Genetic evaluation in Sweden and Interbeef

World Charolais Congress 2018
Emma Carlén
Outline

• Short about Växa Sverige and our responsibility within beef cattle breeding

• Swedish beef breeding programs with emphasis on the national genetic evaluation

• Nordic and international cooperation with focus on status in Interbeef
Växa vision: contribute to a sustainable, competitive agricultural production.

Our aim
To sell products and services developing the farms and improving profitability.
Services for beef producers

- Fertility: AI service and pregnancy test
- Collect registrations: calvings, weights, conformation, horn status etc.
- Advice to plan/follow-up production and breeding
- Statistics and bench-marking
- Pedigree verifications and herd books
- Cattle data base and breeding values
Växa: role and responsibility within breeding

• Official national breeding organization for Swedish cattle breeds
  – 7 dairy breeds and 7 beef breeds

• Responsible for:
  – Breeding goals
  – Breeding values
  – Herd book and data base

Cooperation on national, Nordic and international level. National decision about breeding goals etc. in specific boards.
Our cattle data base is unique...

- Milk analyses
- AI, matings fertility, ET
- DNA-typing Pedigree Verification
- Slaughter data
- Claw data from trimmers
- Disease reporting via veterinary
- Disease reporting via farmers
- Claw data from trimmers
- Disease reporting via veterinary
- Disease reporting via farmers
- Conformation scoring
- Weights Growth
- Milk recording
- Calving traits, birth, death, moving of animals(CDB)

Kodatabasen

- CDB
- Identity Pedigree
- Genetic evaluation
- Breeding planning
- Feeding planning
- Animal health and fertility
- Management tools
- Economic planning

Nils-Erik Larsson, Växa Sverige
Beef part of cattle data base:
KAP = Kött Avel Produktion

• **KAP- avel (breeding)**
  – Pedigree herds that sell breeding animals with official pedigree, herdbook and breeding values
  – Birth, weaning (200d) and yearling (365d) weights
  – Calving and slaughter traits

• **KAP-production**
  – Production herds with suckler cows and slaughter animals that wants follow-up on calvings, growth and slaughter results

Approx. 8 % of the total number of Swedish suckler cows participate in beef recording
Parts of a breeding program

- Registration of traits
- Genetic progress
- Genetic evaluation
- Selection of breeding animals
- Breeding goal
Breeding goal

• Each breed association has recommendations of how the breed should develop genetically

• For 5 breeds it is expressed by a **Total Merit Index** = combined breeding value based on economic importance of traits
  – Breeding value trait 1 * economic weight trait 1 +
    Breeding value trait 2 * economic weight trait 2 ....
## Registration of traits - *Statistics from KAP*

<table>
<thead>
<tr>
<th>Herds and cows in KAP 2016</th>
<th>No. of herds</th>
<th>No of purebred cows</th>
<th>No. of other cows</th>
<th>Cows/herds</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pedigree herds</td>
<td>646</td>
<td>14390</td>
<td>2781</td>
<td>26,6</td>
</tr>
<tr>
<td>Production herds</td>
<td>95</td>
<td>1776</td>
<td>2580</td>
<td>45,9</td>
</tr>
</tbody>
</table>

## Calving results 2016– heifers and cows

<table>
<thead>
<tr>
<th>Breed</th>
<th>No. of calvings</th>
<th>Age 1st calv. (mo)</th>
<th>% difficult calvings*</th>
<th>% stillbirth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charolais</td>
<td>4354</td>
<td>26,4</td>
<td>1,4</td>
<td>2,7</td>
</tr>
<tr>
<td>Hereford</td>
<td>2852</td>
<td>25,9</td>
<td>1,8</td>
<td>3,4</td>
</tr>
<tr>
<td>Simmental</td>
<td>1897</td>
<td>25,0</td>
<td>1,7</td>
<td>2,1</td>
</tr>
<tr>
<td>Angus</td>
<td>1443</td>
<td>26,0</td>
<td>1,4</td>
<td>2,3</td>
</tr>
<tr>
<td>Limousin</td>
<td>1260</td>
<td>27,6</td>
<td>0,7</td>
<td>1,8</td>
</tr>
<tr>
<td>All purebred</td>
<td>13038</td>
<td>26,9</td>
<td>1,5</td>
<td>2,5</td>
</tr>
</tbody>
</table>

* Trait in genetic evaluation
### Weight results 2016 – example bulls

<table>
<thead>
<tr>
<th>Breed</th>
<th># bulls</th>
<th>Birth wt (kg)*</th>
<th># bulls</th>
<th>200d wt (kg)*</th>
<th># bulls</th>
<th>365d wt (kg)*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charolais</td>
<td>1669</td>
<td>49</td>
<td>1438</td>
<td>319</td>
<td>1148</td>
<td>594</td>
</tr>
<tr>
<td>Hereford</td>
<td>1266</td>
<td>44</td>
<td>1045</td>
<td>283</td>
<td>764</td>
<td>502</td>
</tr>
<tr>
<td>Simmental</td>
<td>822</td>
<td>49</td>
<td>730</td>
<td>355</td>
<td>497</td>
<td>612</td>
</tr>
<tr>
<td>Angus</td>
<td>545</td>
<td>40</td>
<td>552</td>
<td>287</td>
<td>353</td>
<td>497</td>
</tr>
<tr>
<td>Limousin</td>
<td>503</td>
<td>43</td>
<td>445</td>
<td>291</td>
<td>356</td>
<td>529</td>
</tr>
</tbody>
</table>

### Slaughter results 2016 – example young bulls

<table>
<thead>
<tr>
<th>Breed</th>
<th># bulls</th>
<th>Slaughter wt (kg)*</th>
<th>Carcass conformation (1 poor-15 excellent)*</th>
<th>Carcass fat (1 lean-15 fat)*</th>
<th>Age (mo)</th>
<th>Slaughter growth (g/d)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Charolais</td>
<td>995</td>
<td>389,8</td>
<td>9,7</td>
<td>7,3</td>
<td>15,6</td>
<td>770</td>
</tr>
<tr>
<td>Hereford</td>
<td>451</td>
<td>345,1</td>
<td>7,5</td>
<td>8,1</td>
<td>18,4</td>
<td>579</td>
</tr>
<tr>
<td>Simmental</td>
<td>357</td>
<td>382,9</td>
<td>9</td>
<td>7,2</td>
<td>15,9</td>
<td>746</td>
</tr>
<tr>
<td>Angus</td>
<td>112</td>
<td>344,7</td>
<td>7,7</td>
<td>8</td>
<td>18,8</td>
<td>567</td>
</tr>
<tr>
<td>Limousin</td>
<td>216</td>
<td>373,6</td>
<td>11,2</td>
<td>6,7</td>
<td>16,4</td>
<td>705</td>
</tr>
</tbody>
</table>

* Trait in genetic evaluation
Official national genetic evaluation beef breeds

- Published 3 times/year
  - Feb/March, Mid-May, Mid-Nov
- BLUP-method
  - 3 multi-trait animal models
- 11 single breeding values (EBVs) based on phenotypes for 7 breeds
  - Aberdeen angus, Blonde d’aquitaine, Charolais, Hereford, Highland cattle, Limousin and Simmental
- 3 sub-indices and 1 total merit index for 5 breeds
  - Not for Blonde and Highland

We also participate in international genetic evaluation....
Model for growth traits (since 2000)

- Birth weight
- 200d weight
- 365d weight

5 + 1 official EBVs
- BWT direct
- BWT maternal
- 200d direct
- 200d maternal
- 365d
- Total growth

Maternal EBVs
- based on registrations on calves after a cow
- describes *genetic ability of the cow* to affect the trait expressed in the calf
- 200d mat – cow’s genetic capacity for milk production affecting early growth
Model for carcass traits *(since 2005)*

- Slaughter weight
- Carcass conformation
- Carcass fat

*3 indirect traits:*

*Birth weight, 200d weight, 365d weight*

3 official EBVs

- Carcass gain
- Carcass conformation
- Carcass fat

Marbling – a future trait of interest for genetic evaluation?
Model for calving traits (since 2005)

- Calving ease (1st parity cows)
  + 3 indirect traits:
    - Calving ease (later parities), Birth weight (first and later parities)

2 official EBVs
- CAE direct
- CAE maternal

- Low but unfavorable genetic correlation between direct and maternal effect
- A bigger cow has easier calvings but if her calf is also bigger it might have more difficulties being born...
Sub-indices and total merit index (since 2009)

- Angus, Charolais, Hereford, Limousin, Simmental
- Breed-specific economic weights

3 sub-indices
- FIX=Födelseindex (Birth)
- MIX=Modersindex (Maternal)
- PIX=Produktionsindex (Production)

1 total merit index
- AIX=Avelsindex ("the breeding goal")
Sub-indices for improving trait groups

**Birth index (FIX)** – based on CAE direct
- Describes calf’s genetic capacity to be easily born

**Maternal index (MIX)** – based on CAE mat and 200d mat
- Describes the cow’s genetic capacity to have easy calvings and give calves with high growth (through high milk production)

**Production index (PIX)** – based on carcass gain, carcass conformation and carcass fat
- Describes the animal’s genetic capacity for high growth and carcass quality
Total merit index (AIX)

➢ Describes genetic capacity for profit

Economic weights for Charolais — *Expressed on the scale of relative breeding values*

<table>
<thead>
<tr>
<th></th>
<th>Weight</th>
<th>Rel. Wt (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAE mat</td>
<td>0,1</td>
<td>4</td>
</tr>
<tr>
<td>200 mat</td>
<td>0,3</td>
<td>13</td>
</tr>
<tr>
<td>PIX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carcass gain</td>
<td>0,7</td>
<td>30</td>
</tr>
<tr>
<td>Carcass conformation</td>
<td>0,3</td>
<td>13</td>
</tr>
<tr>
<td>Carcass fat</td>
<td>0,1</td>
<td>4</td>
</tr>
<tr>
<td>FIX</td>
<td></td>
<td></td>
</tr>
<tr>
<td>CAE dir</td>
<td>0,8</td>
<td>35</td>
</tr>
</tbody>
</table>

Weights give an idea but not the full picture of the effect of a breeding goal.
Presented breeding values

• The genetic capacity...
  • Presented as relative breeding values
  • Can be back-translated into kg, score...

• ...predicted with a certain reliability
  • Depends on heritability and available info
  • Differ a lot between AI bull and a calf

Animals born 5-9 yrs ago have in average EBV=100 (AIX=0)

Breeding values of importance in different levels of selection in the breeding program (herd level, test stations, AI company)
Breeding program for Charolais

Covered more in previous presentation

• Charolais breeding goal
• Performance test station
  – Registrations
  – Tools for selection:
    • Growth index (T-tal)
    • New index coming combining:
      – Growth, conformation, breeding values etc...

• AI bulls
  – Selected to perform well both in beef and dairy herds
Genetic progress in Swedish Charolais

- Improved genetics for total profit and sub-indices:
  - **FIX**: calves that are born more easily
  - **MIX**: cows with easy calvings and high milk production
  - **PIX**: animals with high growth and carcass quality
Genetic progress in Swedish Charolais

- Example on improved genetics for single EBVs for production:
  - **Carcass gain**: improved growth rate to slaughter
  - **Carcass conformation**: improved carcass quality
Challenges for national beef breeding

- Often small beef breed populations
- Limited with resources
- Weak genetic links (herds, countries)
- Difficult to identify suitable bulls/AI for import
Nordic and international cooperation is important

- **NAV** - Joint genetic evaluation and TMI for dairy breeds
  - Soon: joint evaluation of AI beef bulls used in dairy herds
  - Board decision for joint genetic evaluation for beef breeds
  - Currently participates jointly in Interbeef for beef breeds

- **Interbeef**
  - International evaluation for beef breeds
Nordic evaluation of AI beef breeds used in dairy herds I

• Increased used of beef semen in dairy herds
  – Dairy farmers wants to select beef bulls (across breed) giving profitable crossbred calves

• Nordic Breeding values coming (end 2018)
  – Calving traits in first and later parities
  – Carcass traits based on heifers and bulls
Nordic evaluation of AI beef bulls used in dairy herds II

• Crossbred calves
  – Dam: purebred dairy cow
  – Sire: purebred AI beef bull

• Sire breed used differs between county
  – Proportion crossbred calves →

<table>
<thead>
<tr>
<th>Sire breed</th>
<th>DNK</th>
<th>FIN</th>
<th>SWE</th>
</tr>
</thead>
<tbody>
<tr>
<td>Angus</td>
<td>1.9</td>
<td>16.9</td>
<td>11.3</td>
</tr>
<tr>
<td>Blonde</td>
<td>3.2</td>
<td>22.8</td>
<td>2.2</td>
</tr>
<tr>
<td>Danish Blue</td>
<td>66.9</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Simmental (beef)</td>
<td>6.6</td>
<td>9.2</td>
<td>27.1</td>
</tr>
<tr>
<td>Charolais</td>
<td>3.6</td>
<td>9.2</td>
<td>26.4</td>
</tr>
<tr>
<td>Hereford</td>
<td>0.6</td>
<td>4.2</td>
<td>18.4</td>
</tr>
<tr>
<td>Highland</td>
<td>0.0</td>
<td>0.1</td>
<td>0.2</td>
</tr>
<tr>
<td>INRA</td>
<td>4.3</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>Limousin</td>
<td>12.7</td>
<td>37.7</td>
<td>14.3</td>
</tr>
</tbody>
</table>

Freddy Fikse
Nordic genetic evaluation of purebred beef breeds

• Will be developed for breeds and traits in current national evaluations
• Work initiated via joint participation in Interbeef

Summed number of animals (expressed in thousands) with records for the most common breeds in the 3 national evaluations (201605)

<table>
<thead>
<tr>
<th>Trait</th>
<th>CHA</th>
<th>HER</th>
<th>LIM</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calving ease</td>
<td>301</td>
<td>352</td>
<td>390</td>
</tr>
<tr>
<td>Birth wt</td>
<td>275</td>
<td>247</td>
<td>244</td>
</tr>
<tr>
<td>200d wt</td>
<td>166</td>
<td>132</td>
<td>94</td>
</tr>
<tr>
<td>Carcass wt</td>
<td>128</td>
<td>185</td>
<td>235</td>
</tr>
</tbody>
</table>

Future traits of interest: female fertility, longevity, conformation
Difficulties with international exchange of breeding animals based on foreign breeding values

- Different breeding goals
- Different registrations
- Different genetic levels
- Different scales for EBVs
- Different environments
- Different calculations/methods

**International EBVs for comparing animals across countries**

- Uses all known pedigree within and across populations
- Handles differences in national evaluations
  ➢ Possibility for greater genetic progress
International EBVs beef breeds – 3 advantages

1. **Import animals/AI**
   - small populations have a higher need for foreign genetic material suitable for our breeding goals

2. **Export animals/AI**
   - Increased possibilities to sell/spread high quality genetics

3. **More reliable breeding values**
   - For foreign animals or domestic animals with foreign pedigree
Interbeef - organization structure

- ICAR = International Committee for Animal Recording
  - Perform international dairy evaluations

Interbeef Centre
- Operative unit

Interbeef (beef breeds)
- 1 of 15 working groups
Principle for Interbeef

- **Country registrations and pedigree**
  - Genetic links needed

- **Genetic model accounts for differences**
  - Registrations from different countries = different traits

- **One EBV per country for each animal**
  - Re-ranking occurs
INTERBEEF – current routine

- 1st official Interbeef EBVs 2015 (Jan)
- Currently 3 traits – direct and maternal EBVs
  - Adj. weaning weight
  - Birth weight
  - Calving ease
- ...and 3 breeds
  - Charolais, Limousin, beef Simmental
- 2 official runs/year (March and Nov)

- Participating populations/countries
  - CHE, CZE, DEU, DFS (Denmark, Finland, Sweden), FRA, IRL, GBR (LIM) + AUS
Publication of results

- Official Interbeef results on DFS scale for single traits from NAVs web page: www.nordicebv.info

- Current top list of internationally official charolais bulls based on weaning weight direct

<table>
<thead>
<tr>
<th>Ranking</th>
<th>International ID</th>
<th>International name</th>
<th>Birth year</th>
<th>Birth date</th>
<th>AWW direct - Breeding value</th>
<th>AWW direct - Reliability (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>CHAFRAM007121963395</td>
<td>IMPOSANT</td>
<td>2013</td>
<td>20130322</td>
<td>148</td>
<td>49</td>
</tr>
<tr>
<td>2</td>
<td>CHAFRAM00510937940</td>
<td>EPERNAY</td>
<td>2009</td>
<td>20090913</td>
<td>147</td>
<td>69</td>
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<tr>
<td>3</td>
<td>CHASWEM020923167708</td>
<td>DAYBREAKER AV SONARP</td>
<td>2008</td>
<td>20080324</td>
<td>147</td>
<td>80</td>
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<tr>
<td>4</td>
<td>CHASWEM064631190809</td>
<td>ENOK AV NYBO</td>
<td>2009</td>
<td>20090309</td>
<td>147</td>
<td>85</td>
</tr>
<tr>
<td>5</td>
<td>CHAFRAM005706034572</td>
<td>ILESTLA</td>
<td>2013</td>
<td>20130314</td>
<td>146</td>
<td>47</td>
</tr>
</tbody>
</table>

...and top 6 on calving ease direct...
Development ongoing in Interbeef

• New traits in different research projects
  – Female fertility (age 1st calving, calving interval, number of calvings)
  – Slaughter traits

• More breeds
  – Crosses (after purebred beef sire)
  – ANG, HER

• Co-operation with ABRI/Breedplan and new countries...

• Facilitate genomic evaluation

Large differences between countries – many have too small populations and little resources to predict national genomic EBVs for beef
Take home message...

- National beef breeding in Sweden is well-organized but genetic progress is limited by small populations and lack of resources.

- International cooperation is needed to facilitate exchange of genetics and to increase progress by including new traits and genomics.
Thanks for your attention and enjoy your stay in Sweden!

Emma.Carlen@vxa.se