Genetic analysis of reproductive diseases and disorders in Norwegian Red cows

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Fertility related diseases and disorders

- Recorded routinely in the Norwegian health recording system since 1978
- So far not used directly in the breeding program
- The most frequent fertility related diseases and disorders among first lactation cows:
  - Silent heat (**SH**)
  - Cystic ovaries (**CO**)
  - Metritis (**MET**)
  - Retained placenta (**RP**)
- **Objective**: Estimate heritability of and genetic correlations among SH, CO, MET, and RP in 1st lactation Norwegian Red cows.

Traits

Mean frequency among first lactation Norwegian Red cows

- Silent heat (**SH**) 3.1 %
- Cystic ovaries (**CO**) 0.5 %
- Metritis (**MET**) 0.9 %
- Retained placenta (**RP**) 1.5 %
  - SH included veterinary treatments diagnosed as silent heat, anoestrus, and repeated breeding
- Binary traits, scored as 1 or 0, based on whether or not the cow had at least one veterinary treatment
  within 5 days after calving for RP
  within 300 days after caving for the other 3 traits

Data

503,683 first-lactation cows

- First calving: 2000-2006
- Age at 1st calving: 20-36 mo
- Daughters of 1.059 Norwegian Red sires
- Cows that had received treatment for heat synchronization (0.6%) were excluded.

Model

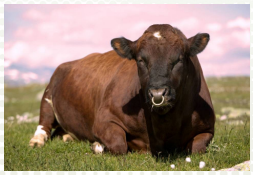
4-variate threshold liability model:

$$\boldsymbol{\lambda} = \mathbf{X}\boldsymbol{\beta} + \mathbf{Z}_h\mathbf{h} + \mathbf{Z}_s\mathbf{s} + \mathbf{e}$$

λ : unobserved liabilities for the 4 traits;
β : systematic effects: age at calving and yr×mo of calving;
h : herd effects ;
s : sire transmitting abilities;
e : residual effects; and
X, $\mathbf{Z}_h$, and $\mathbf{Z}_s$ are the corresponding incidence matrices.

Analyses

- Bayesian approach using MCMC methods
- RJMC procedure in the DMU package (Madsen and Jensen, 2008)
- Burn-in 5.000 iterations
- Total chain length 150.000 iterations



Phenotypic frequencies

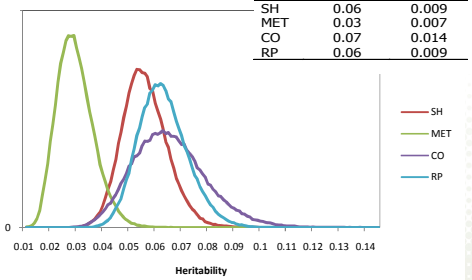
- Cows with one of the diseases also tend to have a higher frequency of other diseases.

Mean disease frequencies (%) for cows with absence (0) or presence (1) of silent heat (SH), cystic ovaries (CO), metritis (MET), and retained placenta (RP).

	Overall	SH		CO		MET		RP	
	mean	0	1	0	1	0	1	0	1
SH	3.1			3.0	10.8	3.0	6.2	3.0	3.6
CO	0.5	0.4	1.6			0.5	1.3	0.5	0.5
MET	0.9	0.8	1.7	0.9	2.4			0.7	9.3
RP	1.5	1.5	1.8	1.5	1.7	1.4	16.1		

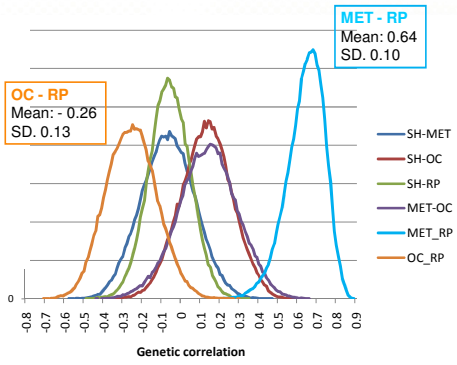
Heritability

	Mean	SD
SH	0.06	0.009
MET	0.03	0.007
CO	0.07	0.014
RP	0.06	0.009



Posterior distributions of heritability of liability to silent heat (SH), metritis (MET), cystic ovaries (CO), and retained placenta (RP)

Genetic correlations



Breeding program

- This group of diseases has so far not been included in the breeding program for Norwegian Red, except RP,
  - RP included in "other diseases", a trait that receives a relative weight of 2 % in the current total merit index.
- Low frequency of each of the 4 diseases
  - Combining all reproductive diseases and disorders into one trait?
  - lack of genetic correlation between traits, except between MET and RP, does not justify this approach.
- Low frequency - not much scope for genetic improvement
- Reasonably precise genetic evaluation of sires is feasible
  - Large daughter groups required

Summary and conclusions

- Low frequency of fertility related diseases and disorders in Norwegian Red
  - Not much scope for genetic improvement
- Heritability: 0.03 – 0.07
- Genetic correlations
  - Strong genetic correlation between MET and RP (0.64)
  - Negative genetic correlation between RP and OC (-0.26)
  - Other genetic correlations close to 0