Connectedness

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Introduction

• What is connectedness?
• Why does it matter?
• How do I interpret connectedness values?
• How do I improve connectedness?
• Take home messages
What is Connectedness?

- It is a measure of the genetic links between animals in separate flocks.
- A number of methods have been devised to calculate the between flock connectedness.
- The more genetic links the higher the connectedness.
Why does it matter?

- Sufficient genetic links are required for unbiased across flock EBVs
Why does it matter?

- Sufficient genetic links are required for unbiased across flock EBVs
- Best Linear unbiased Predictions
Why does it matter?

- Sufficient genetic links are required for unbiased across flock EBVs
- Genetic links are required to provide benchmarks to compare animals from across flocks
Why does it matter?

Weights adjusted for non genetic effects like age, litter size etc
Average of 3 sires is 47kg for both flocks

<table>
<thead>
<tr>
<th>Sire</th>
<th>Flock A</th>
<th>Flock B</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Avg Progeny weight</td>
<td>Avg Progeny weight</td>
</tr>
<tr>
<td>A1</td>
<td>47</td>
<td>0</td>
</tr>
<tr>
<td>A2</td>
<td>49</td>
<td>+2</td>
</tr>
<tr>
<td>A3</td>
<td>44</td>
<td>-3</td>
</tr>
<tr>
<td>B1</td>
<td>47</td>
<td>0</td>
</tr>
<tr>
<td>B2</td>
<td>43</td>
<td>-4</td>
</tr>
<tr>
<td>B3</td>
<td>50</td>
<td>+3</td>
</tr>
</tbody>
</table>

Equal sires
Best sire

Example from E Wall 1998
### Why does it matter?

Weights adjusted for non genetic effects like age, litter size etc

Average of 3 sires is 47kg for both flocks

<table>
<thead>
<tr>
<th>Sire</th>
<th>Flock A Avg Progeny weight</th>
<th>Diff</th>
<th>Flock B Avg Progeny weight</th>
<th>Diff</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>47</td>
<td>+2</td>
<td>B1</td>
<td>47</td>
</tr>
<tr>
<td>A2</td>
<td>49</td>
<td>+4</td>
<td>B2</td>
<td>43</td>
</tr>
<tr>
<td>A3</td>
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<td>-1</td>
<td>B3</td>
<td>50</td>
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<tr>
<td>C1</td>
<td>45</td>
<td>0</td>
<td>C1</td>
<td>49</td>
</tr>
</tbody>
</table>

**Equal sires**

**Best sire**

Using a common sire provides connectedness to allow comparisons

Example from E Wall 1998
Sire Referencing Schemes

Key:
- ○ = progeny of Reference Sires
- ● = progeny of other rams

Reference Sires

Flock A
Flock B
Flock C
Flock D
Flock E
How do I interpret connectedness?

- Lewis et al produced software to calculate connectedness between flocks
  - Based on 8 wk weight and pedigree information
- Values range 0 (no links) to 1 (fully connected)
  - E.g. 0.05 ~ 5% of genetic links in common
- Colour coded
  - Green, OK levels of connectedness
  - Amber, Connectedness not as high as it should be
  - Red, Poor connectedness
How do I interpret connectedness?

• Signet and EGENES have been working together on implementing the connectedness software and formatting the output for industry use

• Connectedness values
  – between individual flocks
  – average across all flocks

• Both individual and across flock connectedness values are important
### How do I interpret connectedness?

The table below represents the connectedness report for a specific batch ID: 20080774.

<table>
<thead>
<tr>
<th>flock i</th>
<th>flock j</th>
<th>rij</th>
<th>Connectedness level</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
<td>Acceptable</td>
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<tr>
<td>1</td>
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<tr>
<td>1</td>
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<tr>
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<tr>
<td>1</td>
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<td>0.1499233</td>
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<tr>
<td>1</td>
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<tr>
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<tr>
<td>1</td>
<td>21</td>
<td>0.0180708</td>
<td>Acceptable</td>
</tr>
</tbody>
</table>

The data was considered for animals born between and including 2000 & 2010. An extra 10 years pedigree was considered with ped from 1990 onwards allowed.
How do I interpret connectedness?

- Across flock values
  - It is important to be generally well connected
  - We want to avoid pockets of connected flocks within an evaluation group
  - If an evaluation group doesn’t have sufficient connectedness then we may need to reconsider if an across flock evaluation is appropriate
How do I interpret connectedness?

• **Across flock values**
  – Is important to be generally well connected
  – We want to avoid pockets of connected flocks within a evaluation group
  – If a evaluation group doesn’t have sufficient connectedness then we may need to reconsider if an across flock evaluation is appropriate

• **Individual pair values**
  – Not so important if across flock connectedness sufficient
  – Useful to help increase connectedness
How do I interpret connectedness?

- The smaller the breed, the easier it is to have good levels of connectedness.
- Connectedness is different from accuracy.
  - Can be high accuracy and low connectedness.
- Connectedness is different from genetic merit.
  - Can be well connected with poor genetic merit.
How do I improve connectedness?

• Increase genetic links
  – Sharing sires (supply and use)
    • Sire reference schemes or young sire programs
      – Added benefit for genomic selection
    • EBLEX Ram Linkage Scheme
      – Using multiple sires
      – Direct links optimised to maximise connectedness much better as only a small amount of linkage is created thru related in animals in pedigree

• Use reproductive technologies
  – ET & AI
  – Fewer disease risks
  – Use more rams and can use better rams
Take home messages

• Connectedness is important
• Poor connectedness will limit genetic progress
  – Across flock evaluations may not be appropriate
  – Bias in the EBVs will reduce selection accuracy
• Improving connectedness can be incorporated into win-win scenarios
  – Implementing genomic selection
  – Improved genetic progress using traditional methods