



# **Heterogeneity in genetic variation for feed intake and residual feed intake between Holstein, Nordic Red, and Jersey cows**

Bingjie Li, Britt Berglund, Freddy Fikse, Jan Lassen, Peter Løvendahl

# Acknowledgement

- Nordic project for feed efficient cows (FUNC)



Sveriges lantbruksuniversitet  
Swedish University of Agricultural Sciences



- Erasmus Mundus Graduate School in Animal Breeding and Genetics



# Introduction

- Dry Matter Intake (DMI):
  - Heritability: 0.2 - 0.4 in Holstein (Berry et al., 2014; Manzanilla Pech et al., 2016)
  - Potential difference among dairy breeds in genetic variation for DMI (Li et al., 2016)
- Residual Feed Intake (RFI):
  - DMI adjusted for energy sinks (e.g., yield, body maintenance, BW change)
  - Heritability: 0.01-0.38 in Holstein (Berry and Crowley, 2014)

# Objectives of study

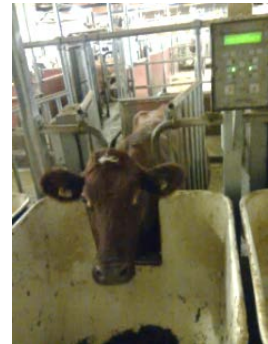
To estimate genetic variance and genetic parameters for DMI and RFI in three dairy breeds:

- ❖ To detect the potential heterogeneity between dairy breeds in genetic variation for DMI and RFI
- ❖ To compare the genetic parameters for DMI with RFI along the whole lactation



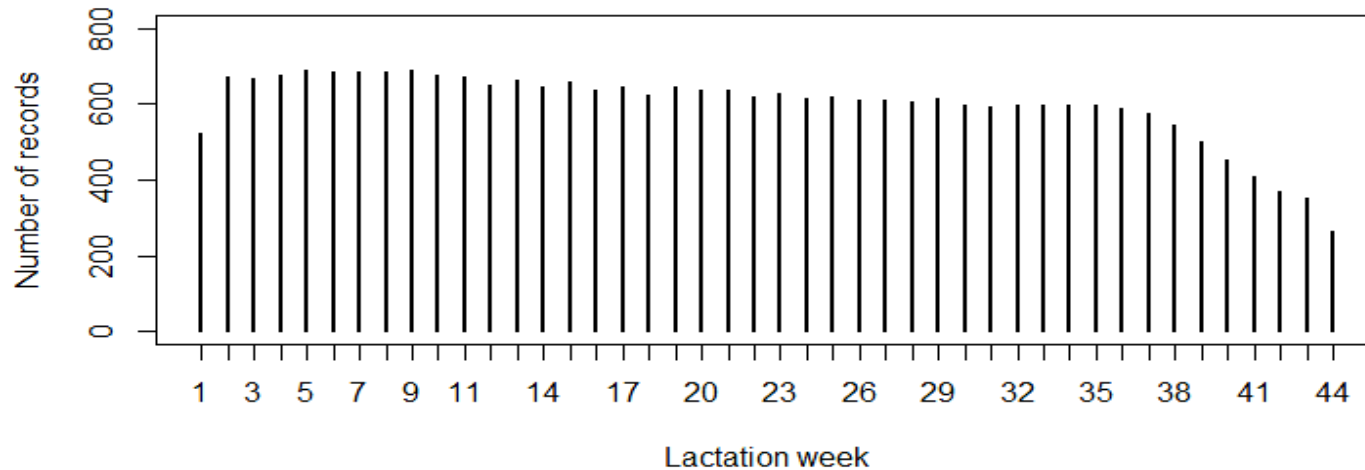
# Data

- 1,902 primiparous cows from Denmark, Finland, Sweden
  - 799 Holstein (HOL) + 737 Nordic Red (RDC) + 366 Jersey (JER)
- Records over 44 lactation weeks (on average 32 records per cow):
  - Feed intake, Milk yield (+ protein%, fat%, lactose%), Body weight
- Feeding: Automatic feeder, total mixed ration
- Pedigree includes 28,002 animals



# Data distribution over 44 lactation weeks

## HOL



Less data in end lactation in all three breeds

# Methods

Random regression analysis for variance component estimation over 44 lactation weeks:

- **DMI**

$$\text{DMI} = \mathbf{u} + \text{Calv\_age} + \text{Herd\_Trial} + \text{Calv\_YS} \\ + \text{Lact\_wk} + \sum \mathbf{a} * \Phi + \sum \mathbf{pe} * \Phi + \mathbf{e}$$

- 2<sup>nd</sup> order legendre polynomials for a and pe
- Residuals were divided into 11 classes (each 4-week period)

# Methods

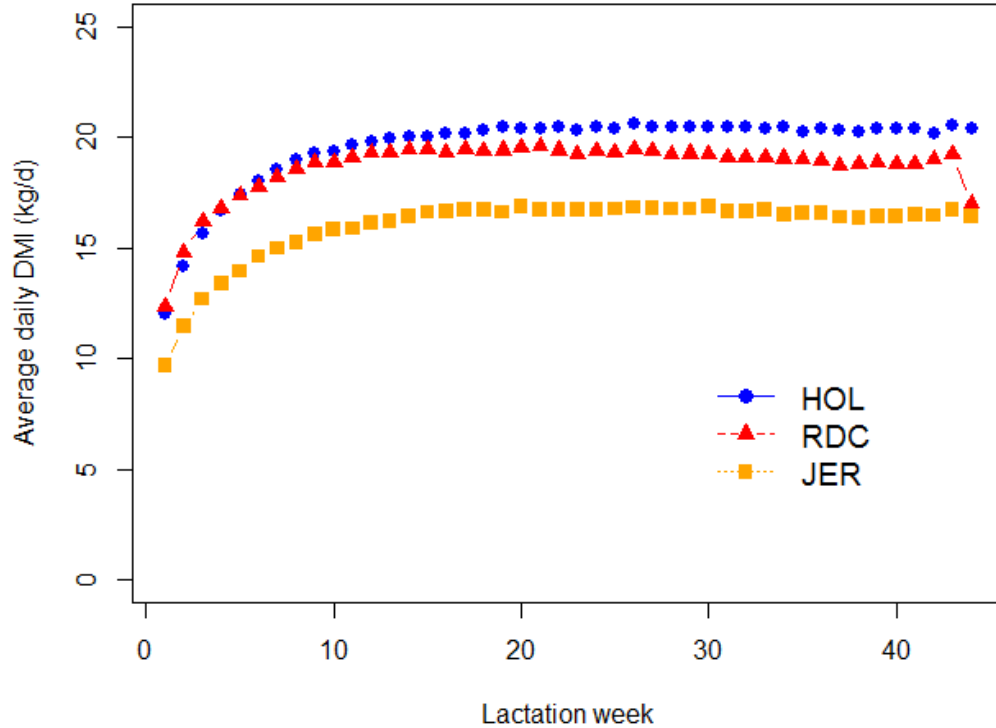
- **RFI** (one-step RFI, Tempelman et al., 2015)

$$\begin{aligned} \text{DMI} = & \mathbf{u} + \mathbf{b}_1 * \text{ECM} + \mathbf{b}_2 * \text{BW}^{0.75} + \mathbf{b}_3 * \Delta \text{BW} \\ & + \text{Calv\_age} + \text{Herd\_Trial} + \text{Calv\_YS} \\ & + \text{Lact\_wk} + \sum \mathbf{a} * \Phi + \sum \mathbf{pe} * \Phi + \mathbf{e} \end{aligned}$$

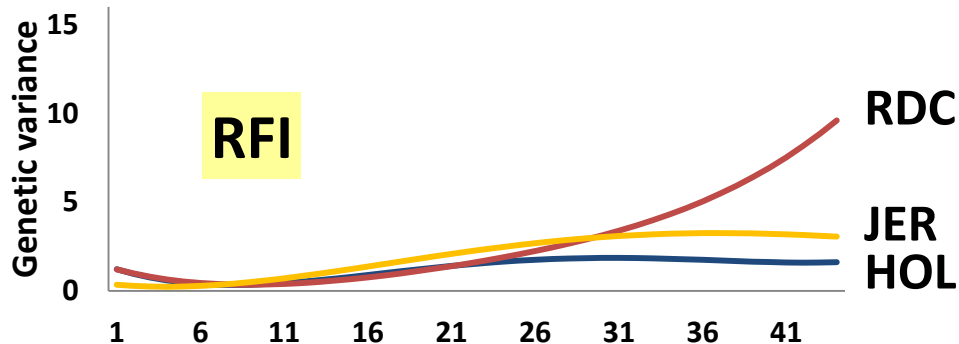
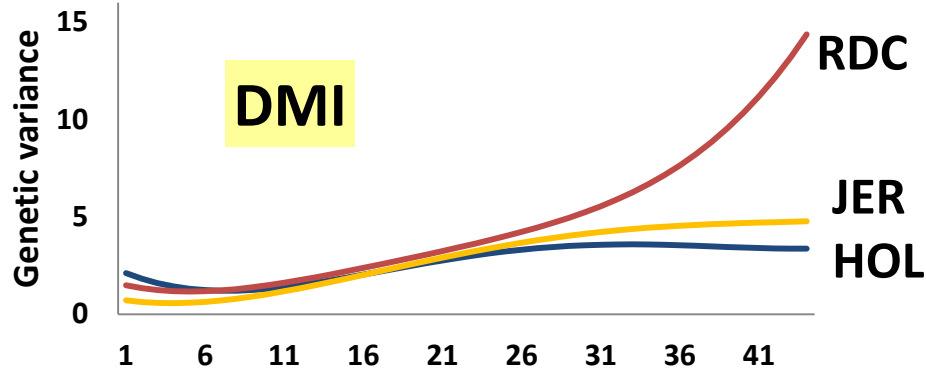
- 2<sup>nd</sup> order legendre polynomials for a and pe
- Residuals were divided into 11 classes (each 4-week period)



# Average daily DMI over the whole lactation

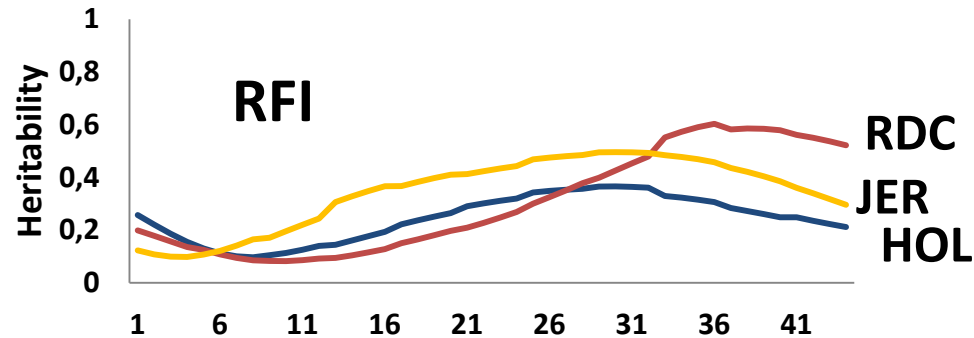
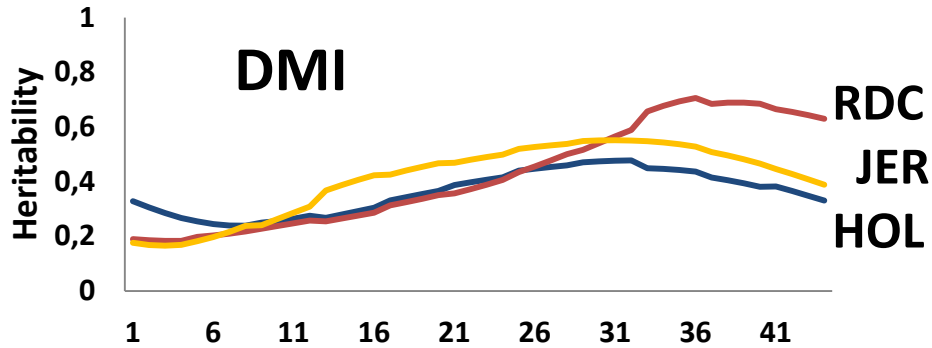


# Results: Genetic variances for DMI and RFI



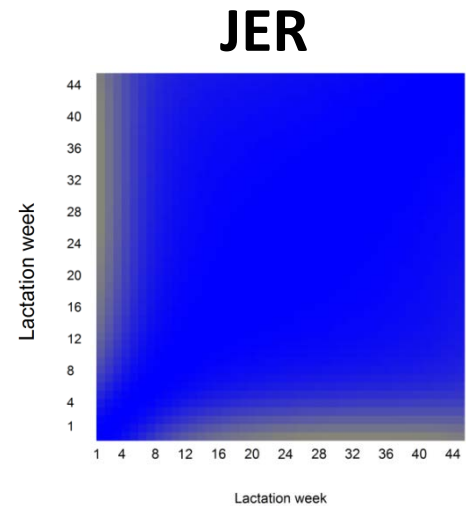
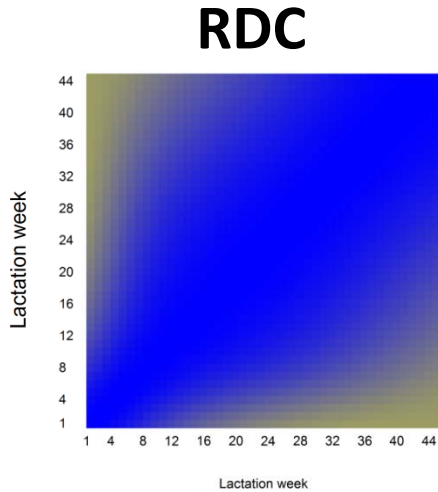
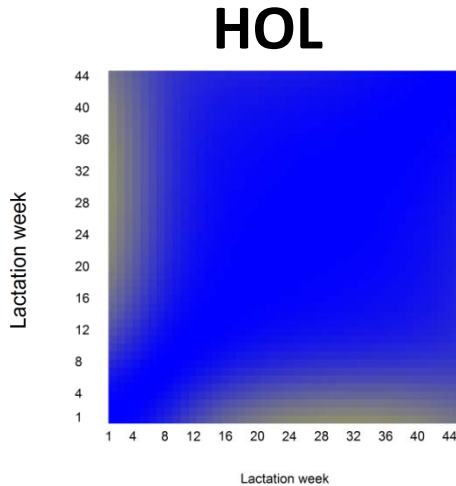
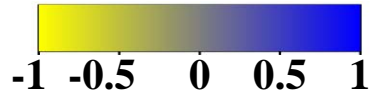
- Different breeds follow a similar trajectory of genetic variance
- Over-estimation in late lactation:
  - Nature of polynomials
  - Less data in end lactation

# Results: Heritability for DMI and RFI



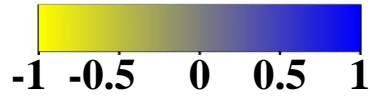
- The trajectory of heritability could be similar between breeds
- Over-estimation in late lactation
- $h^2$  for DMI:  $h^2 \sim 0.2-0.5$   
 $h^2$  for RFI:  $h^2 \sim 0.1-0.4$

# Genetic correlation for DMI across lactation

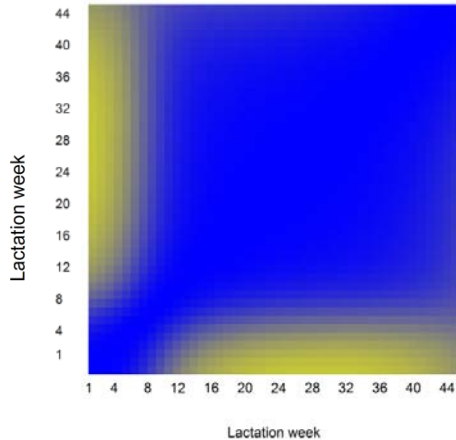


Feed intake in early lactation is genetically different from feed intake in middle and late lactation

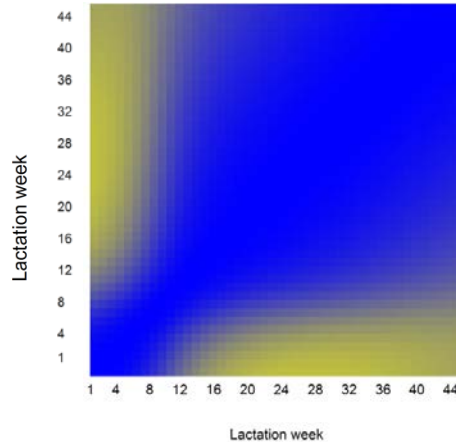
# Genetic correlation for RFI across lactation



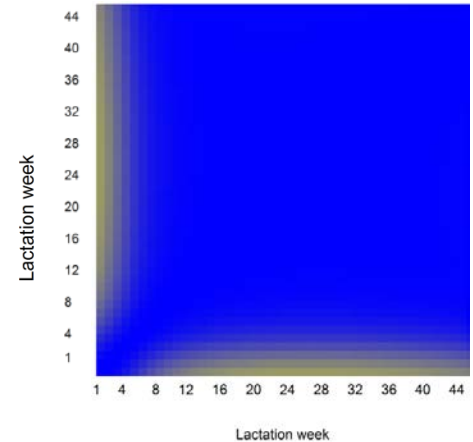
**HOL**



**RDC**

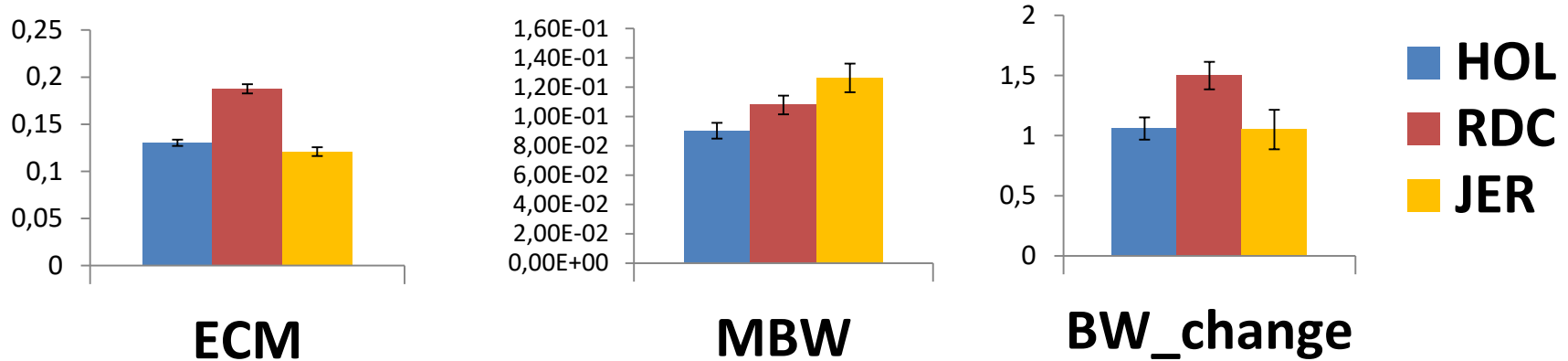


**JER**



RFI is genetically different between early and later lactation

# Regression coefficients of energy sinks on DMI



Regression coefficients of energy sinks on DMI might be different between breeds

# Conclusions

- Breed difference could exist in genetic variance and heritability for DMI and RFI, but their trajectory over lactation could be similar between breeds
- RFI has lower genetic variance and heritability than DMI
- DMI and RFI in early lactation were genetically different from those in middle and late lactation in all breeds

# Conclusions

- In calculating RFI, regression coefficients of energy sinks on DMI could be different between breeds, especially for ECM

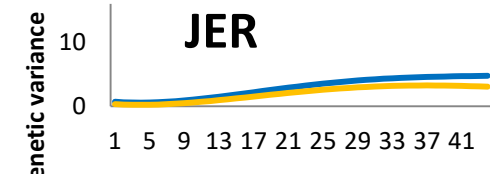
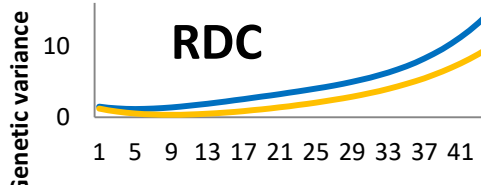
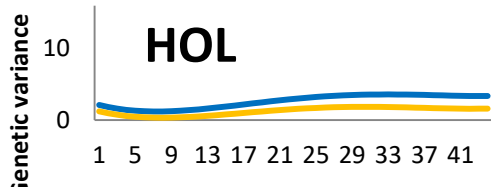
*Thank you for your attention !*





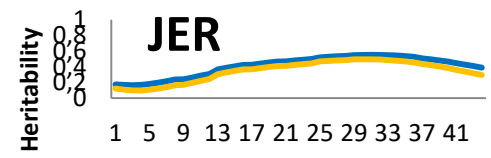
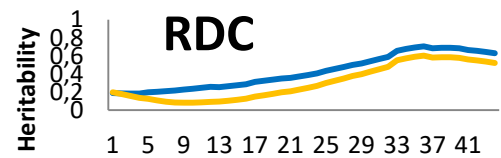
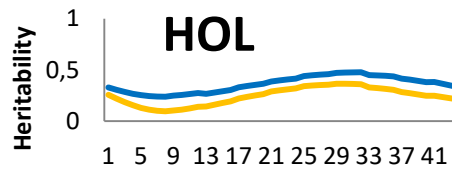
# Genetic variance and heritability: RFI < DMI

## Genetic variance



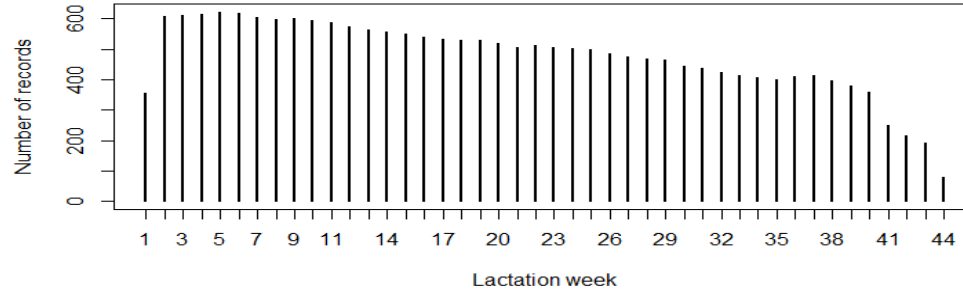
— DMI  
— RFI

## Heritability

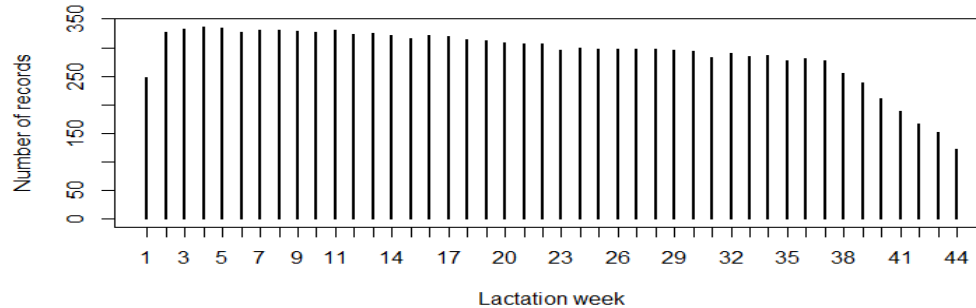


# Data over 44 lactation weeks

## RDC



## JER



# Residual variances

