International genetic evaluations for feed intake

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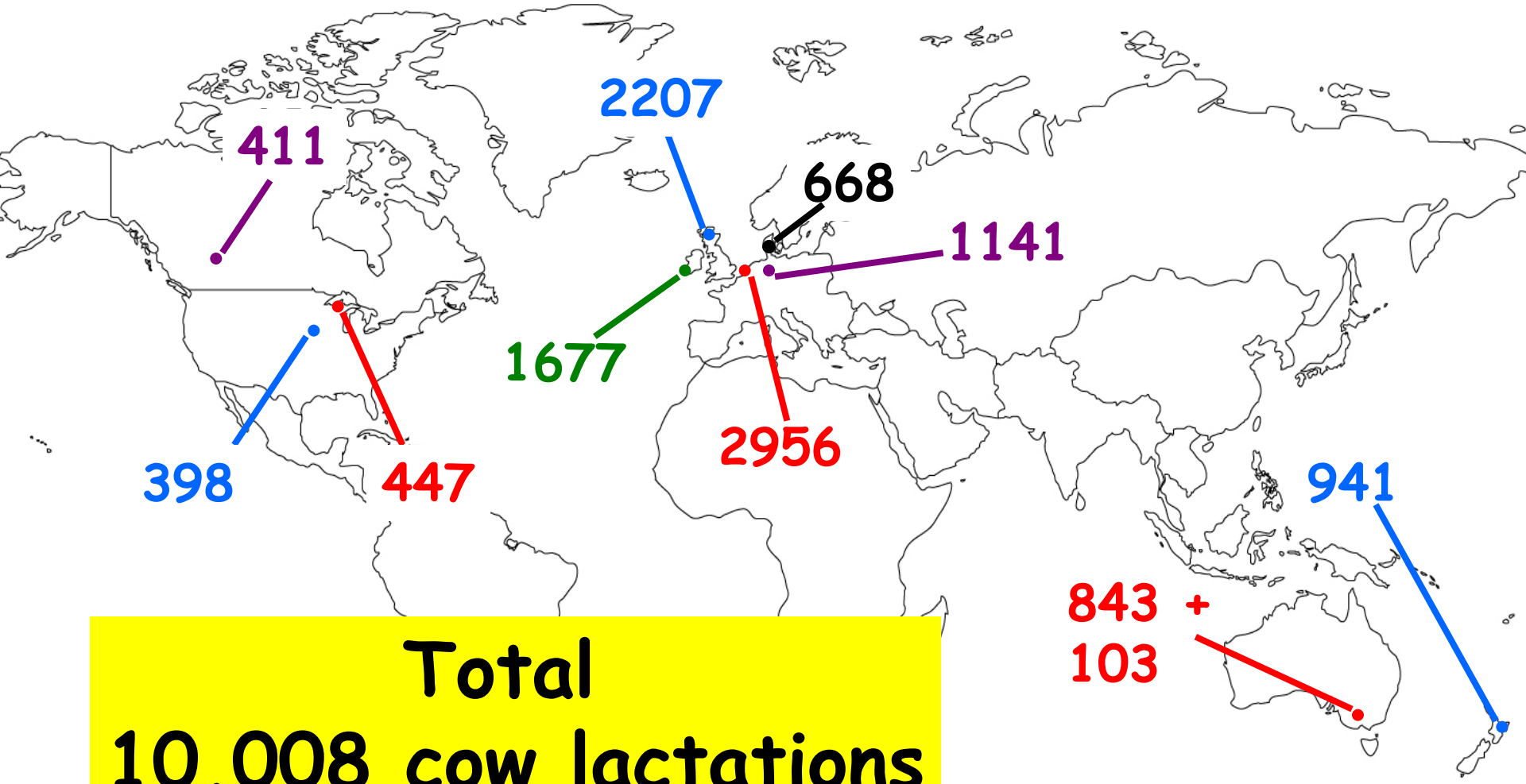
Motivation

- A direct measure of feed intake is missing from all national dairy cow breeding objectives
  - Paucity of data (phenotypic or genomic)
  - Cost of collection
- Data does exist in national repositories
  - Insufficient in size on their own

Objective

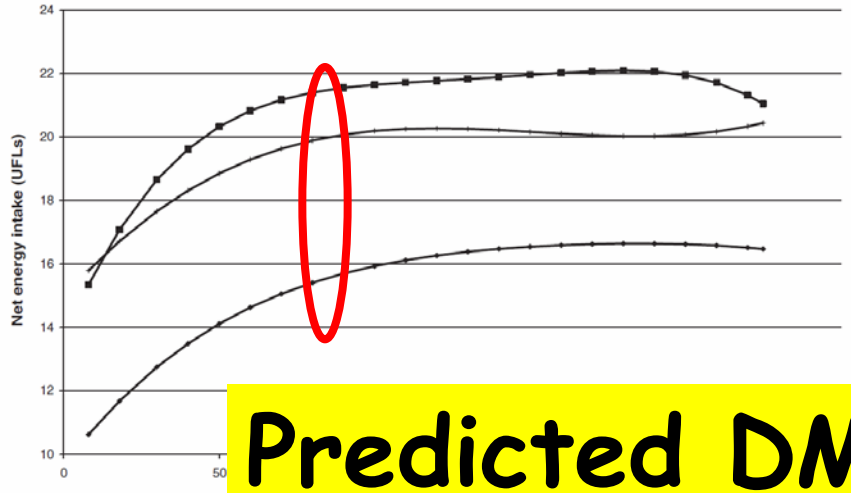
1. Prove that data can be combined from multiple sources
   - Intellectual property
   - Logistics / formats etc
     - Phenotypes, pedigree, genotypes
2. Estimate genetic parameters
   - Within-country heritability
   - Between-country genetic correlations

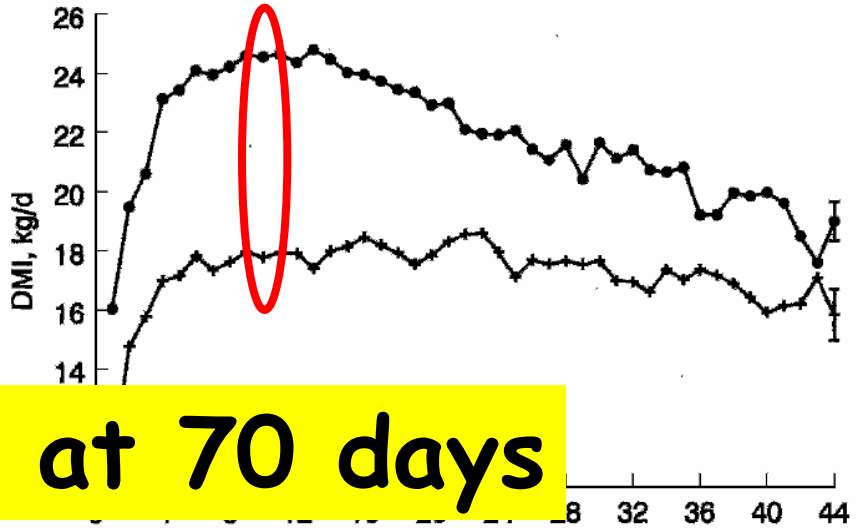
Data



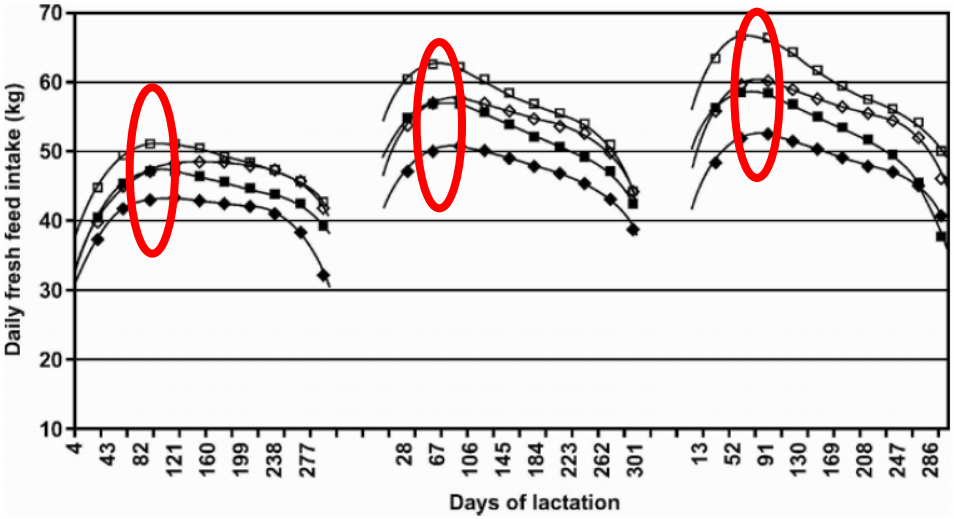
Total
10,008 cow lactations
1,784 growing heifers

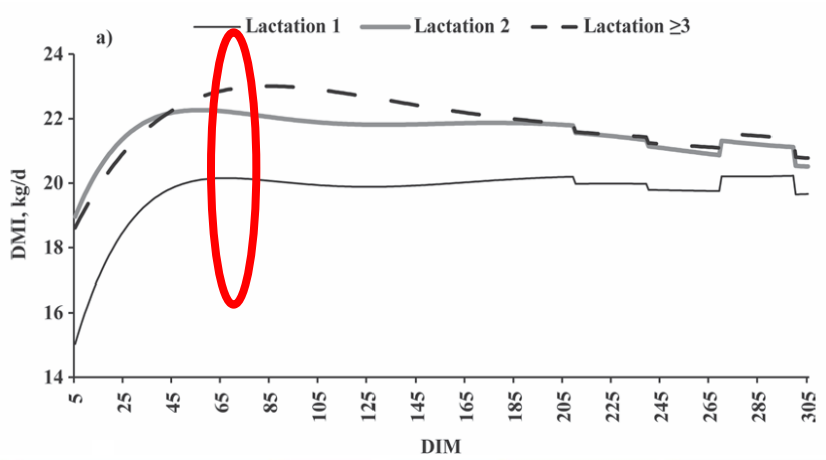
Common phenotype





Predicted DMI at 70 days





Berry et al. (2006) ; Coffey et al. (2004)
Friggens et al. (1998); Vallimont et al (2010)

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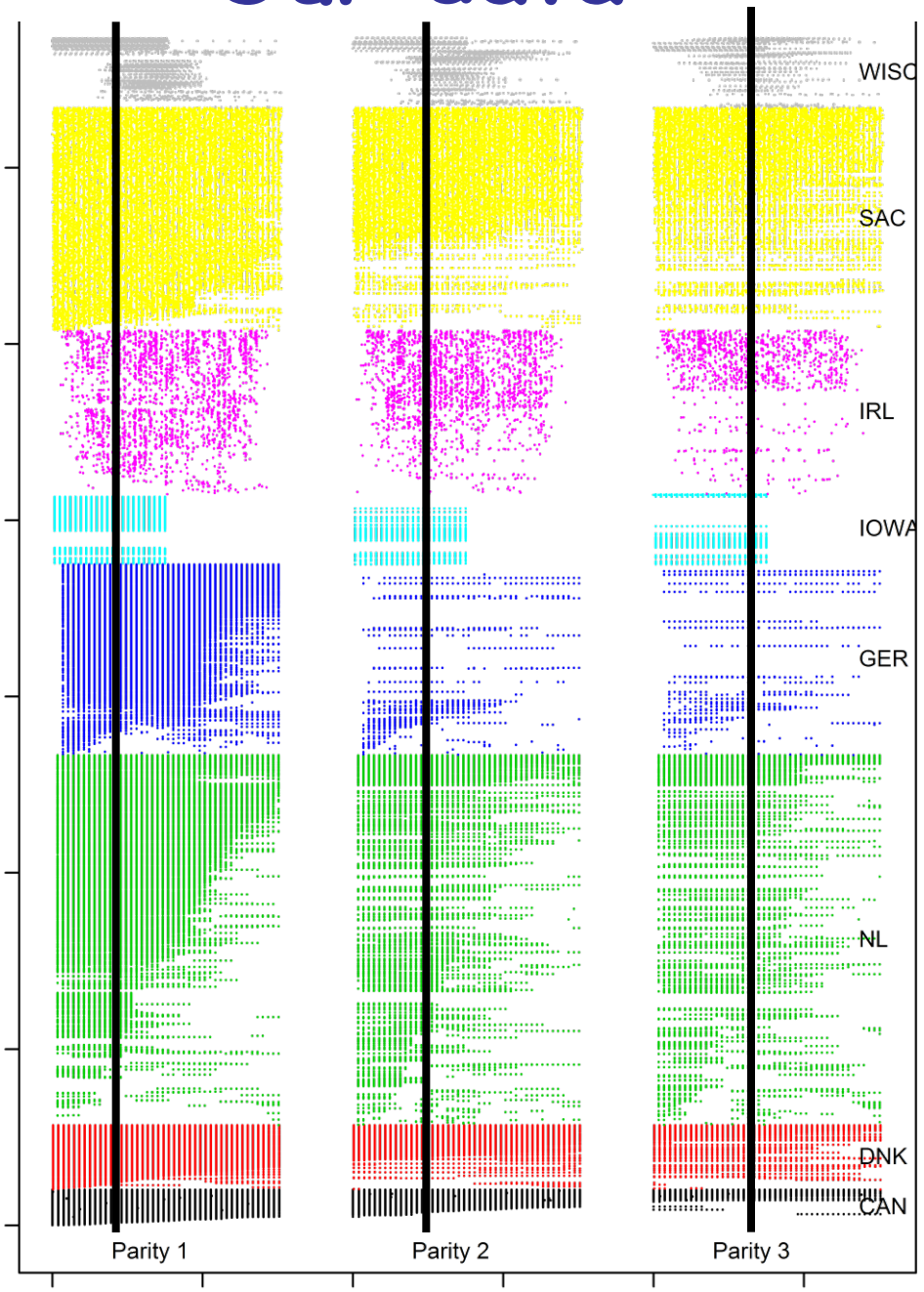
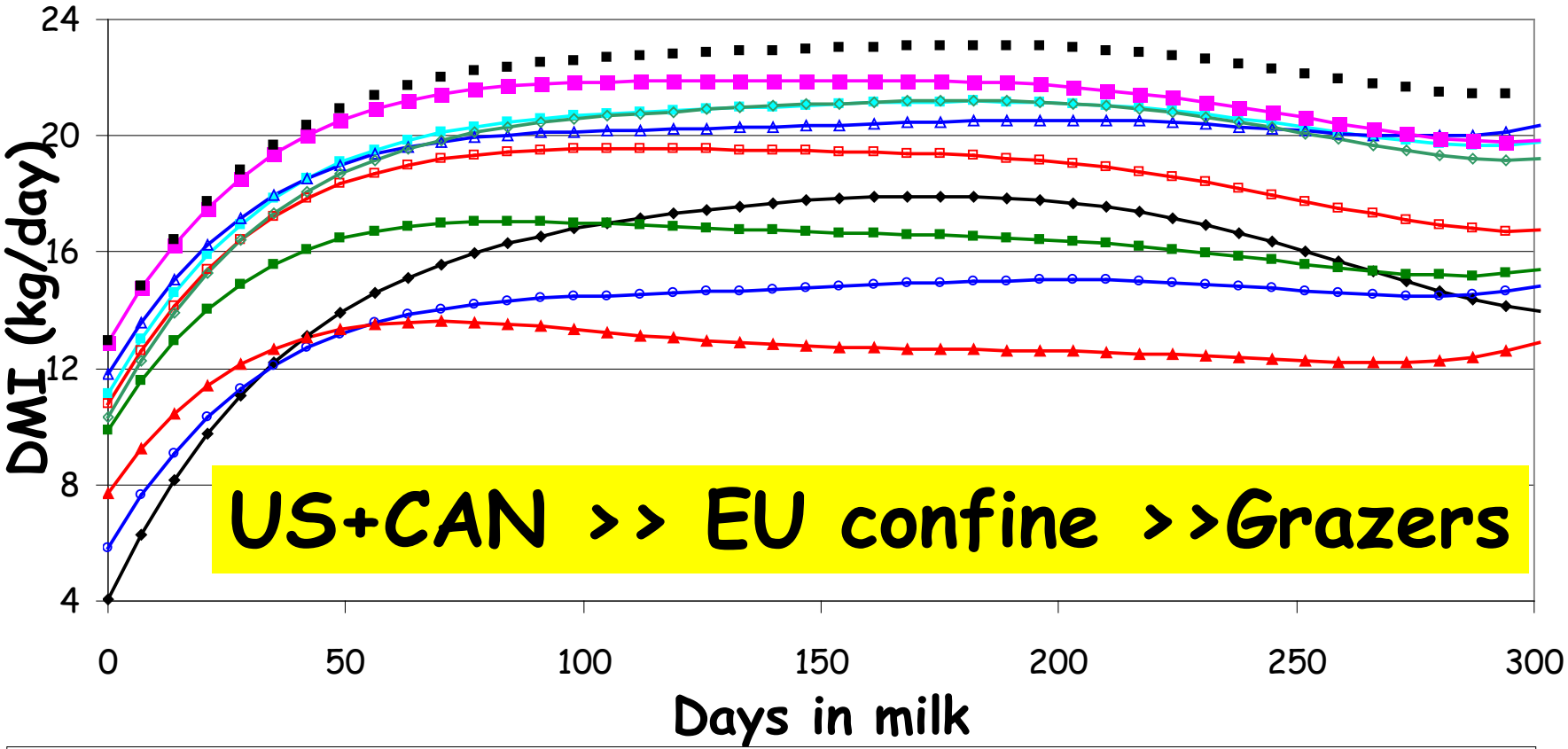
Our data



Lactation profiles



$$DMI = \underbrace{parity \cdot \sum_{n=1}^{5} DIM^n + HYS + CG}_{\text{Fixed}} + \underbrace{herd \cdot \sum_{n=1}^{2} DIM^n + parity \cdot animal \cdot \sum_{n=1}^{2} DIM^n + e}_{\text{Random}}$$

Genetic analysis

- Predicted DMI at 70 days post-calving
- Pedigree file (INTERBULL format)
  - 271,545 animals
- Animal repeatability linear mixed model
  - Fixed effects: Parity + HYS of calving
  - Random: genetic + permanent environment

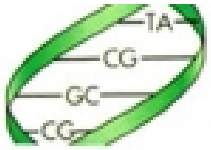
Genetic Correlations

North America
Canada
Iowa
Wisconsin

Grazing
Ireland
Australia

$$\mathbf{H}^{-1} = \mathbf{A}^{-1} + \begin{bmatrix} 0 & 0 \\ 0 & \lambda(\mathbf{G}^{-1} - \mathbf{A}_{22}^{-1}) \end{bmatrix}$$

N=5429



EU-high input
Netherlands
Germany
Denmark
UK high input

EU-low input
UK low input

Growing heifers
Australia
New Zealand

Variance components

Country	N	Mean	SDg	Heritability
Cows				
All	10008	19.7	1.13	0.34 (0.03)
Canada	411	22.2	1.01	0.19 (0.14)
Denmark	668	22.1	1.48	0.52 (0.12)
Germany	1141	20.2	0.64	0.08 (0.06)
Iowa	398	23.5	1.48	0.41 (0.14)
Ireland	1677	16.7	0.88	0.41 (0.10)
Netherlands	2956	21.4	1.15	0.39 (0.05)
UK	2840	17.4	1.07	0.31 (0.06)
Wisconsin	447	24.9	0.90	0.24 (0.16)
Australia	103	15.6		

h^2=0.08 to 0.52

CVg= 8.7 – 9.3%

Genetic correlations

Region	EU-high	EU-low	North America	Grazing
EU-high input		125 (144)	39 (72)	23 (28)
EU-low input			4 (10)	4 (10)
North America				6 (8)
Grazing				

Genetic correlation of 0.67 (0.24) between growing heifer and lactating cow DMI

Conclusions

- DMI data from multiple sources can be combined
  - Common phenotype
- DMI heritability across data of 0.34
  - Ample genetic variation
- Genetic correlations between countries difficult to estimate using pedigree
  - Genotype information helps (H^{-1} matrix)
- GxE exists for grazing environments

Global **D**ry **M**atter **I**nitiative (**gDMI**)

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