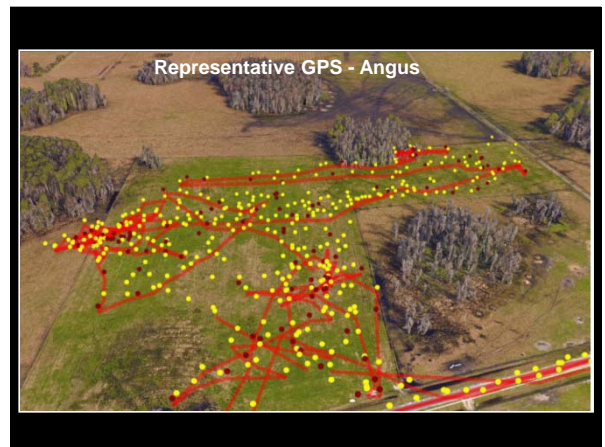
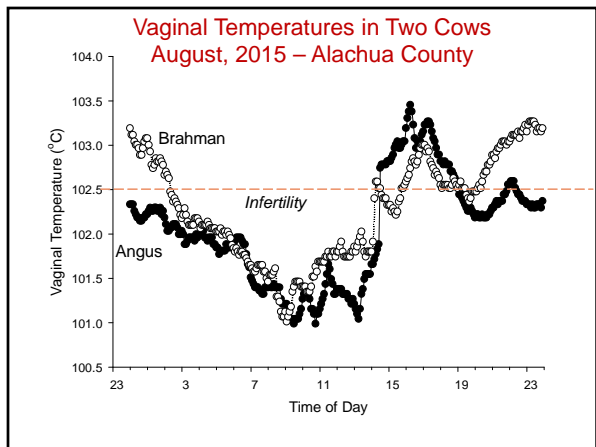
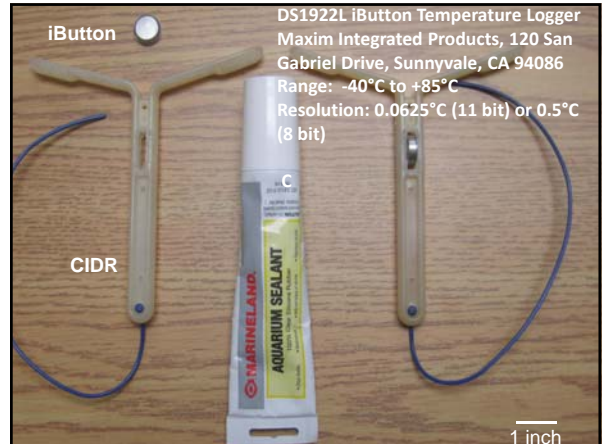
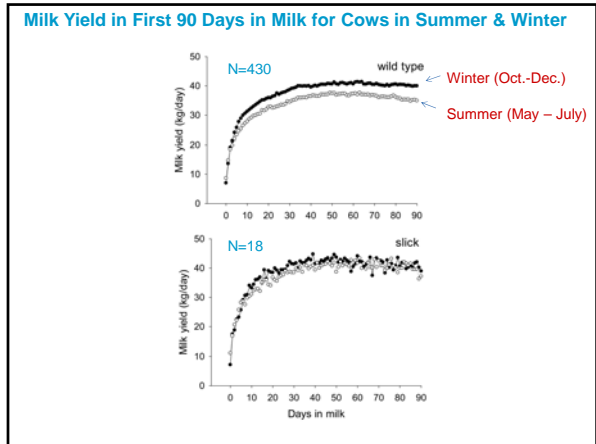
- They produce much less metabolic heat than dairy cattle
- They are not always bred during the hottest times of the year
- Many breeds are thermally adapted



Take Home Message #6

The best long-term solution to heat stress is to use cattle that are genetically-adapted to heat stress



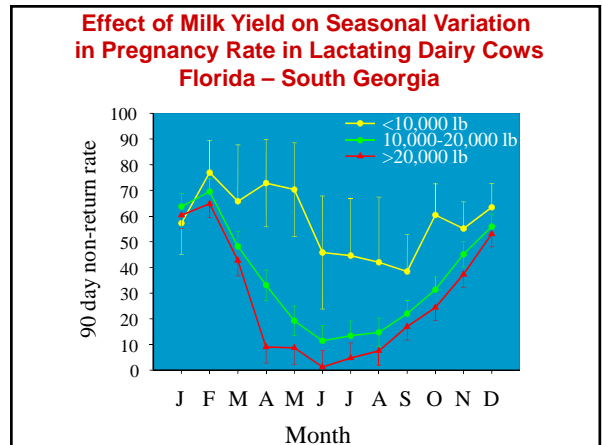
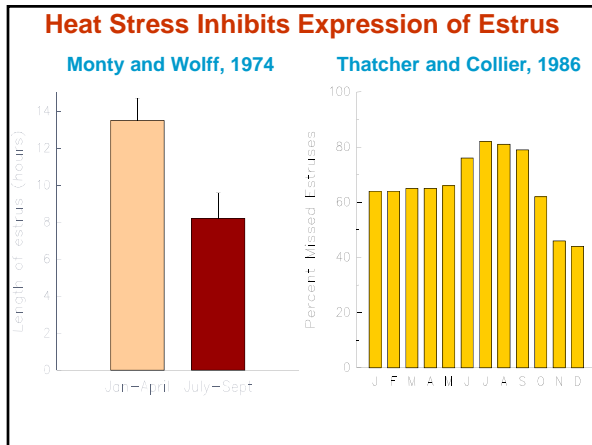


Final Thoughts

Magnitude of heat stress effects will vary from herd to herd
 --greater where high air temperatures, high humidity and high solar radiation predominate, in fescue containing pastures & where there is little shade or water
 --magnitude of effect depends on the breeding season

When heat stress is a problem, fixed time AI is better than AI but ET is best of all
 --TAI will improve submission rate but not fertility
 --ET will prevent heat stress effects on fertility

Genetics is the best way to solve effects of heat stress
 --new genetic techniques may mitigate increased risk from heat stress due to global climate change

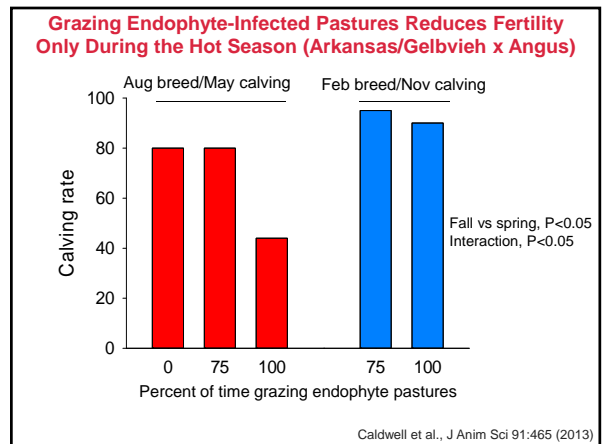


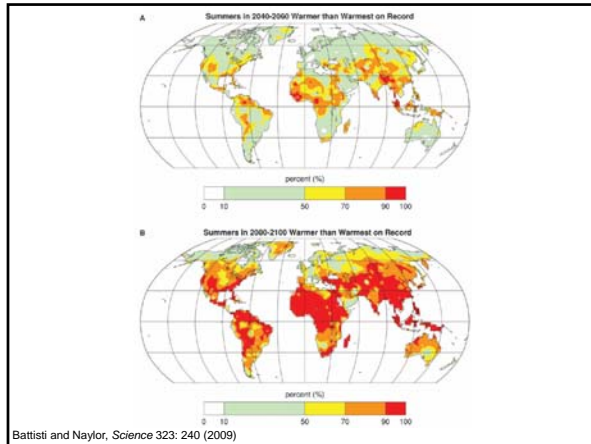
Body Temperatures at Which Cows Experience Declines in Production and Reproduction

Conception rates decline as afternoon rectal temperatures **> 102.2°F**

normal rectal temp~ 101.3-101.5°F

The critical vaginal temperatures are ~ **102.5°F** in the PM

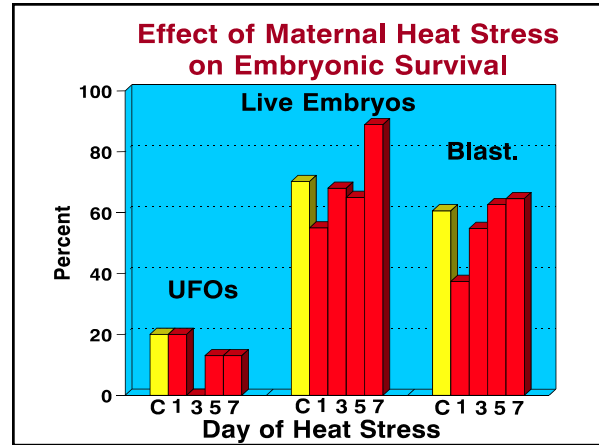
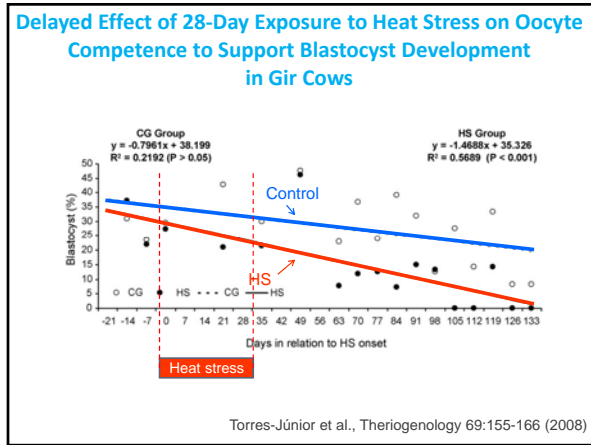




Differences in Calf Crop for Cows Calving in Fall (Sept-Nov) vs Spring (Feb-April) in Oklahoma

Crossbred cow group ^b	Calving percentage	
	Spring (Hot)	Fall (Cool)
H × A	89.6 ± 3.5 ^{cd}	80.6 ± 13 ^{ce}
A × H	81.2 ± 5.6 ^{cdef}	72.0 ± 5.1 ^{efg}
BH × A	87.3 ± 2.4 ^{cdh}	69.7 ± 2.8 ^{fg}
BA × H	85.6 ± 3.1 ^{cdh}	73.1 ± 3.9 ^{ef}
B × A	90.0 ± 2.7 ^{cd}	80.4 ± 3.0 ^{ch}
B × H	92.6 ± 3.2 ^d	60.6 ± 3.7 ^g

Spring calving group - breeding May-July calving Feb-April
 Fall calving group - breeding Jan-March calving Sept-Nov



Gene editing to create new genes in cattle

These new tools enable researchers to rewrite genes, making targeted changes to an organism's DNA with unprecedented specificity. "With the advent of TALENs and CRISPRs, the [GM] landscape is going to change," says [James] Murray [of University of California, Davis].

Jeff Akst, *The Scientist*, June 1, 2014

<http://www.the-scientist.com/images/June2014/cow.jpg>

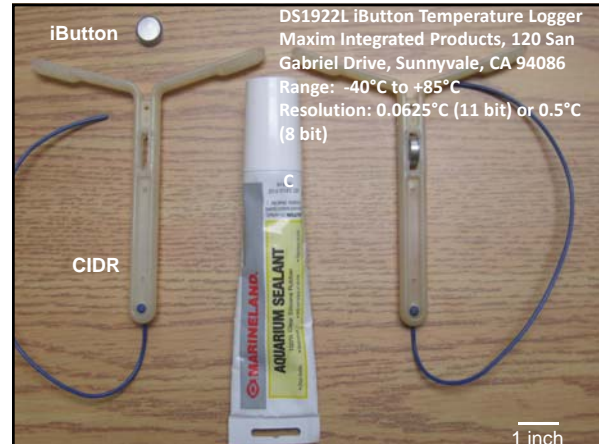
FAST GENOME EDITING IS THE NEW REALITY
The Cas9 SmartNuclease System

CRISPRs (clustered regularly interspaced short palindromic repeats) are DNA loci containing short repetitions of base sequences found in eubacteria & archaea.

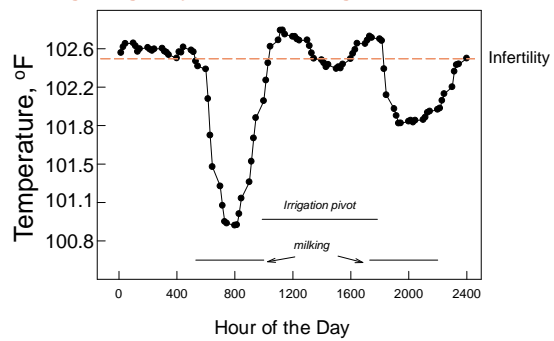
CRISPRs are often associated with cas genes that code for proteins related to CRISPRs.

By inserting a plasmid containing cas genes and specifically designed CRISPRs, an organism's genome can be cut at any desired location.

Wikipedia



Average vaginal temperatures for lactating Holsteins on a grazing dairy in Florida during the summer



Vaginal temperatures are about 0.2-0.4°F higher than rectal temperatures

