Interbull and International Genetic Evaluations in Dairy Cattle - Global trends

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Uppsala, Sweden
Dramatic Internationalization of Dairy Cattle Breeding

• The Polish FAO-experiment with 10 HF-strains
• Heavy increase in international trade of semen

**Rapid breed changes in 25 years**

- **Friesian**  "Holsteinization" via N.A.
- **Braunvieh**  Brown Swiss via N.A.
- **Jersey**  N.Z., USA, Denmark
- **Ayrshire**  Scandinavia
Few Bulls Heavily Used ...

Sire: To-Mar Blackstar  
#sons: 3800

Sire: Rothrock Tradition Leadman  
#sons: 2700
Genetic trends in female fertility for SRB and SLB
Outline

- What is Interbull
- International comparisons
- Selection of dairy bulls: global perspective
- Global trends
  - Genetic progress
  - Diversity
- Concluding remarks
  - Components of sustainable breeding programs
Interbull is …

- A non-profit, non-governmental organization

- Promoting the development and execution of international comparisons of cattle
PUCK
Patron-Merrill-Aerostar-Belltone-Spirit

- Components
- Daughterfertility
- Excellent Mammary
- Legs
- Disposition

Laudan

www.skanesemin.se
+46-415-164 60
Interbull Activities

- Communication: publications, meetings, workshops, homepage
- Conduct R&D
- Technology support to members
- *International genetic evaluations*
Interbull Supporters

- EAAP
- IDF
- FAO
- ICAR
- EU
- ~40 member countries
International Comparison

Country A
- Bull A6
- Bull A3
- Bull B3

Country B
- Bull B6
- Bull B5
- Bull B3
- Bull B1

International ranking

Country A
- Bull A6
- Bull A3
- Bull B5
- Bull B3
- Bull B6
- Bull B1

Country B
- Bull A6
- Bull B6
- Bull B5
- Bull B3
- Bull A3
- Bull B1

MACE
Genetic Correlation

- Low input grazing herds of New Zealand
- Intensely managed herds in North America

0.60
## Mean Genetic Correlations

### Holstein

<table>
<thead>
<tr>
<th>Trait</th>
<th>Pops</th>
<th>Mean $r_g$</th>
<th>SD of $r_g$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Protein yield</td>
<td>24</td>
<td>0.84</td>
<td>0.05</td>
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<tr>
<td>Somatic cells</td>
<td>23</td>
<td>0.90</td>
<td>0.05</td>
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<tr>
<td>Clinical mastitis</td>
<td>4</td>
<td>0.85</td>
<td>0.07</td>
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<tr>
<td>Longevity</td>
<td>19</td>
<td>0.71</td>
<td>0.14</td>
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<tr>
<td>Direct calving ease</td>
<td>12</td>
<td>0.78</td>
<td>0.11</td>
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<tr>
<td>Maternal calving ease</td>
<td>11</td>
<td>0.77</td>
<td>0.09</td>
</tr>
<tr>
<td>Direct stillbirth</td>
<td>5</td>
<td>0.69</td>
<td>0.11</td>
</tr>
<tr>
<td>Maternal stillbirth</td>
<td>5</td>
<td>0.80</td>
<td>0.07</td>
</tr>
<tr>
<td>Interval calving-first ins.</td>
<td>5</td>
<td>0.81</td>
<td>0.17</td>
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<tr>
<td>Non-return rate</td>
<td>5</td>
<td>0.74</td>
<td>0.09</td>
</tr>
<tr>
<td>Calving interval</td>
<td>8</td>
<td>0.81</td>
<td>0.10</td>
</tr>
</tbody>
</table>
Global perspective on selection of dairy bulls
“Many countries selecting on Interbull breeding values causes loss of genetic variation”

Accounting for G×E in Interbull evaluations enlarges gene pool
Before Interbull ...
Number of bulls in common between the top 100 lists

<table>
<thead>
<tr>
<th></th>
<th>Protein</th>
<th></th>
<th>Somatic cells</th>
<th></th>
<th>Longevity</th>
<th></th>
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<tbody>
<tr>
<td></td>
<td>NL</td>
<td>US</td>
<td>NZ</td>
<td>NL</td>
<td>US</td>
<td>NZ</td>
</tr>
<tr>
<td>SW</td>
<td>86</td>
<td>90</td>
<td>80</td>
<td>75</td>
<td>70</td>
<td>39</td>
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<tr>
<td>NL</td>
<td>82</td>
<td>75</td>
<td></td>
<td>69</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td>US</td>
<td></td>
<td>75</td>
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<td>34</td>
<td></td>
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<td></td>
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<td></td>
<td></td>
</tr>
</tbody>
</table>
Any positive effect of \( r_G < 1 \)?

<table>
<thead>
<tr>
<th>Breed group</th>
<th>Number of populations</th>
<th>( r_g = 1 )</th>
<th>( r_g &lt; 1 )</th>
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</thead>
<tbody>
<tr>
<td>Brown Swiss</td>
<td>9</td>
<td>100</td>
<td>179</td>
</tr>
<tr>
<td>Guernsey</td>
<td>6</td>
<td>100</td>
<td>140</td>
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<tr>
<td>Holstein</td>
<td>24</td>
<td>100</td>
<td>309</td>
</tr>
<tr>
<td>Jersey</td>
<td>10</td>
<td>100</td>
<td>282</td>
</tr>
<tr>
<td>Red Dairy Cattle</td>
<td>10</td>
<td>100</td>
<td>192</td>
</tr>
<tr>
<td>Simmental</td>
<td>10</td>
<td>100</td>
<td>179</td>
</tr>
</tbody>
</table>
Effects on Genetic Gain
Holstein, protein yield

Gain in sel. diff.
range 0.06 - 1.71
median 0.53

Selection differential

National  International
Effects on Genetic Gain
Holstein, somatic cells

Gain in sel. diff.
range  0.04 - 1.31
median  0.39
Relative emphasis on functional traits in Total Merit Indexes

(Miglior et al., 2005)
<table>
<thead>
<tr>
<th>Country</th>
<th>Code</th>
<th>No. of Traits</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>APR</td>
<td>9</td>
</tr>
<tr>
<td>Germany</td>
<td>RZG</td>
<td>13</td>
</tr>
<tr>
<td>Spain</td>
<td>ICO</td>
<td>9</td>
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<tr>
<td>France</td>
<td>ISU</td>
<td>11</td>
</tr>
<tr>
<td>Great Britain</td>
<td>PLI</td>
<td>6</td>
</tr>
<tr>
<td>Italy</td>
<td>PFT</td>
<td>9</td>
</tr>
<tr>
<td>Japan</td>
<td>NTP</td>
<td>4</td>
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<tr>
<td>New Zealand</td>
<td>BW</td>
<td>6</td>
</tr>
<tr>
<td>United States</td>
<td>NM$</td>
<td>9</td>
</tr>
</tbody>
</table>
## TMI for Foreign Bulls

<table>
<thead>
<tr>
<th>Country name</th>
<th>TMI</th>
<th>Covered by Interbull service portfolio</th>
</tr>
</thead>
<tbody>
<tr>
<td>Australia</td>
<td>APR</td>
<td>93</td>
</tr>
<tr>
<td>Germany</td>
<td>RZG</td>
<td>95</td>
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<tr>
<td>Spain</td>
<td>ICO</td>
<td>97</td>
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<td>France</td>
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<tr>
<td>Great Britain</td>
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<td>100</td>
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<td>New Zealand</td>
<td>BW</td>
<td>100</td>
</tr>
<tr>
<td>United States</td>
<td>NM$</td>
<td>97</td>
</tr>
</tbody>
</table>
Interbull Evaluations - Traits

- Production
- Conformation
- Udder health
- Longevity
- Calving traits
- Female fertility
## Size of Operation

<table>
<thead>
<tr>
<th>Breed</th>
<th>No. bulls</th>
<th>No. populations</th>
</tr>
</thead>
<tbody>
<tr>
<td>RDC</td>
<td>11 671</td>
<td>10</td>
</tr>
<tr>
<td>BSW</td>
<td>7 418</td>
<td>9</td>
</tr>
<tr>
<td>GUE</td>
<td>900</td>
<td>6</td>
</tr>
<tr>
<td>HOL</td>
<td>99 084</td>
<td>25</td>
</tr>
<tr>
<td>JER</td>
<td>7 710</td>
<td>10</td>
</tr>
<tr>
<td>SIM</td>
<td>20 638</td>
<td>10</td>
</tr>
</tbody>
</table>

Production traits May 2007
Global trends
Global Trends in Mastitis Traits and Calving Ease

Mean BVs for HOLSTEIN bulls per birth year

DFS/SWE Scale

Year

Protein
SCC
CalvDir
Mastitis

Global Trends in Mastitis Traits and Calving Ease
Global Trends in Mastitis Traits and Calving Ease

Mean BVs by birth year for RDC bulls

- DFS/SWE Scale
- PR
- SCC
- CalvDir
- Mastitis

Year

Global Trends in Fertility and Longevity

Mean BVs of HOLSTEIN bulls per birth year

Graph showing changes in DFS/SWE Scale over years.
Global Trends in Fertility and Longevity

Mean BVs of RDC bulls by birth years

DFS/SWE Scale

115
110
105
100
95
90
85
80
75


Year

Prot
Longev
CFI
Days op
Percentage bulls after 5 bull sires

Birth year:
- 1980
- 1981
- 1982
- 1983
- 1984
- 1985
- 1986
- 1987
- 1988
- 1989
- 1990
- 1991
- 1992
- 1993
- 1994
- 1995

Percentage:
- BSW
- JER
- GUE
- HOL
Number of sons per bull sire

Number of sons

Birth year of bull sire

BSW  JER  GUE  HOL

Tools to manage inbreeding exist

- Selection for TMI

- Optimum contribution selection
  - Considers relatedness to the population in addition to genetic merit
Sustainable Breeding

- Continuous genetic improvement
- Marketable products
- Broad breeding objectives
- Control of inbreeding

Positive examples:
- Guernsey, Nordic Red
Developments of international genetic evaluations of dairy cattle for sustainable breeding programs

Fikse & Philipsson
Interbull Centre
AGRI Bulletin 41, 31-45