Genetics of claw health traits

Cecilie Ødegård
Researcher at Geno Breeding and AI association
Norway

Why the importance of claw health?

• Farm economy

• Animal welfare
To breed for improved claw health

- Routine recording of claw health traits
  - Including normal claws
- Information to correct for environmental effects
  - Claw trimmer, herd, season etc.
- Pedigree information

- Genotype information improves the predictions further

Difficult traits

- Recorded as affected or unaffected (binary trait)
- Require large datasets for estimation of genetic parameters
- Important with standardized definitions of the traits
Recording of claw health at claw trimming

- Date of claw trimming
- ID of animal
- Normal claws or one or more claw disorders
- Other disorders or remarks
- Claw trimmer ID

Total number of claw health records in Norway

*per Sept. 2016*
Frequency of claw disorders in Norway (% of all claw health records)

Heritability of claw health traits

<table>
<thead>
<tr>
<th>Trait</th>
<th>Heritability</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corkscrew claw</td>
<td>0.07(^1)</td>
</tr>
<tr>
<td>Heel horn erosion</td>
<td>0.04(^1)</td>
</tr>
<tr>
<td>Sole ulcer</td>
<td>0.03(^1)</td>
</tr>
<tr>
<td>Digital dermatitis</td>
<td>0.07(^2)</td>
</tr>
<tr>
<td>Interdigital dermatitis</td>
<td>0.015(^2)</td>
</tr>
<tr>
<td>Sole hemorrhage</td>
<td>0.04(^2)</td>
</tr>
<tr>
<td>White line disease</td>
<td>0.02(^2)</td>
</tr>
</tbody>
</table>

\(^1\)Ødegård et al. (2015), \(^2\)Malchiodi et al. (2015)
Genetic correlations among claw health traits

<table>
<thead>
<tr>
<th>Trait</th>
<th>Heel horn erosion</th>
<th>Sole ulcer</th>
<th>Sole hemorrhage</th>
<th>White line disease</th>
<th>Interdigital hyperplasia</th>
</tr>
</thead>
<tbody>
<tr>
<td>Digital dermatitis/interdigital dermatitis</td>
<td>0.65&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.19&lt;sup&gt;1&lt;/sup&gt;</td>
<td>-0.45&lt;sup&gt;2&lt;/sup&gt;</td>
<td>0.04&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.66&lt;sup&gt;2&lt;/sup&gt;</td>
</tr>
<tr>
<td>Heel horn erosion</td>
<td>0.42&lt;sup&gt;1&lt;/sup&gt;</td>
<td>-0.07&lt;sup&gt;3&lt;/sup&gt;</td>
<td>0.22&lt;sup&gt;1&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sole ulcer</td>
<td>0.38&lt;sup&gt;3&lt;/sup&gt;</td>
<td>0.79&lt;sup&gt;1&lt;/sup&gt;</td>
<td>0.04&lt;sup&gt;2&lt;/sup&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Sole hemorrhage</td>
<td></td>
<td>0.39&lt;sup&gt;3&lt;/sup&gt;</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<sup>1</sup>Ødegård et al. (2013), <sup>2</sup>Van der Spek et al. (2013), <sup>3</sup>Häggman and Juga (2013)

Genetic correlations among claw health traits and foot and leg conformation traits

<table>
<thead>
<tr>
<th>Trait</th>
<th>Rear leg rear view new</th>
<th>Rear leg rear view old</th>
<th>Rear leg side view</th>
<th>Foot angle</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corkscrew claw</td>
<td>0.07 (0.06)</td>
<td>0.15 (0.05)</td>
<td>-0.04 (0.05)</td>
<td>0.09 (0.05)</td>
</tr>
<tr>
<td>Infectious claw disorder</td>
<td>-0.20 (0.07)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Laminitis-related claw disorder</td>
<td>0.21 (0.06)</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Low genetic correlations
Direct selection most efficient

Ødegård et al. 2014
Claw health index in routine genetic evaluations

**Denmark, Sweden and Finland**
- Included since 2011
- Data from claw trimming
- Seven traits included
  - sole ulcer
  - sole hemorrhage
  - heel horn erosion
  - digital dermatitis
  - interdigital dermatitis
  - skin proliferation
  - white line separation
  - corkscrew claw

**The Netherlands**
- Included since 2010
- Data from claw trimming
- Six traits included
  - sole hemorrhage
  - digital dermatitis
  - interdigital dermatitis
  - sole ulcer
  - interdigital hyperplasia
  - white line disease


---

Claw health index for Norwegian Red

- Claw health at claw trimming recorded in the Norwegian Dairy Herd Recording System since 2004
- Routine genetic evaluation of claw health since 2014
- Claw health index included in the total merit index

<table>
<thead>
<tr>
<th>Claw health index</th>
<th>Weight %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Corkscrew claw</td>
<td>50</td>
</tr>
<tr>
<td>Infectious claw disorder</td>
<td>30</td>
</tr>
<tr>
<td>Laminitis-related claw disorder</td>
<td>20</td>
</tr>
</tbody>
</table>

**Infectious claw disorders:**
- Digital dermatitis, interdigital dermatitis, heel horn erosion and interdigital phlegmon

**Laminitis-related claw disorders:**
- Sole ulcer, toe ulcer, sole bleeding, white line fissure and white line abscess
Summary

• Claw health can be improved by breeding
  – Low heritability – need large scale routine recording
  – Low genetic correlation to confirmation traits – direct
    selection most efficient

• Standardization – ICAR claw health atlas –
  comparable high quality data across countries

Thank you!