The link between energy balance pattern and fertility in dairy cows

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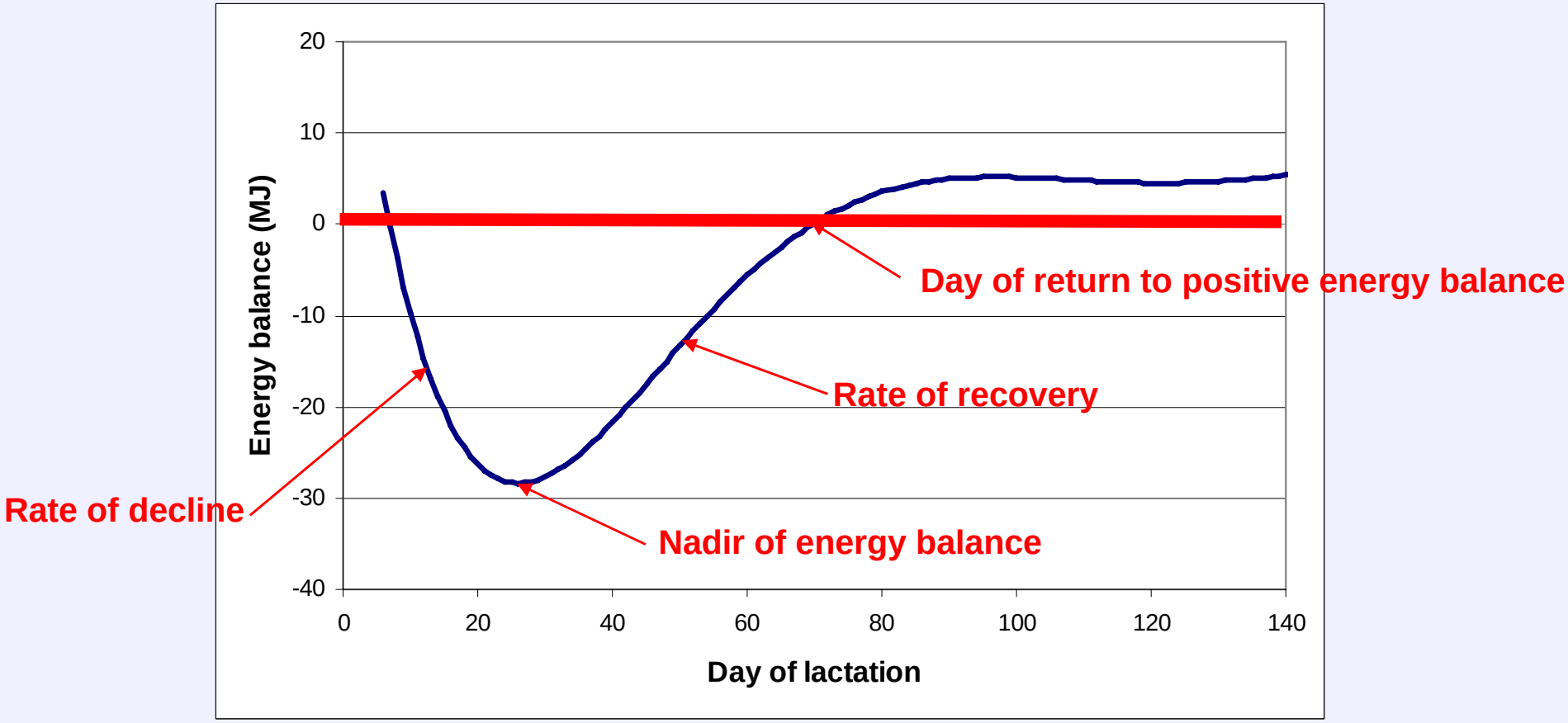
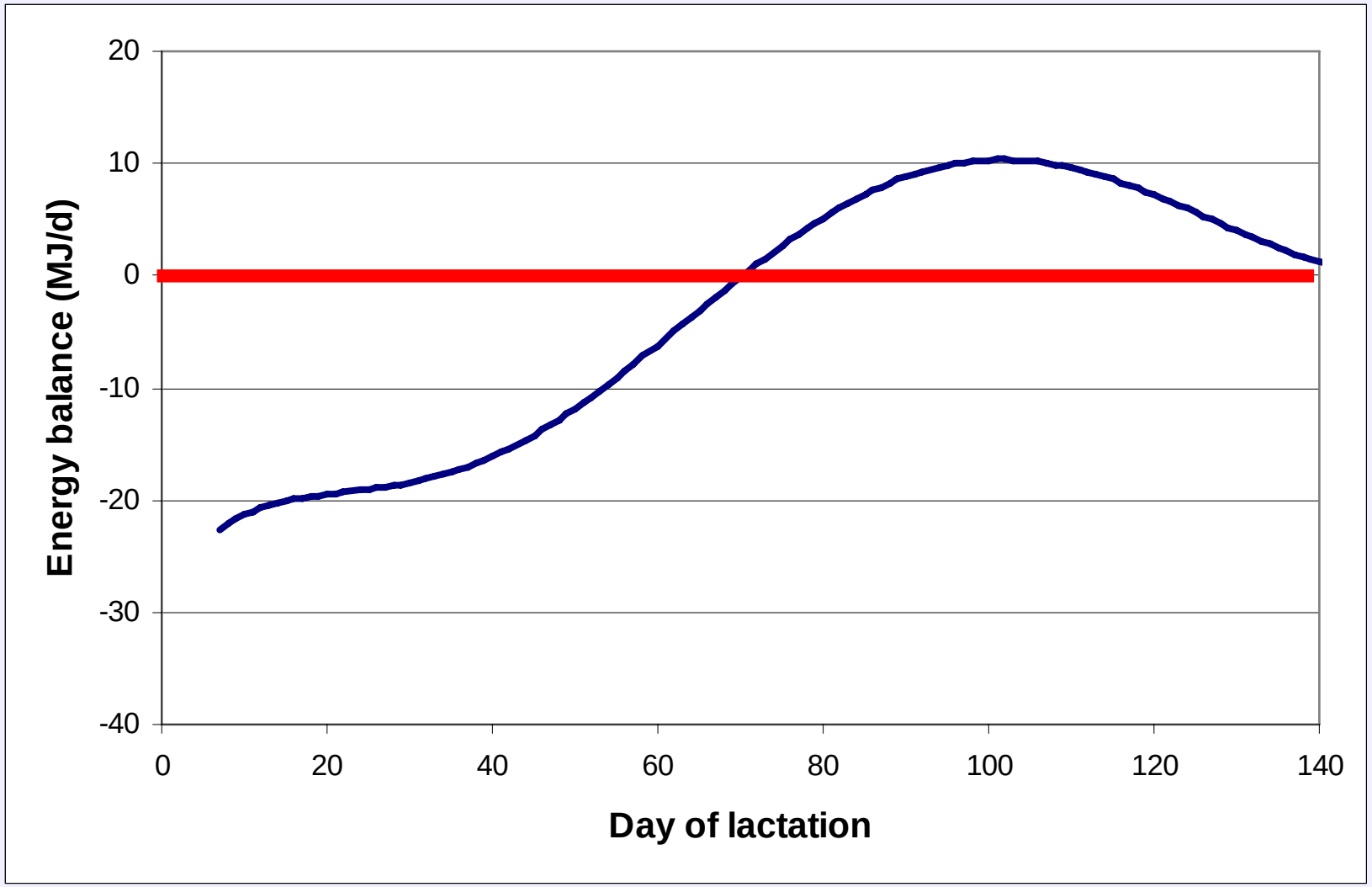
Motivation

- Several authors have suggested a link between energy balance and fertility in early lactation
- Energy balance pattern varies between cows
- Weak relationships shown between energy balance characteristics and fertility traits
- What determines when a cow exhibits her first heat?

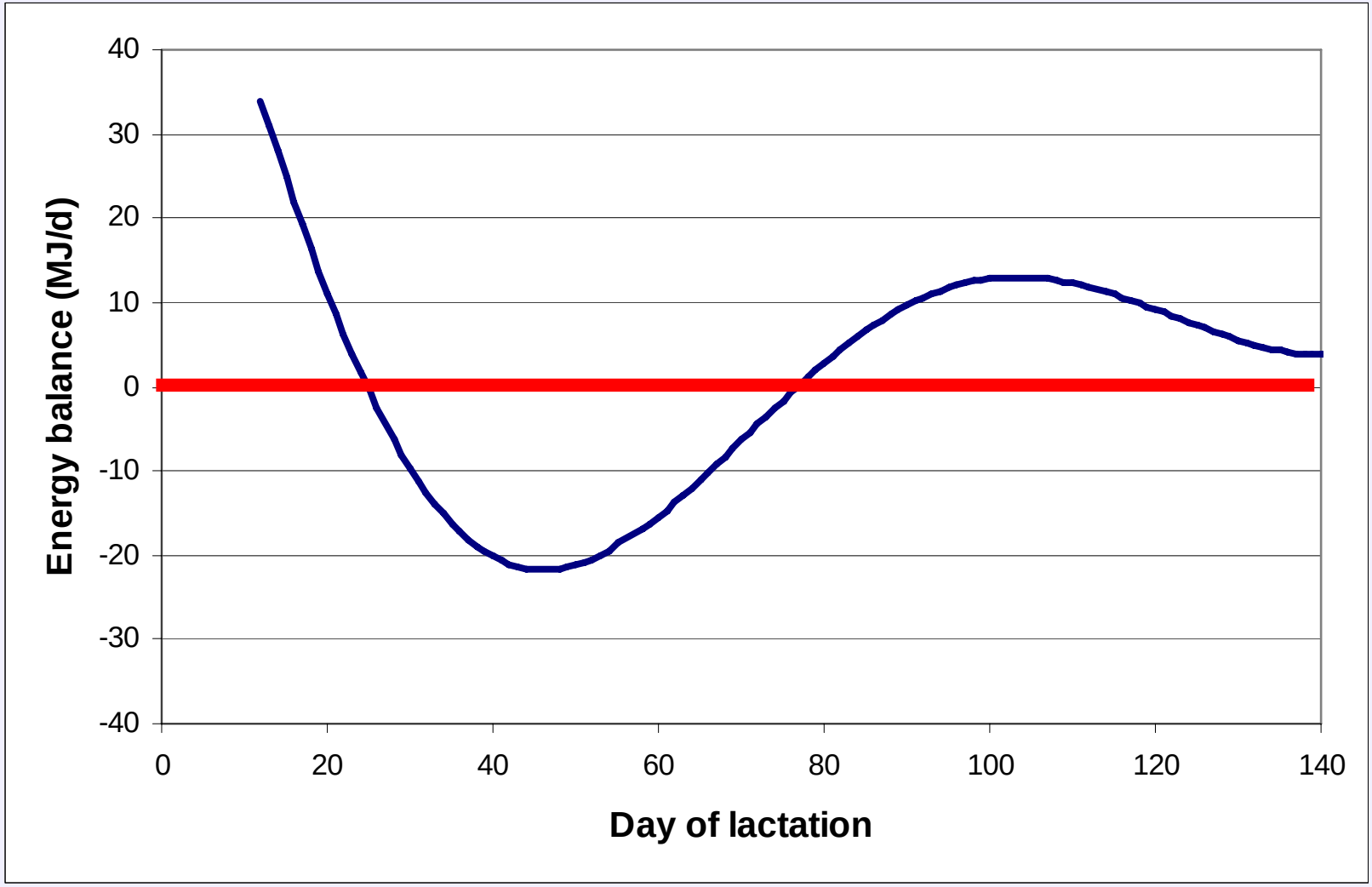
Characteristics of the energy balance curve



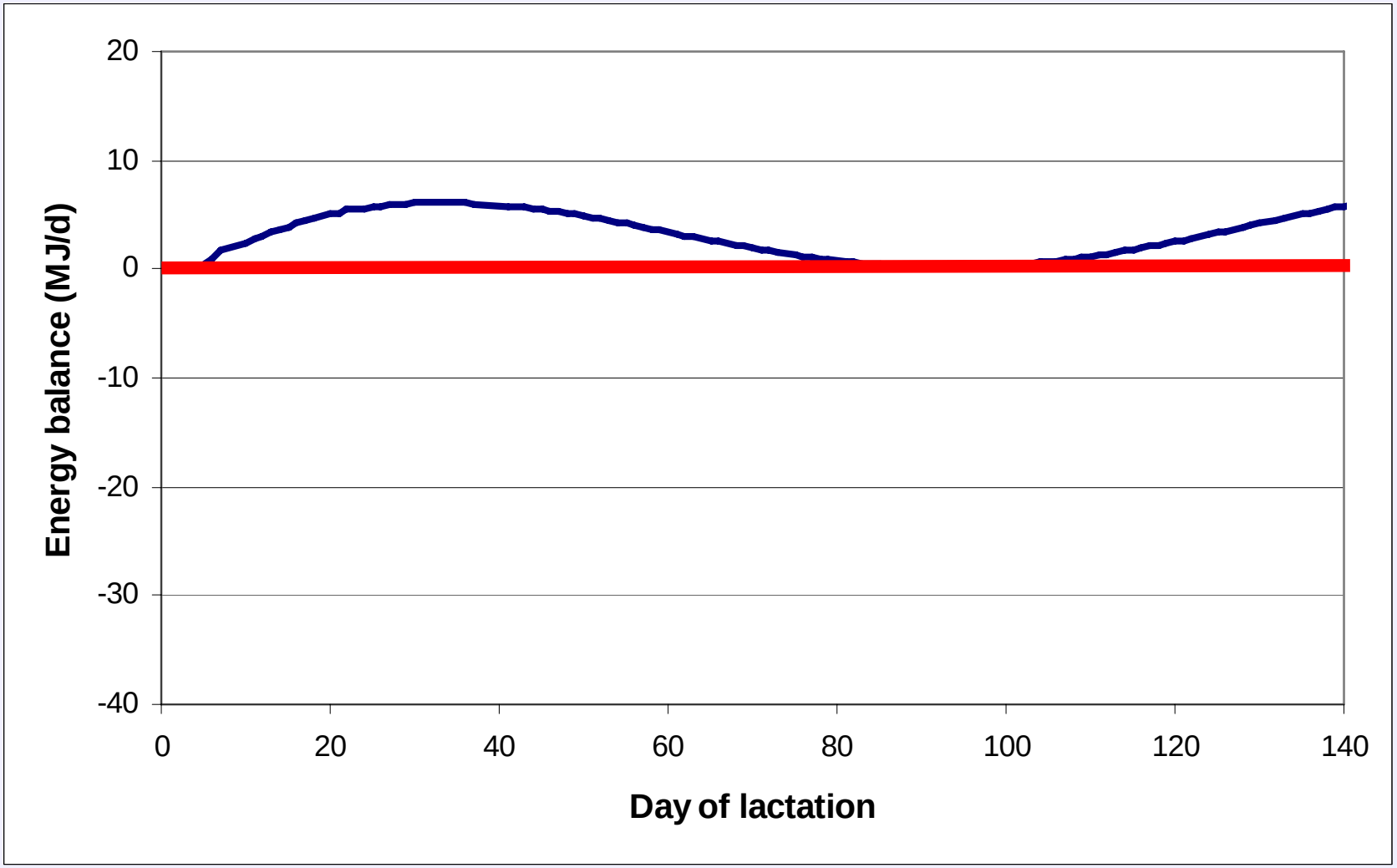
Energy balance pattern 2



Energy balance pattern 3



Energy balance pattern 4



Mixed model approach

- Take traits like day of first heat, day of first service, calving interval and do a classical mixed model type of analysis and look for significant factors
- No great relationships
- Low R^2
- Poor predictive ability
- No strong link between energy balance and fertility – even within EB curve types

Examples of results from mixed model approach

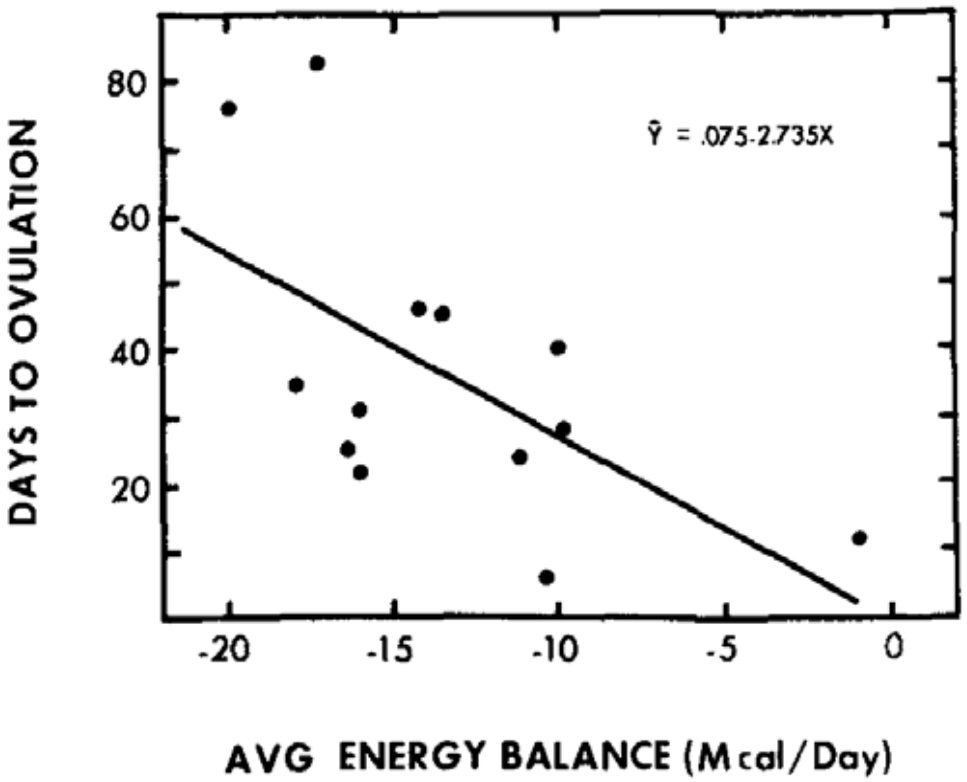
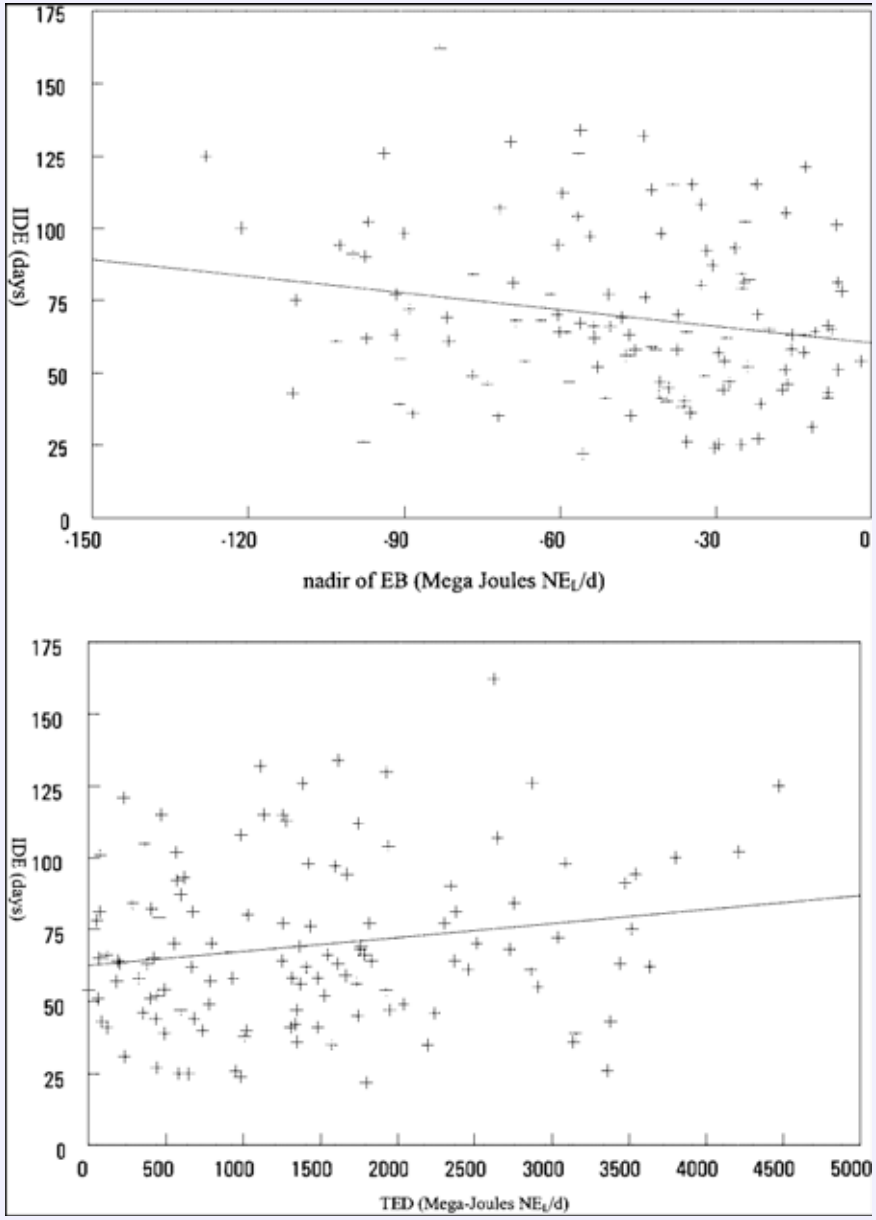


Figure 1. Relationship between average energy balance during the first 20 days of lactation and number of days postpartum to ovulation in dairy cows.

Butler et al., 1981

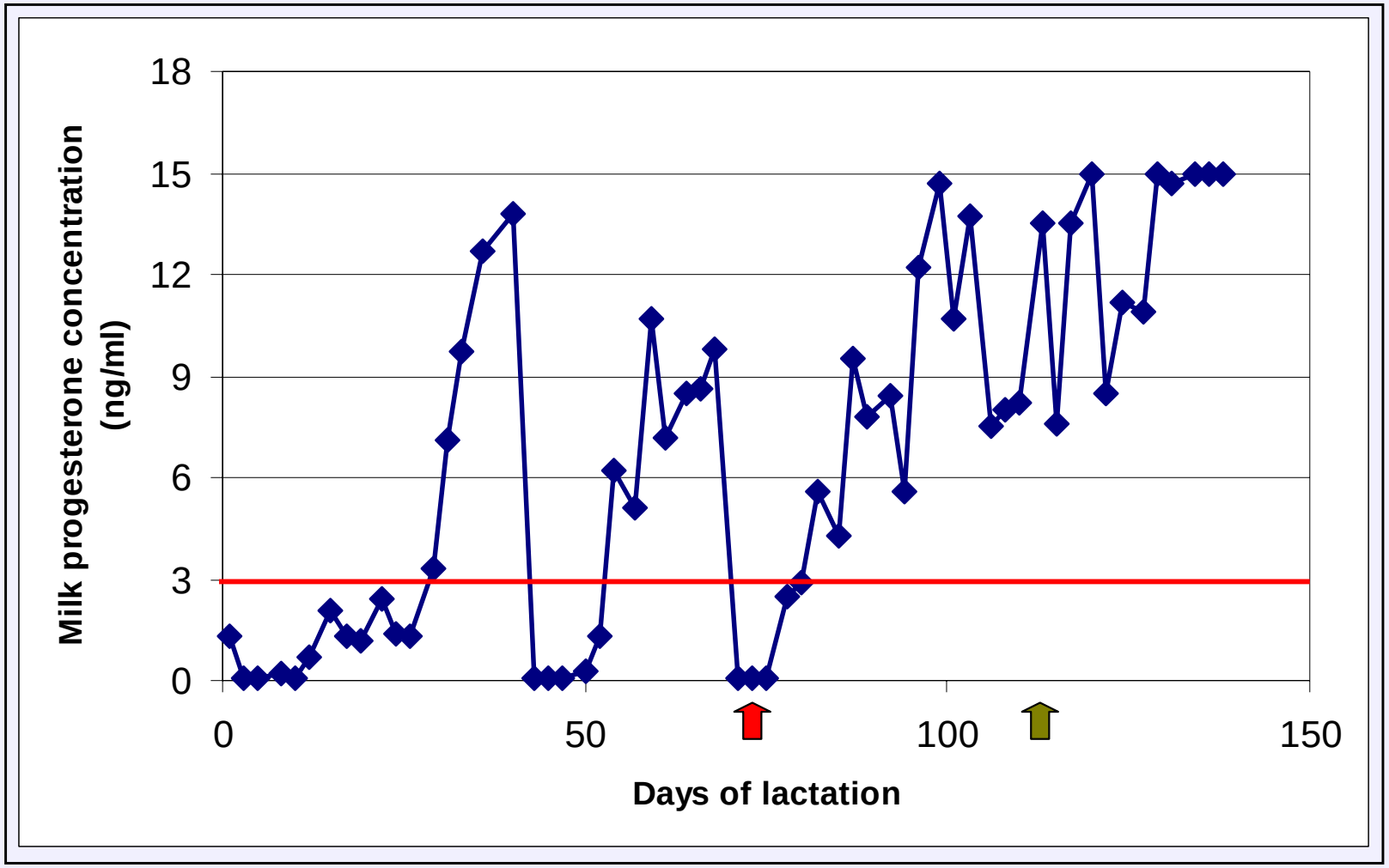


De Vries et al 1999

Experimental animals

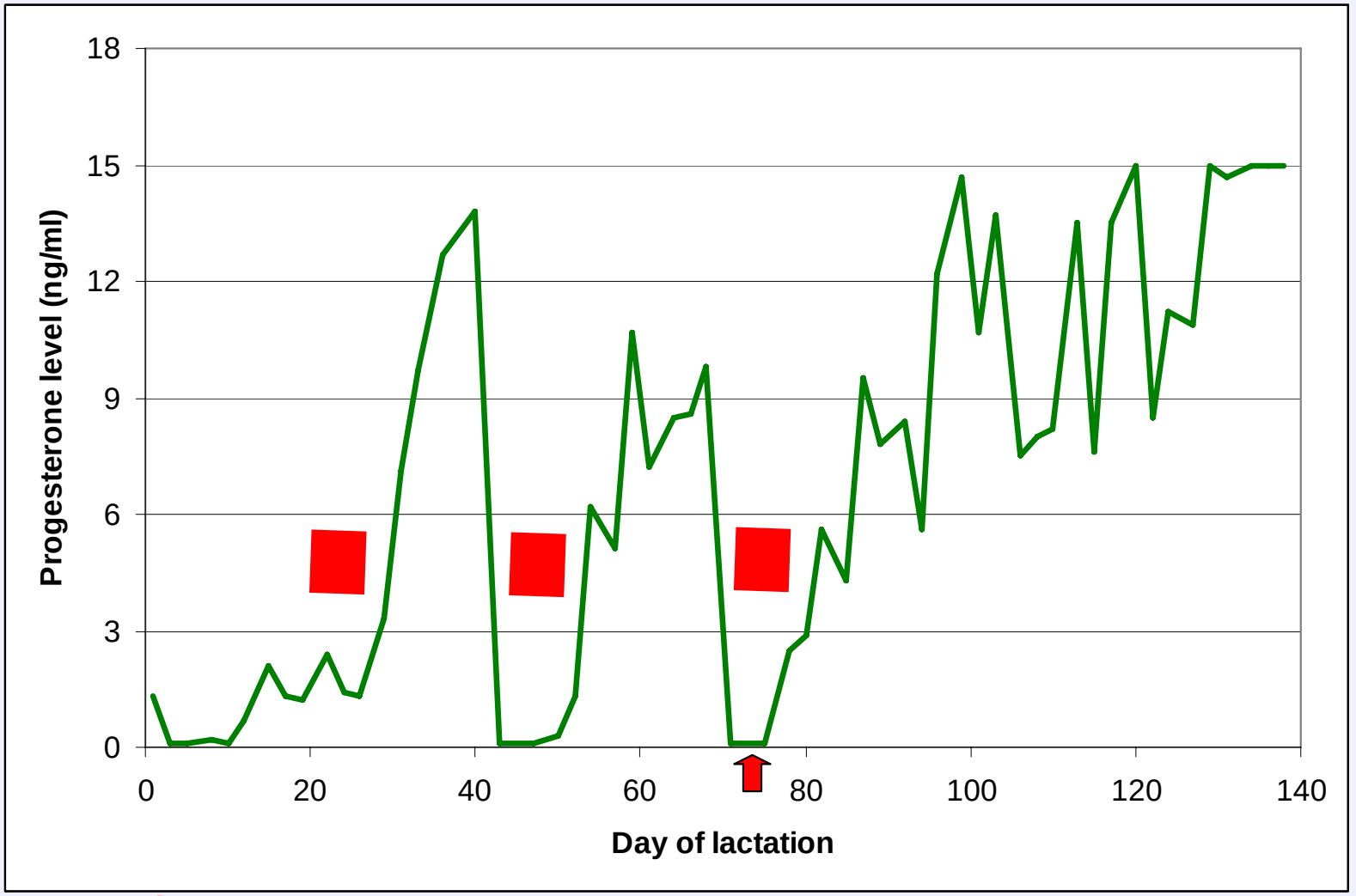
- 200-cow dairy herd at SAC's Crichton Royal farm
- 2x2 experiment maintaining 2 genetic lines on 2 production systems
- Fully recorded to allow energy balance calculations
- Milk progesterone recorded for first 140d of lactation for 2 years
- Farm fertility observations maintained

A typical progesterone profile



= day of first heat and service. = day of pregnancy diagnosis

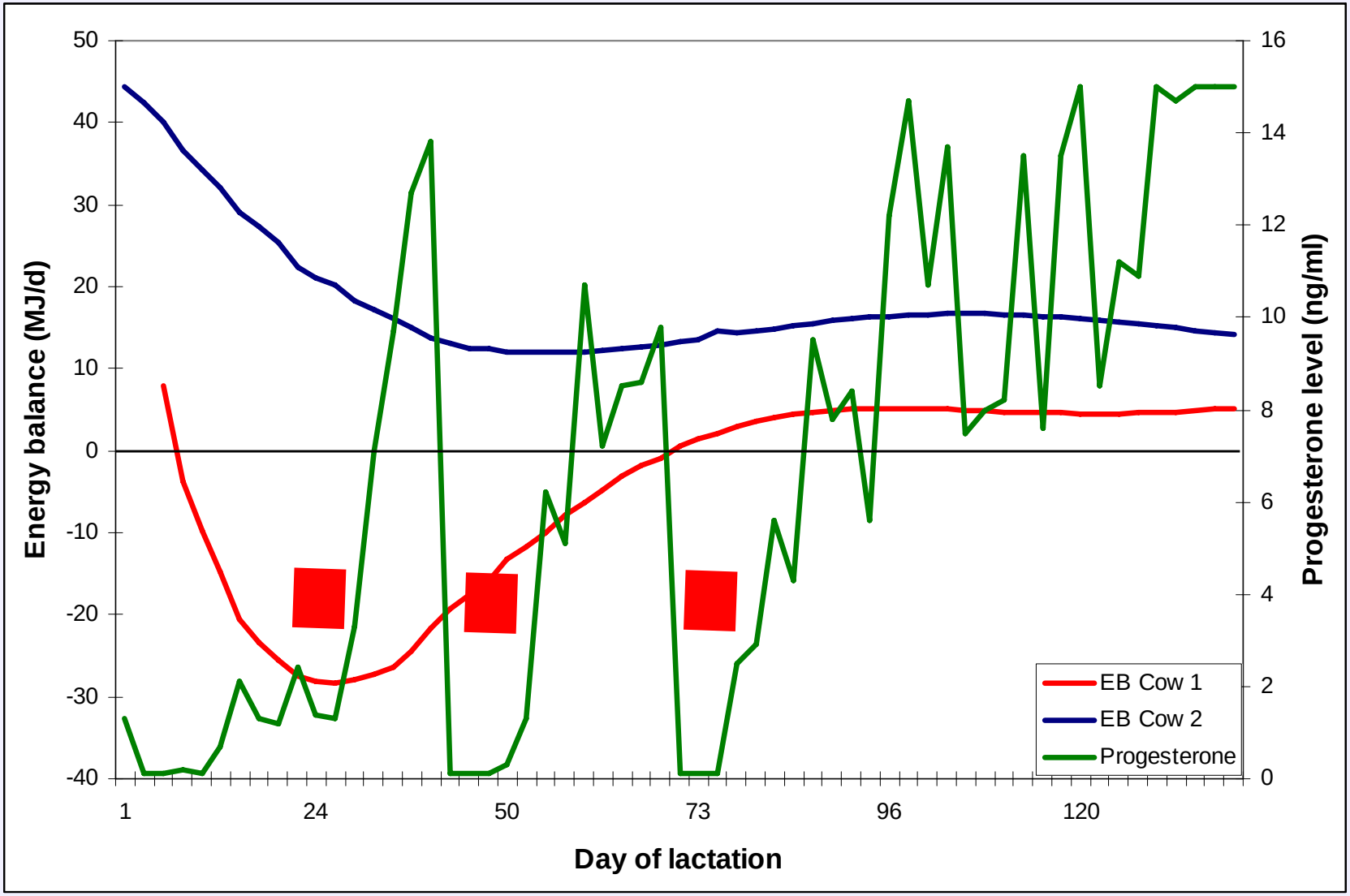
Heats and progesterone cycles



= Heat opportunity

= day of first heat and service.

Energy balance and ovarian cycles



Heat opportunities

- Instead of analysing day of first heat analyse the outcomes of “heat opportunities”
- For any given “heat opportunity”, does it result in an observed heat?
- What factors determine whether a “heat opportunity” results in an observed heat?
- Interested in first observed heat

Preliminary screening of factors likely to influence day of first observed heat

- Cow in positive energy balance at the start of the previous cycle
- High level of progesterone in previous cycle
- In positive energy balance at time of heat
- Level of nadir of energy balance
- Rate of recovery to positive energy balance
- Heifer
- Health status; metritis (10d), lameness (16d), mastitis (13d), cystic ovaries (45d)

Summary of 142 healthy cows

- 89 met criteria
- 3 had 1st heat one cycle later than expected
- 25 had heat just before return to PEB
  - 16 had high nadir of energy balance
  - 9 had fast recovery rate
- 25 had a later 1st heat - unexplained

Summary of 144 cows with a health condition prior to 1st heat

- Prior analyses showed that cows with certain health conditions had delayed day of 1st heat
- Mastitis, metritis, lameness, cystic ovaries
- 76 met criteria
- 20 had 1st heat one cycle later than expected
- 12 had heat just before return to PEB
  - 10 had high nadir of energy balance
  - 2 had fast recovery rate
- 36 had a later 1st heat - unexplained

Comparing healthy cows to those with a health condition

- Significant Chi^2 test P=0.0002
- No difference between those meeting criteria
- More non-healthy cows had 1st heat during cycle after expected
- More healthy cows had 1st heat just before reaching positive energy balance

Conclusions

- The heat opportunities approach promises a better understanding of the factors which influence fertility than the mixed model method
- Positive energy balance and nadir of energy balance involved with heat expression
- Health traits affect fertility differentially

Acknowledgements

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land-based industries
for over a century

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