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What is an outlier telling us? Hot summers might affect reproductive performance of sheep in autumn

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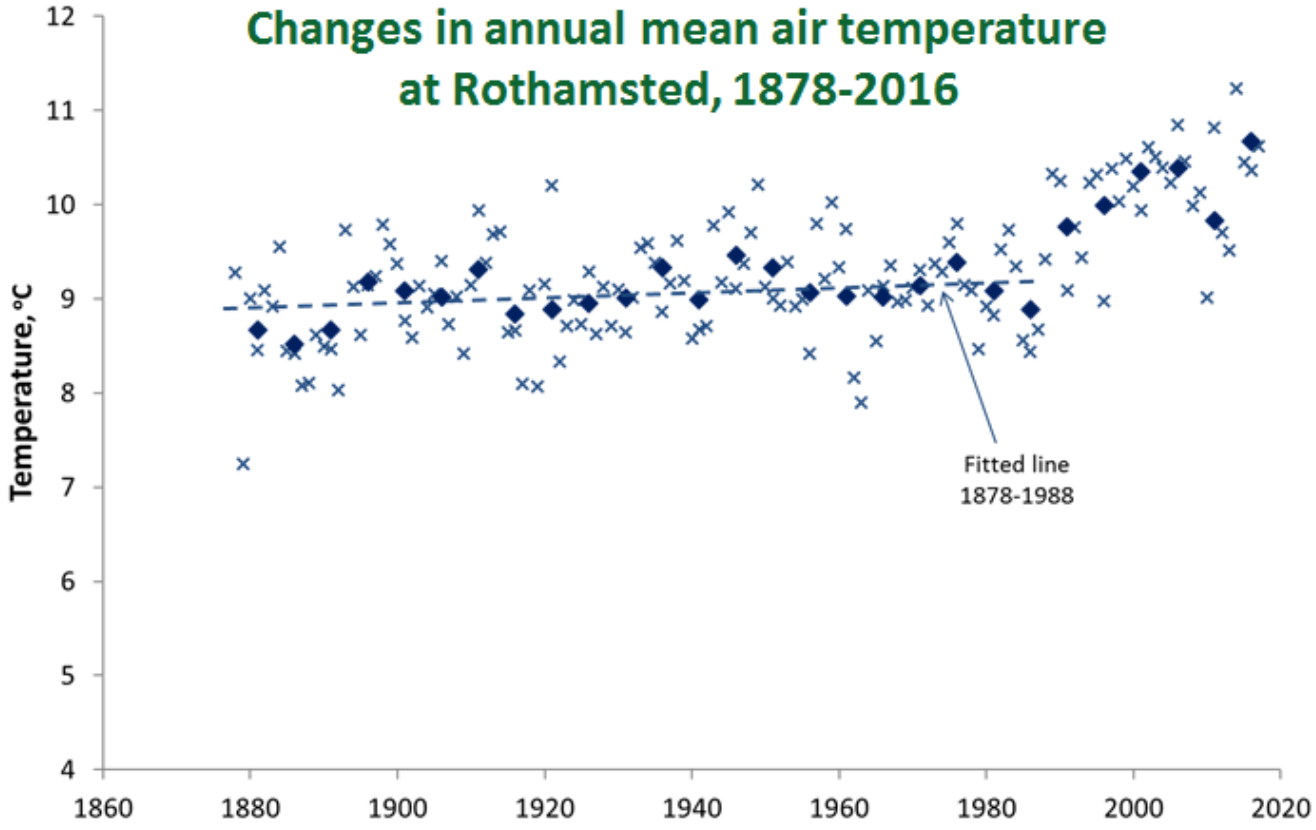
Climate change



May accentuate the thermal stress in response to differences in the balance of temperature between the animal and the environment (radiation, temperature, relative humidity and wind speed vs. thermoregulation mechanisms).

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Heat stress and reproduction

- Effects of stress on reproductive performance in ewes may have severe consequences for fecundity and fertility, and therefore reduce lambing percentage.
- Exposure to heat stress triggers a series of drastic changes in the animals' biological functions.

Objective: explore the relationship between summer heat stress risk and the reproductive performance of sheep in a flock of southwest England.

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Comprehensive Climate Index (Mader et al., 2010)

- We studied the CCI from post-weaning (Jul-1) to the end of summer (Sep-30) and tested whether it was linked to reproductive performance at mating (late Oct – mid Dec) determined at scanning (Jan) for a UK sheep flock.
- CCI provides an adjustment to Ta for RH, WS and RAD → CCI or apparent temperature is defined as Ta + Eq. [1] + Eq. [2] + Eq. [3].

Equation [1] RH correction factor =

$$e^{(0.00182\times RH + 1.8\times 10^{-5}\times Ta\times RH)} \times (0.000054\times Ta^2 + 0.00192\times Ta - 0.0246) \times (RH - 30).$$

Equation [2] WS correction factor =

$$\left[e^{\left\{\left\langle \frac{1}{(2.26\times WS+0.23)^{0.45}}\right\rangle \times \left\langle 2.9+1.14\times 10^{-6}\times WS^{2.5} - \log_{0.3}(2.26\times WS+0.33)^{-2}\right\rangle\right\}}\right] \frac{-6.56}{} - 0.00566\times WS^2 + 3.33.$$

Equation [3] RAD correction factor =

$$0.0076\times RAD - 0.00002\times RAD\times Ta + 0.00005\times Ta^2\times\sqrt{RAD} + 0.1\times Ta - 2.$$

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Data and analysis

- A regression analysis was performed using the sum of hours CCI was above 25°C (CCI25) and the ram percentage (%R) as predictors of the scanning percentage (%S) of Suffolk x mule ewes (~400).

- The data comprised records for six seasons (2013-2018) at Rothamsted Research, North Wyke (Devon, UK).

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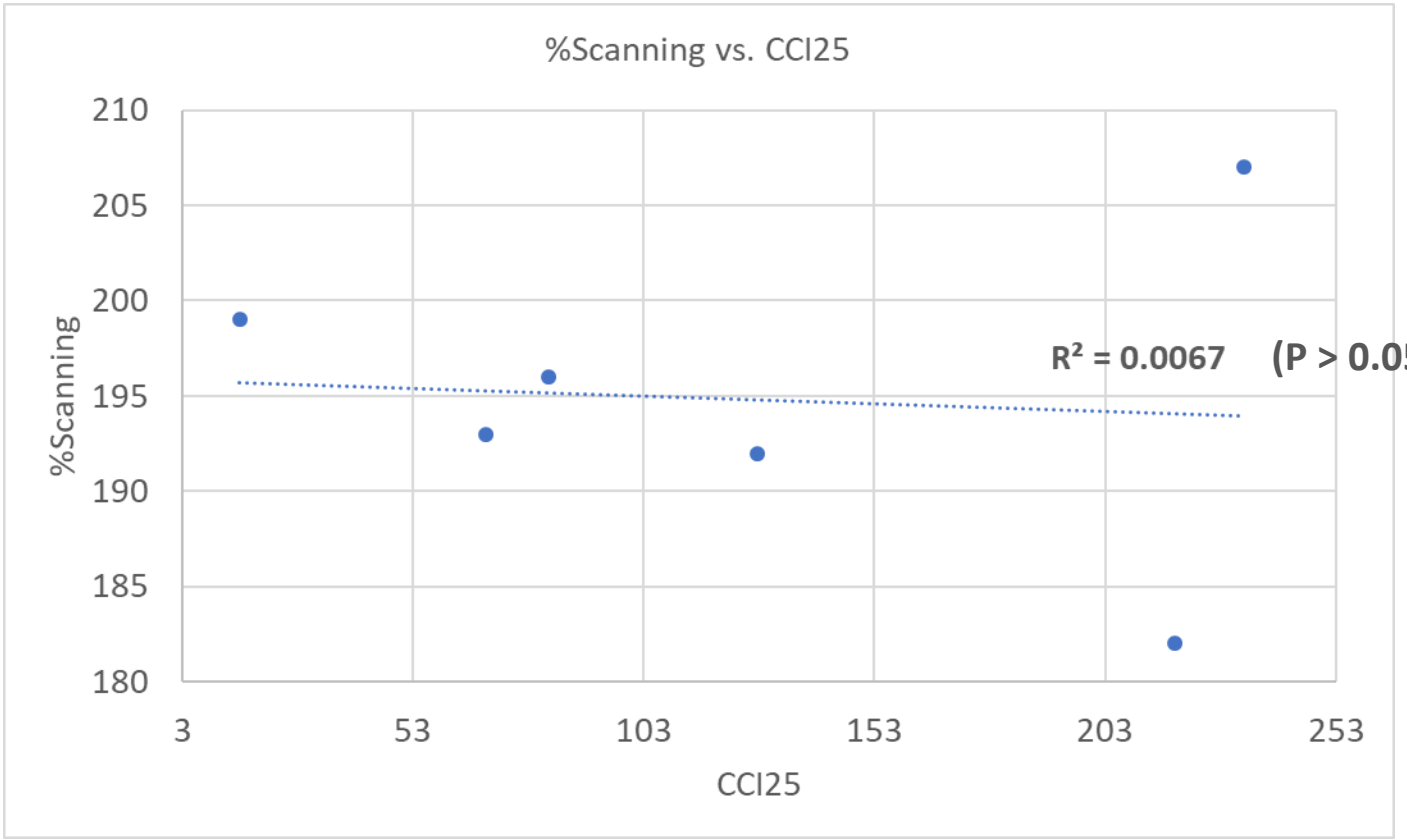
Results



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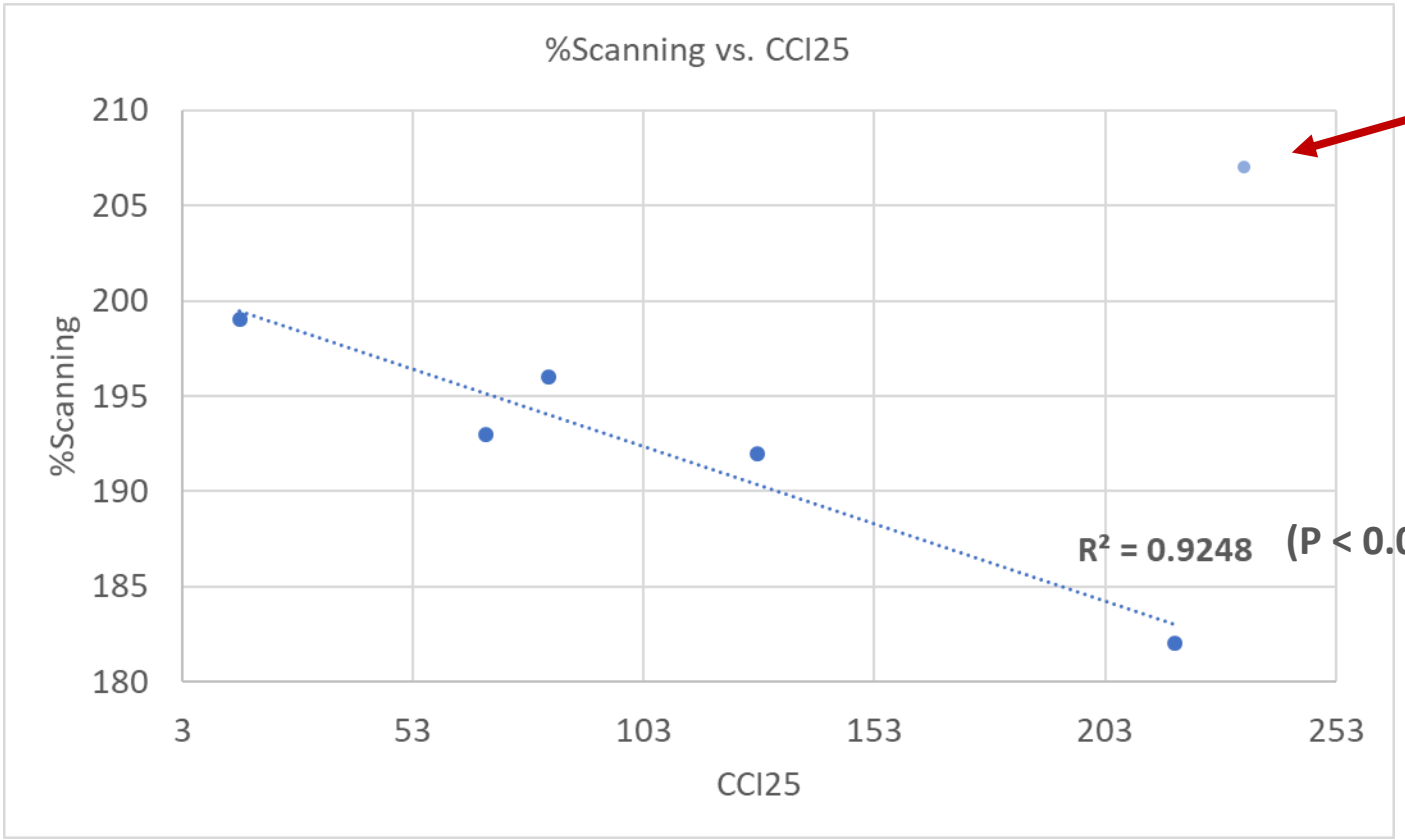
Results



Year with the greatest ram percentage!

H: the potential negative effect of the heat stress was overcome by the highest %Ram applied, i.e., extra sperm in the system…

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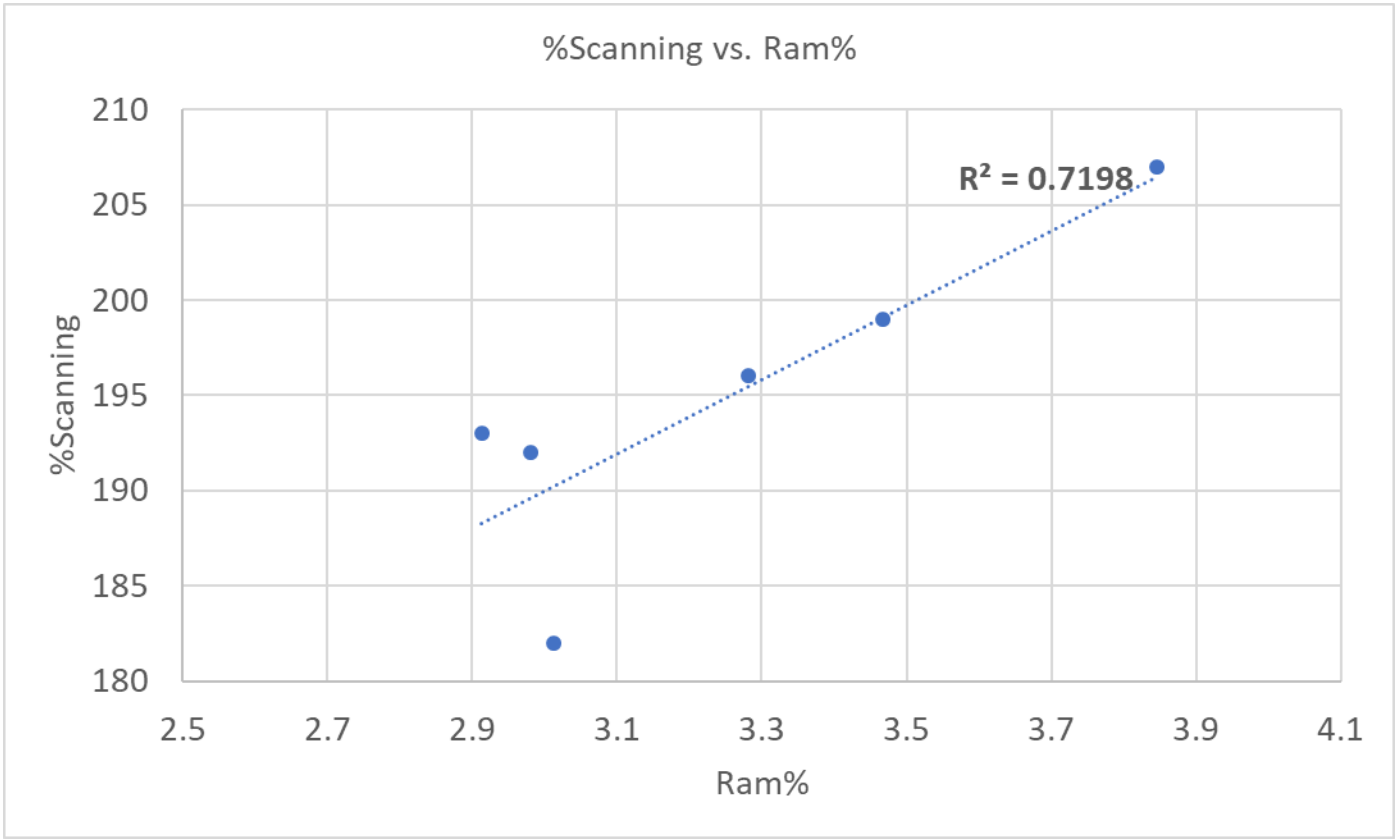
Results: ram percentage



… therefore, the effects of heat stress would be only expressed when the %Ram is more challenging (<3%).

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Delay in rams

Spermatogenesis?

The effects of a stressor on spermatogenesis would not be observed until about 60 days after the stressor (cell division → mature sperm, i.e., the spermatogenic cycle).

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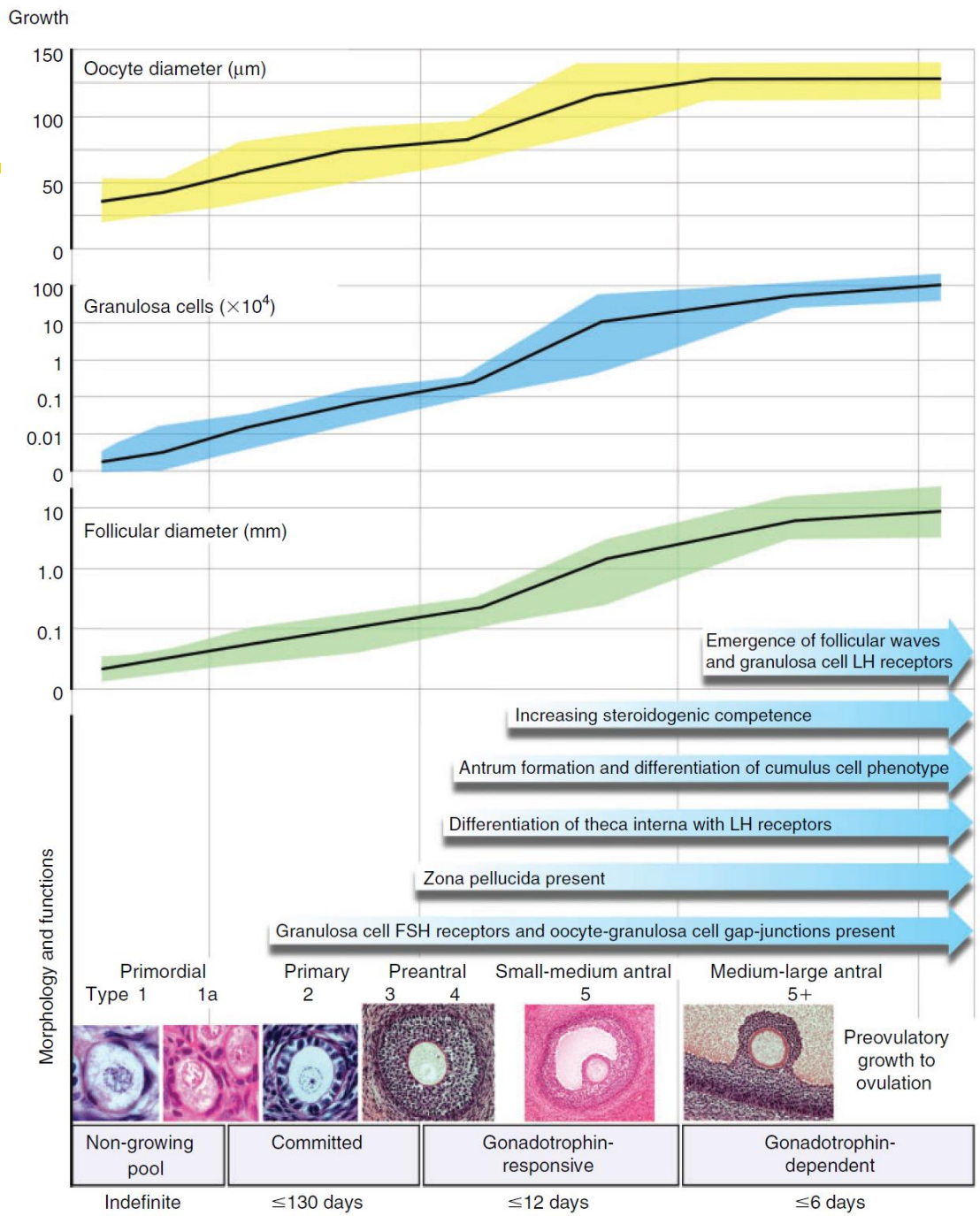

Scaramuzzi et al., 2011

Delay in females

The time taken for follicles to develop.

- The stress is proxy falling in the period when follicles are becoming committed (entering the terminal growth phase).

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Final considerations

- Other factors also need to be considered (e.g. forage quality, ewe age, lambing status, etc.)…
- … but **the evidence suggests that the previous summer weather may affect reproductive performance of sheep in temperate climates**.

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BBSRC bioscience for the future

Lawes Agricultural Trust