The development of population structure and inbreeding parameters in dairy cattle breeds kept for conservation and grazing purposes.

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Norwegian Genetic Resource Centre
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Outline

> Native and endangered cattle breeds in Norwegian landscape

> Population development of five native and endangered cattle breeds in Norway

> A case study;
  > Differences between Western Fjord cattle and Western Red Polled in population structure and development
  > Possible explanations to the differences
Døla (DC)  
Telemark (TC)  
Sided Trønder and Nordland (STN)  
Western Red Polled (WRP)  
Eastern Red Polled (ERP)  
Western Fjord (WF)
Native and endangered cattle breeds and their value to the environment

> Frequently used for grazing outlying land

> Landscape management

> Summer forage harvesting by utilizing the outlying land

> 75% of the farms with endangered cattle breeds utilize outlying land (national mean = 50%)
Native and endangered cattle breeds and their value to the environment

> Frequently used for grazing outlying land
  > Landscape management
  > Farms base some of their forage harvesting on the resources in the outlying land

> Easy movement in steep and rough terrain
  > Local and endangered breeds are often smaller and lighter than for example Norwegian Red (NRF) or beef cattle breeds
    > Mountains and mountainous plateaus cover 44.4% of the land area of Norway.

> Grazing differences between breeds (Sæther et al. 2006)
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Development of the populations of the native and endangered cattle breeds

> Conservation programs started in 1989
Number of breeding females

- Telemark Cattle
- Western Fjord Cattle
- Western Red Polled Cattle
- Døla Cattle
- Eastern Red Polled Cattle

1990: 0
1995: 0
2000: 0
2005: 0
2010: 0
Number of born calves

- Telemark Cattle
- Western Fjord Cattle
- Western Red Polled Cattle
- Øla Cattle
- Eastern Red Polled Cattle

Year: 1990, 2000, 2009

- Telemark Cattle: 0, 84, 247, 398
- Western Fjord Cattle: 0, 95, 122, 398
- Western Red Polled Cattle: 0, 122, 247, 398
- Øla Cattle: 0, 84, 95, 247
- Eastern Red Polled Cattle: 0, 95, 122, 398
Estimating effective population size ($N_e$)

> $N_e$ based on rate of inbreeding ($N_e = \frac{1}{2}\Delta F$)

$$\Delta F = \frac{F_t - F_{t-1}}{1 - F_{t-1}}$$

> $N_e$ based on the number of parents

$$N_e = \frac{4N_m N_f}{N_m + N_f}$$

> PopReport, Institute of Farm Animal Genetic, Mariensee, Germany

> http://popreport.tzv.fal.de
Average pedigree completeness for six generations
Effective population size based on $\Delta F$

<table>
<thead>
<tr>
<th>Year</th>
<th>Telemark Cattle</th>
<th>Western Fjord Cattle</th>
<th>Western Red Polled Cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\Delta F$</td>
<td>Ne</td>
<td>$\Delta F$</td>
</tr>
<tr>
<td>1990</td>
<td>0,0087</td>
<td>57</td>
<td>0,0053</td>
</tr>
<tr>
<td>1995</td>
<td>0,0019</td>
<td>263</td>
<td>0,0067</td>
</tr>
<tr>
<td>2000</td>
<td>-0,0106</td>
<td>-</td>
<td>0,0148</td>
</tr>
<tr>
<td>2005</td>
<td>-0,01</td>
<td>-</td>
<td>-0,0011</td>
</tr>
<tr>
<td>2009</td>
<td>-0,0082</td>
<td>-</td>
<td>0,0005</td>
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</table>

<table>
<thead>
<tr>
<th>Year</th>
<th>Døla Cattle</th>
<th>Eastern Red Polled Cattle</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>$\Delta F$</td>
<td>Ne</td>
</tr>
<tr>
<td>1990</td>
<td>0,015</td>
<td>33</td>
</tr>
<tr>
<td>1995</td>
<td>0,0168</td>
<td>30</td>
</tr>
<tr>
<td>2000</td>
<td>0,0015</td>
<td>333</td>
</tr>
<tr>
<td>2005</td>
<td>-0,0011</td>
<td>-</td>
</tr>
<tr>
<td>2009</td>
<td>0,0064</td>
<td>78</td>
</tr>
</tbody>
</table>

\[
\Delta F = \frac{F_t - F_{t-1}}{1 - F_{t-1}}
\]
Effective population size based on the number of parents

\[ Ne = \frac{4N_m N_f}{N_m + N_f} \]
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Western Fjord vs. Western Red Polled

> Two endangered Norwegian cattle breeds

> Populations where recorded for conservation in 1989

> Started of with approximately the same population structure
  > 50 breeding females (>2 year and pure bred)
  > 20 breeding bulls on farm
  > 10 AI bulls
  > 20 herds

> More or less the same size
  > Withers height 120/121 cm
  > Breast size 170/172 cm
Number of breeding females

- Western Fjord Cattle
- Western Red Polled Cattle
## Western Fjord vs. Western Red Polled Population Structure – use of sires

### Al bulls vs. on farm bulls

<table>
<thead>
<tr>
<th></th>
<th>Western Fjord</th>
<th>Western Red Polled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Al bull</td>
<td>43,4 %</td>
<td>61,7 %</td>
</tr>
<tr>
<td>On farm bull</td>
<td>43,3 %</td>
<td>21,4 %</td>
</tr>
<tr>
<td>No. of Al bulls (2011)</td>
<td>50</td>
<td>48</td>
</tr>
<tr>
<td>Unknown sire</td>
<td>13 %</td>
<td>16,8 %</td>
</tr>
</tbody>
</table>
Effective population size based on the number of parents

- Western Fjord Cattle: 34, 45, 176
- Western Red Polled Cattle: 84
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Differences in milk yield

The chart compares the milk yield of different cattle breeds. The breeds include:
- Telemark Cattle
- Western Fjord Cattle
- Western Red Polled Cattle
- Døla Cattle
- Eastern Red Polled Cattle
- Norwegian Red

The milk yield is measured in kilograms, with the following yields:
- Telemark Cattle: 3900 kg, N = 159
- Western Fjord Cattle: 3800 kg, N = 196
- Western Red Polled Cattle: 4000 kg, N = 56
- Døla Cattle: 3000 kg, N = 35
- Eastern Red Polled Cattle: 3800 kg, N = 33
- Norwegian Red: 6900 kg, N = 233,000

Ref: National Recording Scheme for dairy cattle
Differences in phenotype and owners

> Fjord cattle:
  > Nicer colours?
  > Better organized owners?
Differences in regional landscape and farming traditions in the breeds’ center of origin

Western Fjord Cattle

Extensive small farms

Western Red Polled

Intensive animal production
Summary

> Native and endangered cattle breeds frequently graze outlying land
> Their population structure has developed in different ways
> Possible explanations for these differences have been discussed
  > Milk yield
  > Phenotype
  > Owners
  > Landscape and tradition
Thank you for your attention