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GENOMIC BREEDING VALUES FOR CLAW HEALTH IN NORWEGIAN RED

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INTRODUCTION

- Claw health status recorded at claw trimming since 2004
- Genetic analyses show low to moderate heritabilities for 9 single and 3 groups of claw disorders (Ødegård et al., 2013)
- Question: How will new traits perform in genomic prediction with limited historical data and small reference population?

AIM

Evaluate reliability of genomic breeding values for claw traits in Norwegian Red

CLAW HEALTH RECORDS

- At claw trimming normal claws or one or more of the following 9 claw disorders are recorded:
 - corkscrew claw
 - heel horn erosion
 - dermatitis
 - sole ulcer
 - white line disorder
 - haemorrhage of sole and white line
 - interdigital phlegmon
 - acute trauma
 - lameness

TRAITS INCLUDED IN THE ANALYSES

- Single claw disorder:
 - **Corkscrew claw**
- Grouped claw disorders:
 - **Infectious**, *heel horn erosion, dermatitis and interdigital phlegmon*
 - **Laminitis related**, *sole ulcer, white line disorder and haemorrhage of sole and white line*
 - **Overall**, *all the 9 single claw disorders recorded at claw trimming*

CLAW HEALTH DATA

- Recorded to the Norwegian Dairy Herd Recording System
 - Data from 2004 to February 2013
- Included only:
 - Cows with claw health records
 - Lactating cows
 - Herds with less than 10 % or less than 10 normal claws reported during 2004 to Feb. 2013 were excluded
 - Daughters of Norwegian Red AI sires
 - At least one claw trimming record in the lactation

TRAIT DEFINITION AND FREQUENCY OF CLAW DISORDERS

In each lactation a cow was defined as either healthy (0) or sick (1) for corkscrew claw, infectious claw disorders, laminitis related claw disorders and overall claw disorder

Frequency of claw disorders (% of all claw health records)

<i>Claw disorders</i>	<i>Frequency (%)</i>
Corkscrew claw	10.2
Infectious claw disorder	6.2
Laminitis related claw disorders	7.3
Overall claw disorder	22.4

ESTIMATED BREEDING VALUES

- EBV were obtained using threshold sire models
 - Systematic effects:
 - Lactation number
 - Calving year and month
 - Time for claw trimming in months after calving
 - Claw trimmer
 - Random effects
 - Herd
 - Sire
 - Residual

SNP DATA

- Imputed 25K/54K-SNP dataset
 - 48,204 SNP
 - 3,315 sires
- 2,428 sires had marker information and EBVs for the claw disorders
- Sires included in the analyses
 - > 30 daughters with claw health records
 - Total 959 sires

CROSS-VALIDATION

- The 959 sires were randomly assign to 10 groups
 - 10-fold cross-validation
 - 1 group as validation set and 9 as reference population
- Prediction of GEBV
 - EBVs as response variables
 - Sires were weighted by number of daughters with claw health records
 - GBLUP (Meuwissen et al., 2001)

G-MATRIX

- G-matrix were obtained based on SNP data using the G-matrix package (Su and Madsen, 2012)
- Inverse G-matrix was used in prediction of GEBV
- Sire effect:

$$s \sim N(0, G\sigma_s^2)$$

PREDICTION OF GEBV

$$y = 1\mu + Zs + e$$

y – vector of sire EBV from threshold model

1 – vector of ones

μ - mean

s – vector of sire effect

e – vector of residual

Z is the corresponding matrix to **s**

- DMUAI in DMU (Madsen and Jensen, 2008)

RELIABILITY OF GEBV

- Reliability of GEBV was calculated as the squared correlation between EBV and GEBV divided by the average reliability of EBV for sires in the validation set

RELIABILITIES OF GEBV

From 10-fold cross-validation

Claw disorder	Mean reliability	Standard deviation	Minimum	Maximum
Corkscrew claw	0.39	0.08	0.22	0.52
Infectious	0.65	0.12	0.51	0.88
Laminitis related	0.56	0.13	0.42	0.87
Overall	0.46	0.09	0.33	0.62

RELIABILITIES OF GEBV

- Included grouped claw disorders
 - Higher frequency and heritability
- Weighting of sire effect to account for different contribution of information
- 85 % of the sires had less than 100 daughters with claw health records

CHALLENGES

- Low heritability traits
 - Large effective population size
 - Small daughter groups
 - 30 % of herds records claw health
 - Small reference population
 - Data since 2004
- This makes genomic predictions challenging

SUMMARY

- The reliabilities of GEBV for claw health were moderate to high, with large standard deviation
- Few daughters per sire and small reference population are challenging
- Important that the recording of claw health still increases



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THANK YOU FOR THE ATTENTION!

Breeding for better **lives**

RELIABILITIES OF EBV (959 SIREs)

Claw disorder	Mean reliability	Standard deviation	Minimum	Maximum
Corkscrew claw	0.79	0.08	0.63	0.99
Infectious	0.65	0.13	0.44	0.99
Laminitis related	0.65	0.13	0.44	0.99
Overall	0.68	0.12	0.48	0.99
