Conservation of a native dairy cattle breed through crossbreeding with commercial dairy cattle breeds in Sweden

Julie Clasen, SLU, Sweden
Søren Østergaard, AU, Denmark
Erling Strandberg, SLU, Sweden
Freddy Fikse, Växa Sverige, Sweden
Morten Kargo, AU/SEGES, Denmark
Lotta Rydhmer, SLU, Sweden
Conservation of animal genetic resources

- Convention on Biological Diversity (1993)
- “Global plan of action for animal genetic resources and the Interlaken declaration” (FAO, 2007)
- Plan of action for conservation of Swedish livestock breeds 2010-2020 by Jordbruksverket
  - Includes 9 native cattle breeds
Swedish Polled Cattle (SKB)  
"Svensk Kullig Boskap"

- 1937-38: Merging of herdbooks Swedish Mountain Cattle (Fjällras) and Swedish Red Poll (Rödkulla) to SKB in milk recording
- 1955: 18,631 milk recorded cows
- 1975: 4,219 milk recorded cows
- 2010: 1,254 milk recorded cows
- **2017: 735 milk recorded cows**

(Number of milk recorded SKB cows) (Växa, 2018)
Swedish Polled Cattle (SKB)

- Commercial dairy breed – ”Not at risk” (Bett et al., 2008)
- 400-500 kg liveweight
- Sturdy ”mountain” breed
- ~5,500 kg milk, 4.3% fat and 3.6% protein
  - Good cheese properties
- Currently semen from 13 bulls available from VikingGenetics/Växa
  - Born 1994-2007
  - Not much genetic improvement the last 30 years (?)
Swedish Polled Cattle (SKB)

Average milk yield
(Växa Sverige, Cattle Statistics, 2018)

Same milk yield in 25 years!
Crossbreeding strategy

Terminal (sustained) crossbreeding
Crossbreeding strategy
Terminal (sustained) crossbreeding

Dairy farm

Nucleus

SKB females
Crossbreeding strategy
Terminal (sustained) crossbreeding

Dairy farm

SKB females

Purebreeding

Nucleus

Crossbreeding

Swedish Holstein or Swedish Red

F1 females
Crossbreeding strategy
Terminal (sustained) crossbreeding

- Dairy farm
- SKB females
- Purebreeding
- Nucleus
- Crossbreeding
  - Swedish Holstein or Swedish Red
- F1 females
- Beef x F1 bulls + heifers
Crossbreeding strategy
Terminal (sustained) crossbreeding

- **Dairy farm**
  - SKB females
  - Crossbreeding: **Swedish Holstein** or **Swedish Red**
  - F1 females

- **Nucleus**
  - Purebreeding
  - SKB bulls

- **Beef producers**
  - F1 bulls
  - Beef x F1 bulls + heifers
Simulation of herd dynamics and economy

<table>
<thead>
<tr>
<th>Three scenarios</th>
</tr>
</thead>
<tbody>
<tr>
<td>Only SKB cows</td>
</tr>
<tr>
<td>SKB + Swedish Holstein x SKB (SHX) cows</td>
</tr>
<tr>
<td>SKB + Swedish Red x SKB (SRX) cows</td>
</tr>
</tbody>
</table>

- Input parameters (breed traits) based on means of data from Swedish milk recording (2011-2016)
  - Data from few SKB cows (production records on 1037 cows)
  - Some assumptions on reproduction parameters and diseases

- Beef semen was used in all scenarios to minimize surplus of replacement heifers
SimHerd Crossbred
Østergaard et al. 2018

• Stochastic herd simulation using a SimHerd model (Østergaard et al. 2010)

• Simulates week-to-week state of production, reproduction, diseases etc. on animal level

• This model: Breed effects and heterosis included but no simulation of genetic progress
Results – herd dynamics
at state equilibrium

• 100 cows in the herd
Results – herd dynamics at state equilibrium

• 100 cows in the herd

• 75% of purebred females selected for purebreeding
  • Fertility + mortality (+ reproduction technologies)

SKB females

75% 25%
Results – herd dynamics
at state equilibrium

- 100 cows in the herd
- 75% of purebred females selected for purebreeding
  - Fertility + mortality (+ reproduction technologies)

<table>
<thead>
<tr>
<th></th>
<th>SKB</th>
<th>SKB + SHX</th>
<th>SKB + SRX</th>
</tr>
</thead>
<tbody>
<tr>
<td>SKB cows</td>
<td>100</td>
<td>72</td>
<td>69</td>
</tr>
<tr>
<td>F1 cows</td>
<td>0</td>
<td>28</td>
<td>31</td>
</tr>
</tbody>
</table>
Results – herd dynamics
at state equilibrium

<table>
<thead>
<tr>
<th></th>
<th>SKB</th>
<th>SKB + SHX</th>
<th>SKB + SRX</th>
</tr>
</thead>
<tbody>
<tr>
<td>305-d kg ECM yield per cow</td>
<td>6,121</td>
<td>+601</td>
<td>+505</td>
</tr>
<tr>
<td>Replacement heifers (all ages)</td>
<td>76</td>
<td>-6</td>
<td>-8</td>
</tr>
<tr>
<td>SKB bull calves sold</td>
<td>36</td>
<td>-10</td>
<td>-11</td>
</tr>
<tr>
<td>F1 bull calves sold</td>
<td>0</td>
<td>+8</td>
<td>+8</td>
</tr>
<tr>
<td>Beef x dairy crosses sold</td>
<td>22</td>
<td>+4</td>
<td>+7</td>
</tr>
</tbody>
</table>
Results – herd economy (in €)
at state equilibrium

<table>
<thead>
<tr>
<th></th>
<th>SKB</th>
<th>SKB + SHX</th>
<th>SKB + SRX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk production</td>
<td>233,287</td>
<td>+21,168</td>
<td>+18,015</td>
</tr>
<tr>
<td>Live calves</td>
<td>1,759</td>
<td>+1,610</td>
<td>+1,965</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>248,798</td>
<td>+21,636</td>
<td>+18,599</td>
</tr>
</tbody>
</table>
### Results – herd economy (in €)

at state equilibrium

<table>
<thead>
<tr>
<th></th>
<th>SKB</th>
<th>SKB + SHX</th>
<th>SKB + SRX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk production</td>
<td>233,287</td>
<td>+21,168</td>
<td>+18,015</td>
</tr>
<tr>
<td>Live calves</td>
<td>1,759</td>
<td>+1,610</td>
<td>+1,965</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>248,798</td>
<td>21,636</td>
<td>18,599</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding, cows</td>
<td>81,454</td>
<td>+5,949</td>
<td>+5,266</td>
</tr>
<tr>
<td>Feeding, young stock</td>
<td>20,979</td>
<td>-1,519</td>
<td>-2,230</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>129,330</td>
<td>+3,874</td>
<td>+2,055</td>
</tr>
</tbody>
</table>
# Results – herd economy (in €)

at state equilibrium

<table>
<thead>
<tr>
<th></th>
<th>SKB</th>
<th>SKB + SHX</th>
<th>SKB + SRX</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Income</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Milk production</td>
<td>233,287</td>
<td>+21,168</td>
<td>+18,015</td>
</tr>
<tr>
<td>Live calves</td>
<td>1,759</td>
<td>+1,610</td>
<td>+1,965</td>
</tr>
<tr>
<td>Total</td>
<td>248,798</td>
<td>+21,636</td>
<td>+18,599</td>
</tr>
<tr>
<td><strong>Costs</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Feeding, cows</td>
<td>81,454</td>
<td>+5,949</td>
<td>+5,266</td>
</tr>
<tr>
<td>Feeding, young stock</td>
<td>20,979</td>
<td>-1,519</td>
<td>-2,230</td>
</tr>
<tr>
<td>Total</td>
<td>129,330</td>
<td>+3,874</td>
<td>+2,055</td>
</tr>
<tr>
<td><strong>Profit</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>119,468</td>
<td>+17,762</td>
<td>+16,544</td>
</tr>
<tr>
<td>Per cow</td>
<td>1,173</td>
<td>+181</td>
<td>+169</td>
</tr>
</tbody>
</table>

+11-13%
Opportunities

- Increased profit in the herd → "survival", herd investments
- Selection among breeding females → genetic improvement
- Sustainability → purebred nucleus of native breed remains essential
  - The system requires enough replacement animals in the nucleus
Challenges

• Breeding structure
  • Are there enough breeding animals for this strategy?
  • Inbreeding risk?

• Farmers
  • Willingness to crossbreeding

• Breed organizations
  • Supportiveness

• Practical issues on-farm
  • Feeding and rearing etc.
Concluding remarks

• Sustained crossbreeding may be a feasible strategy for conservation of a native dairy cattle breed
  • *Still need for in-depth research (e.g. Genetics)*

• Crossbreeding may not be enough – but it may be a part of the solution

• Could be relevant for any European country. Not only Sweden.

• Guidelines by FAO (2010)
Thank you!

Picture by Glassbonden, Vännäs, Sweden
Concluding remarks

• Sustained crossbreeding may be a feasible strategy for conservation of a native dairy cattle breed
  • *Still need for in-depth research (e.g. Genetics)*

• Crossbreeding may not be enough – but it may be a part of the solution

• Could be relevant for any European country. Not only Sweden.

• Guidelines by FAO (2010)