Effect of climatic conditions on the conception rates of dairy cows in Central Europe
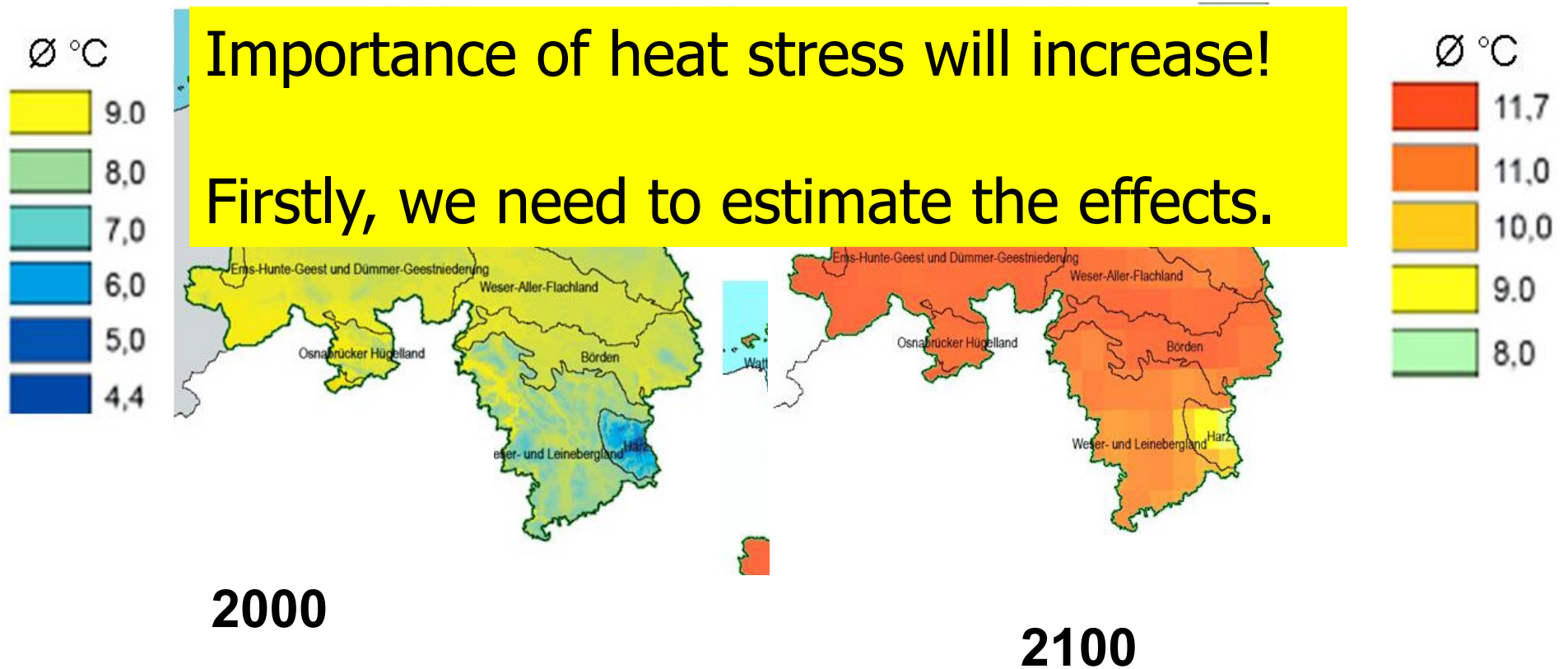
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SA1 Stefanie Ammer, 27/08/2014

Background

- An increase of heat periods and weather extremes are predicted for middle Europe (Schwarz et al., 2007).

- Dairy industry will be indirectly and directly effected (e.g.):

  - feed production

  - most dairy cows are directly exposed to weather conditions

  - high yielding increases the production of metabolic heat

2

Temperature development in Lower Saxony until 2100 → + 3 °C

Importance of heat stress will increase!

Firstly, we need to estimate the effects.

2000

2100

Estimation of Heat Stress in Dairy Cattle

- Air temperature (T) ⎫
- Relative humidity (RH) ⎭ Temperature-Humidity Index (THI)

Heat stress leads to reduced milk yields and increased health and reproductive problems (e.g. Ravagnolo et al., 2000).

RH (%)
T (°C)

T (°C)							Category
0							
4	45	44	43	42	41	40	
8	50	50	49	48	48	47	No Stress
12	55	55	55	54	54	54	
16	60	60	60	60	60	61	Mild Stress
20	65	65	66	66	67	67	
24	70	70	71	72	73	74	Moderate Stress
28	74	76	77	78	80	81	
32	79	81	83	84	86	88	Massive Stress

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Impact of heat stress on reproductive traits

Indirect $\longrightarrow$ $\longleftarrow$ **Direct**

- Reduced feed intake
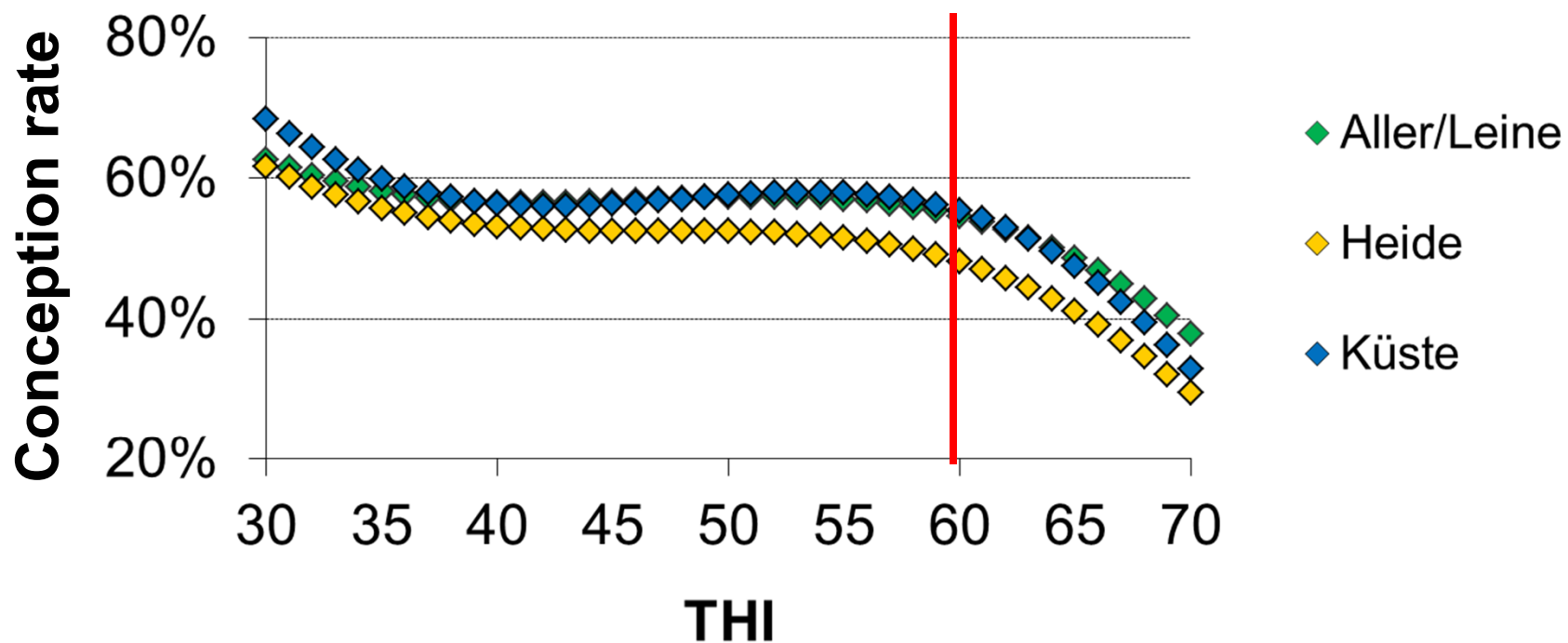- ➢ Changes in energy balance
- ➢ Altered nutrient availability

- Hyperthermia impairs cellular functions of the reproductive system
- ➢ e.g. changes in hormone level

Predominant influence

(Wolfensen & Meidan, 2000; Aggarwal & Upadhyay, 2013)

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Conception Rate and THI in 3 regions of Lower Saxony

(Brügemann & König, 2013)

Objectives

Estimate

- climatic effects on the conception rate of dairy cows (n = 75, artificially inseminated) on a farm in Lower Saxony

Material and methods

- 2650 artificial inseminations (AI) between 1993 and 2013; randomly distributed over the year

- Hourly measurement of T in °C and RH in %

  - Daily mean of T and RH

  - $THI = (1.8 * T + 32) - (0.55 - 0.0055 * RH) * (1.8 * T - 26)$

T - and THI classes

- Daily mean and max Temperature and THI

Parameter	Class 1	Class 2	Class 3	Class 4
THI	< 40	≥ 40 to < 60	≥ 60 to < 70	> 70
Temperature (°C)	< 16	≥ 16 to < 20	≥ 20 to < 22	> 22

- Estimation of the weather effects (mean, max and classes) from 21 days before until 30 days after AI on conception rates.

- Only first AIs (n = 1.233) were taken into account.
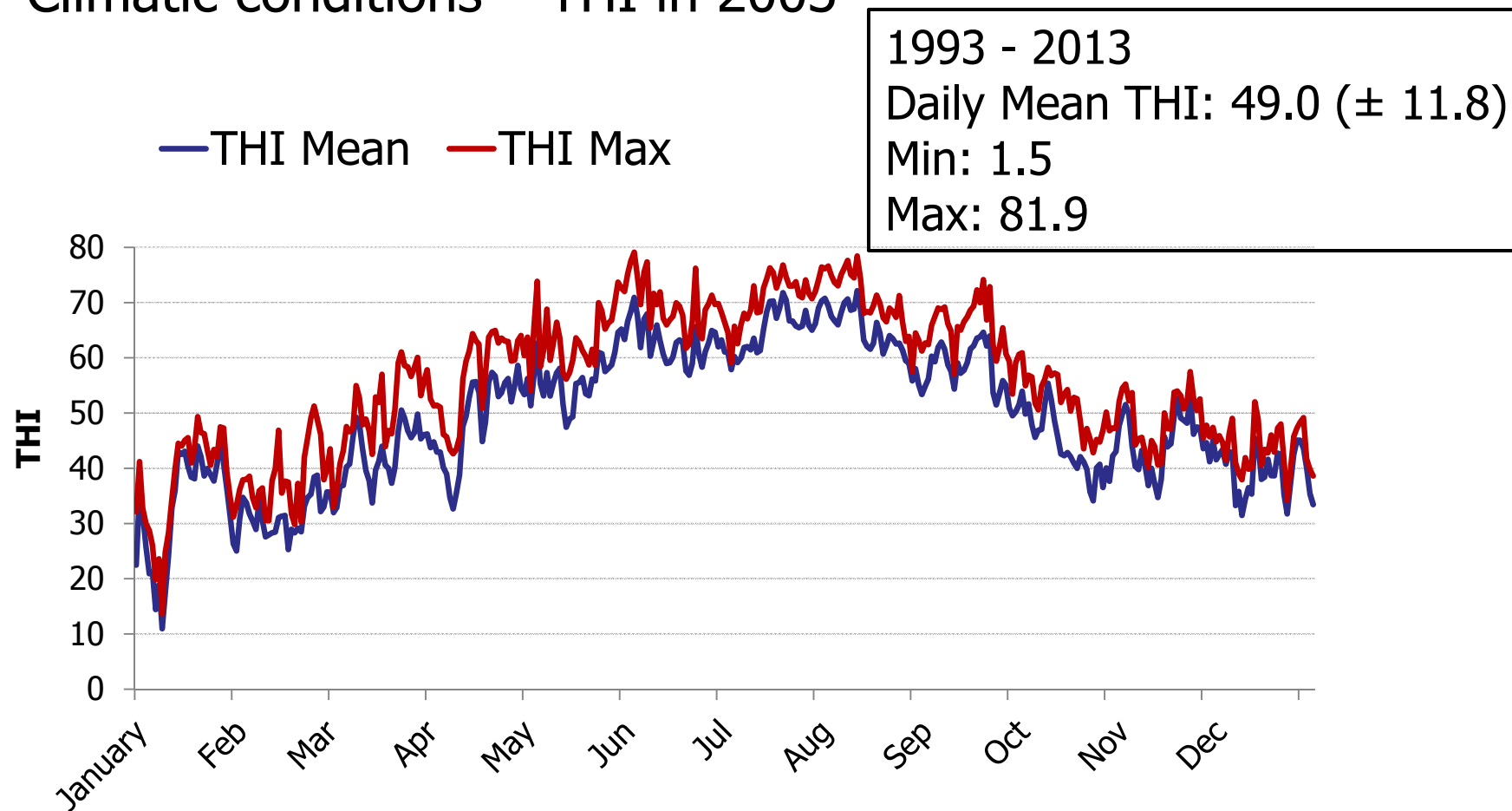
- Statistical analysis: SAS 9.3

Results

Climatic conditions – T in 2003

1993 - 2013
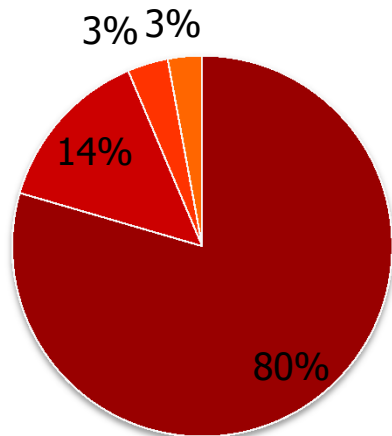Daily mean T: 9.3 °C (± 7.3)
Min: - 22.7 °C
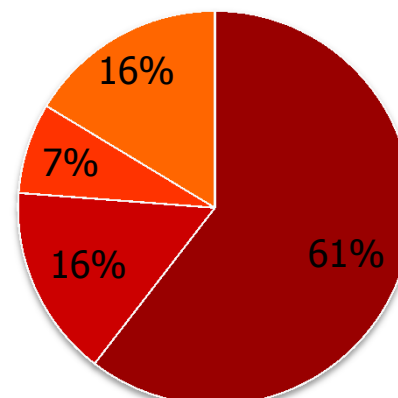Max: 35.9 °C
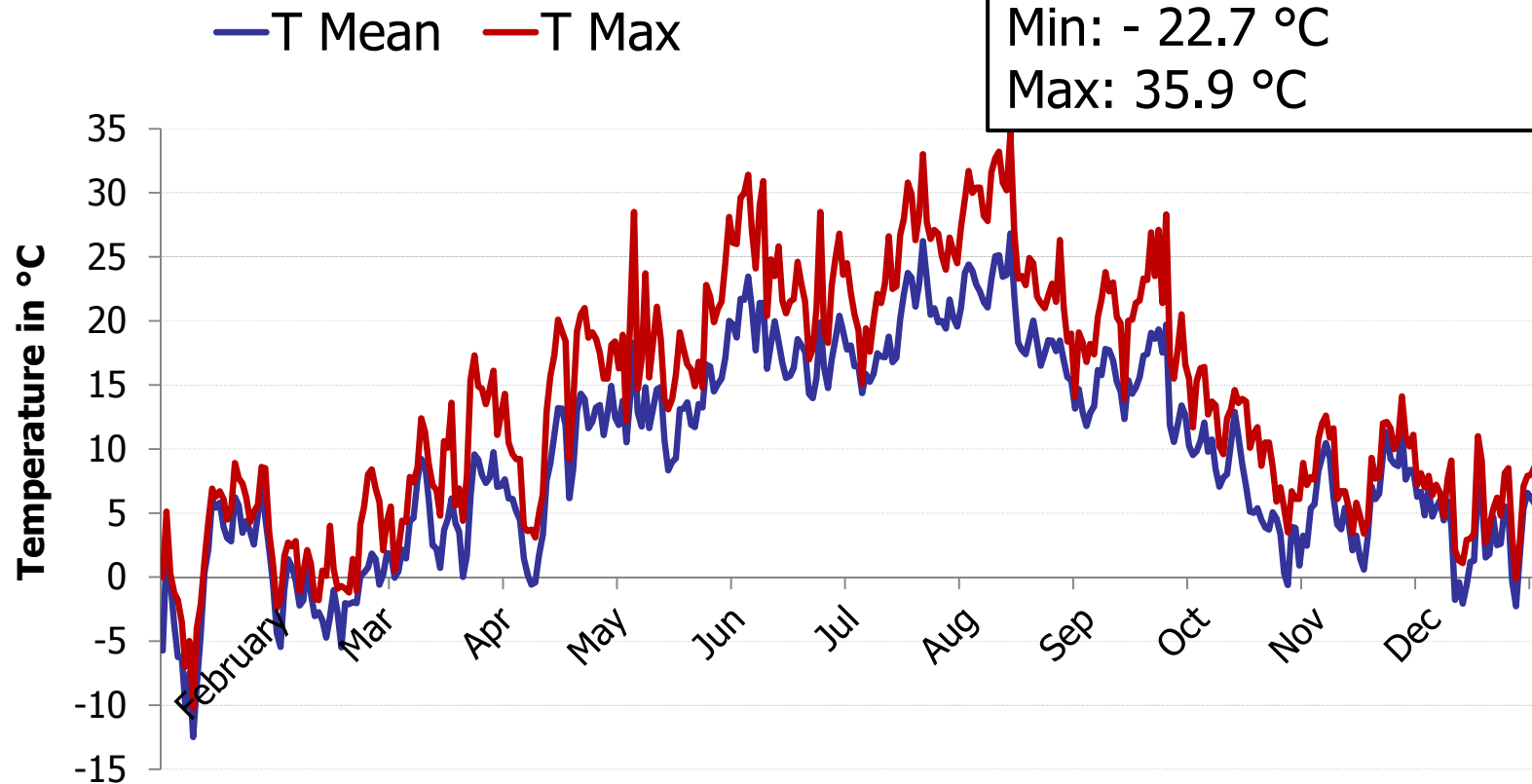
Results

Climatic conditions – THI in 2003

1993 - 2013
Daily Mean THI: 49.0 (± 11.8)
Min: 1.5
Max: 81.9

Proportions of T and THI classes

T-Mean

T-Max

- ■ < 16 °C
- ■ ≥ 16 °C < 20 °C
- ■ ≥ 20 °C < 22 °C
- ■ ≥ 22 °C

THI-Mean

THI-Max

- ■ < 40
- ■ ≥ 40 < 60
- ■ ≥ 60 < 70
- ■ ≥ 70

13
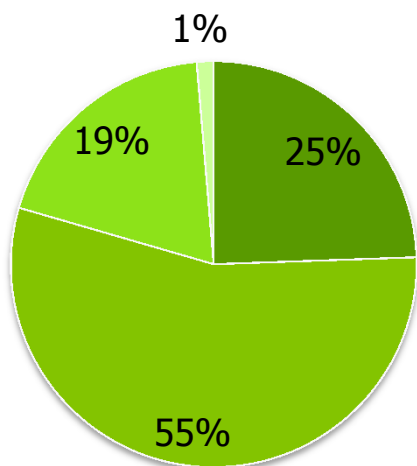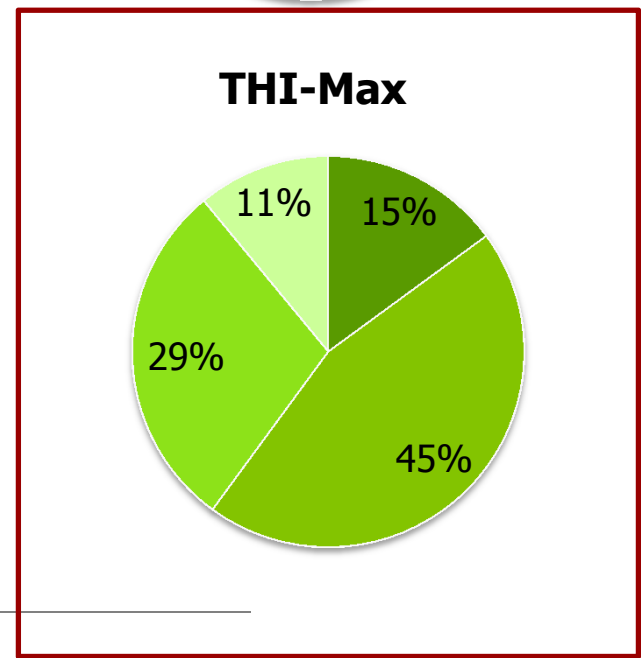
Reproductive parameters

- AI: n = 1.233 → 40.3 % success rate

- Overall:

  - Days open: Ø 120 d
  - Calving interval: Ø 398 d
 - Pregnancy period: Ø 279 d

Climate and conception rate

Climate and conception rate

- Measured climatic parameters (21 days before until 30 days after AI) had no significant (p > 0.05) effect on conception rates, with one exception ... day 21 before AI.

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Frequency of first services according to THI Classes – 21 d before AI

Frequency of first services according to THI Classes – 21 d before AI

Legend: ■ Success ■ Failure
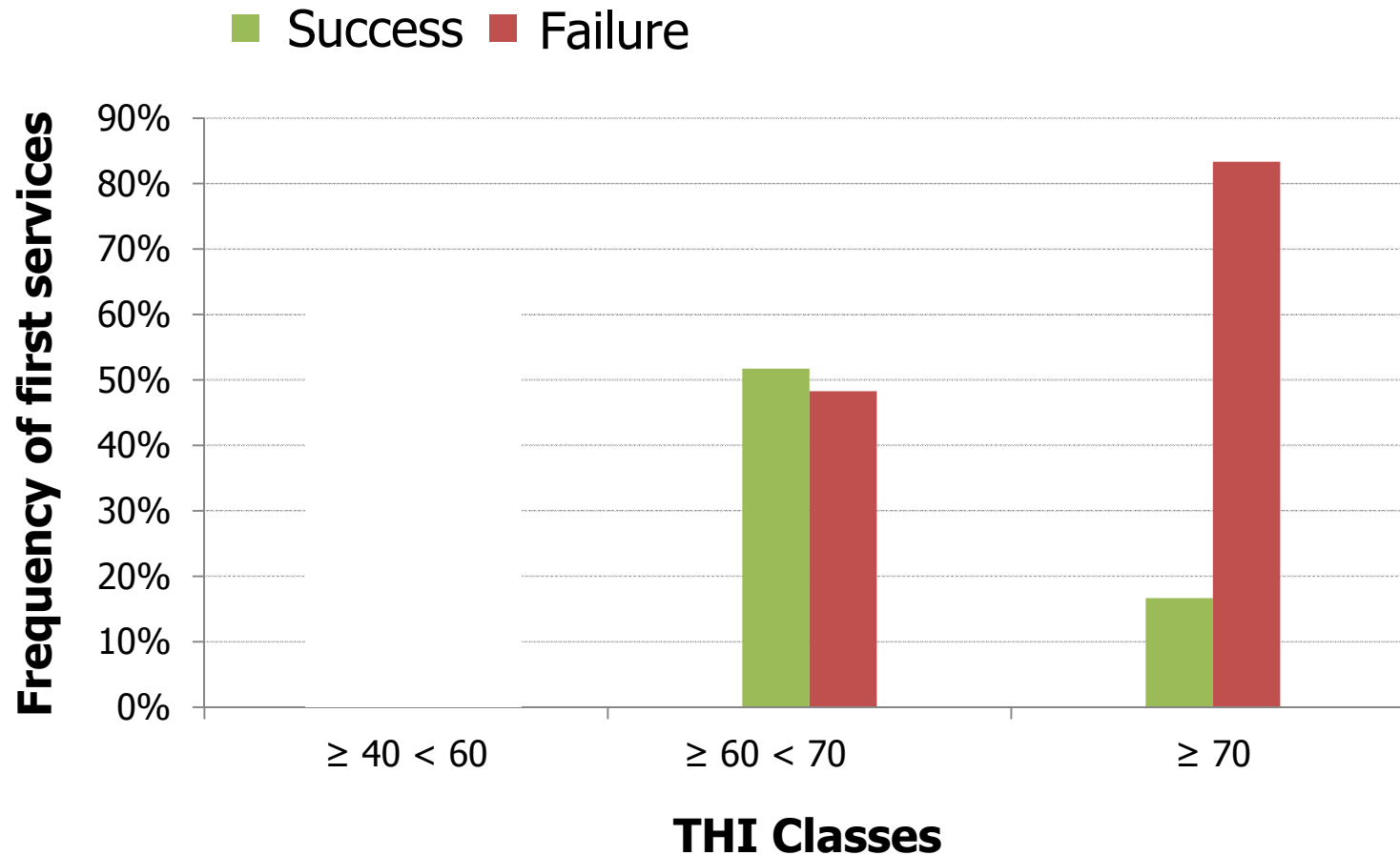
Y-axis: Frequency of first services (0% – 90%)
X-axis: THI Classes (≥ 40 < 60, ≥ 60 < 70, ≥ 70)
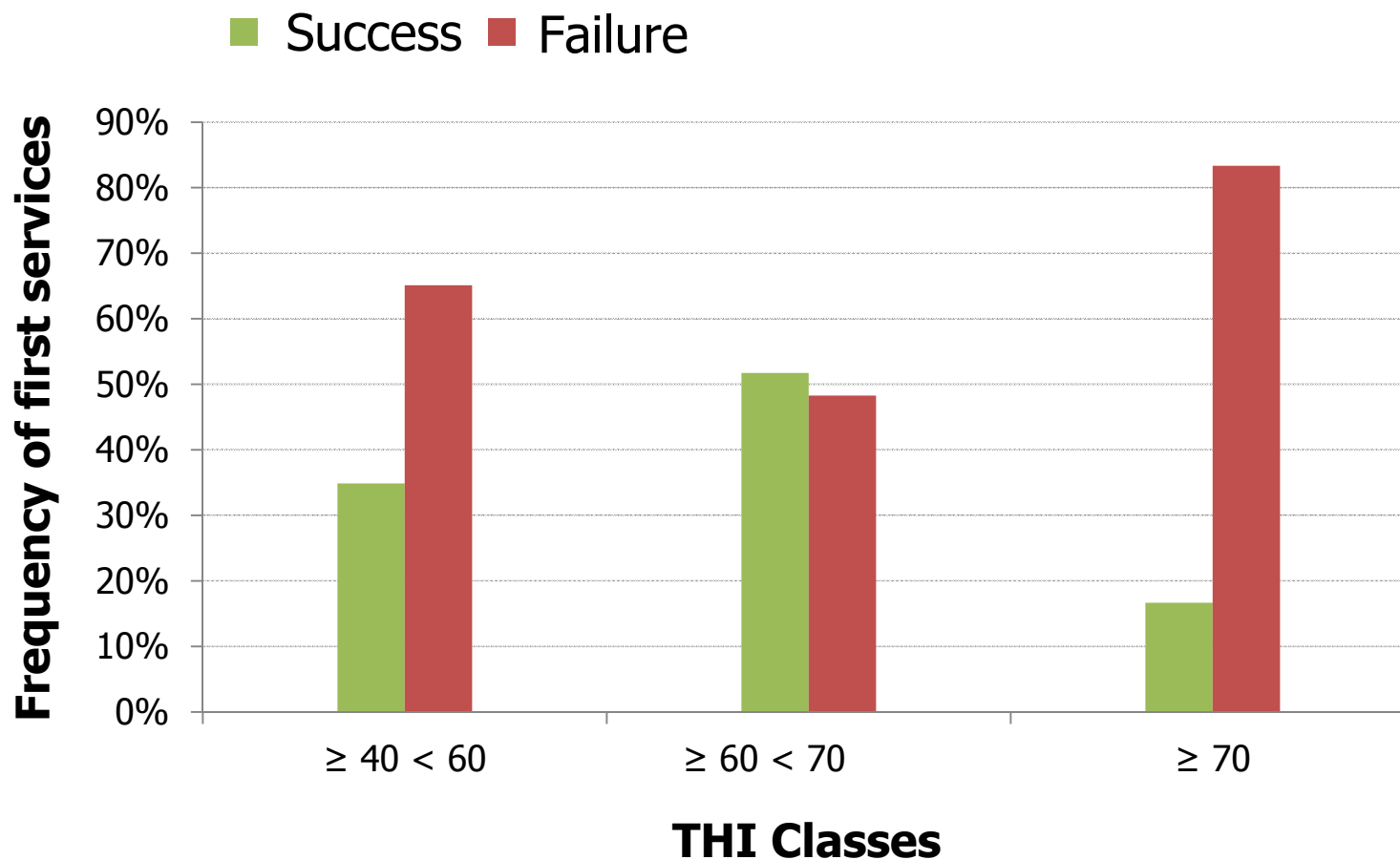
Conclusions

- Conception rates on this farm were not or only minor effected by climatic parameters.

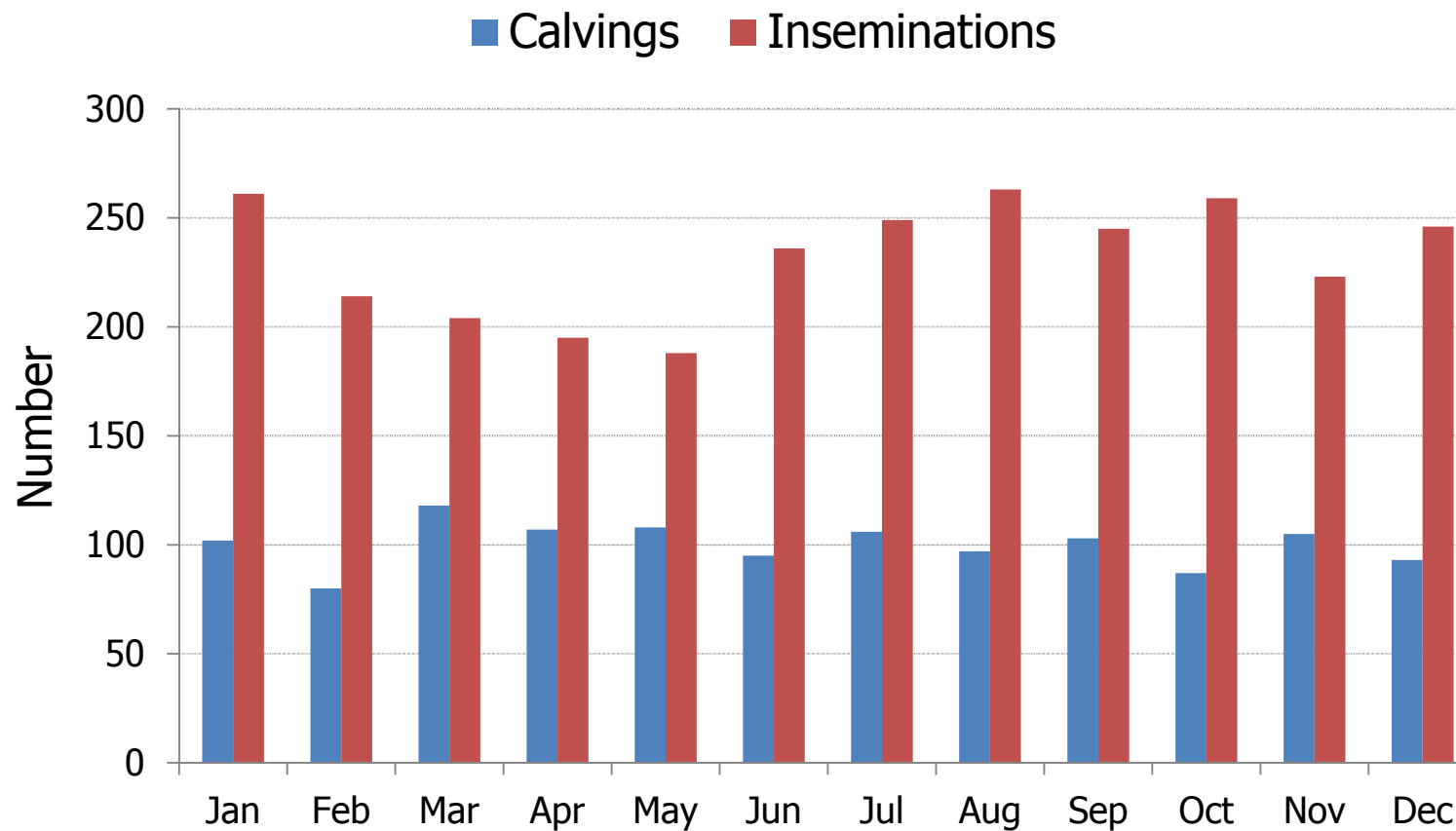- Farm specific effects (e.g. management, nutrition) may have compensated the potential impact ?

Thank you for your attention !

Monthly distribution of Calvings and AI (1993-2013)

Frequency of first services according to THI Classes - Summer