Breeding strategies for long term benefits (for society and farmers)

AN INTRODUCTION

Side event

1st Int. Technical Conference on Animal Genetic Resources for Food and Agriculture
Interlaken, Switzerland
September 3rd 2007

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Norwegian University of Life Sciences

www.umb.no
Computer tomography in pigs- a new way of improving selection for optimal body composition
120 generations of selection for litter size in mice- a story of changing litter size from 10 to 23, and still maintain genetic variation.
Quality of Bioproduction

Quality Control  Tracing & Tracking  Genetic Improvement

Large Scale Recording  Genomics  Applied Genetics

Biostatistics
The “leading stars” for Norwegian Breeding Organizations were formulated around 1960 and were expressed as such:

- **Genetic progress for the many** *(the farmers, heavily involved in recordings for the breeding organisation, have the right to shear a part of the outcome of genetic progress)*
- **The farmers’ ownership to their genetics** *(involvement, ownership)*
- **Utilizing the scientific improvements** *(utilizing new knowledge, bridge between theory and practice)*
The success of a breeding organisation is dependant on the genetic improvement created, and this genetic improvement is dependant on scientific inputs.

- Norwegian breeding organizations have some success on the export market. WHY:
  - Strongly organised
  - High AI percentage (high selection intensities and efficient use of males)
  - High health status
  - Short distance theory-practice
  - Interested and motivated breeders
  - Openness of breeding system
  - Documentation of genetic level
Key elements

- The present success of Norwegian farm animal breeding nationally and internationally is a result of these leading stars and the investments in animal breeding and genetics from then to present.

- Some of the key elements of this development have been the close links between breeding industry and genetic/breeding research and education. The success of a breeding organisation is dependant on the genetic improvement created, and this genetic improvement is dependant on scientific inputs.

- The success of Norwegian fish farming (especially salmon) was as well developed from the same breeding philosophy and from the same scientific groups linked to our department and to the scientists within the breeding organisations.
How to maintain these advantages for farmers and society?

- Breed for future traits
- Maintain production efficiency
- Maintain strong alliances with the breeders
- Beware of importance of field recording systems and health status
- Strengthen breeding for health, longevity and fertility -
  in both purebreeding and crossbreeding
Present and future traits - important for future improvements

- Growth
- Feed efficiency
- Fertility, male and female
- Body composition
- Quality parameters
- Health traits
- Other traits
- Production economy
- "
- Product quality
- Animal welfare/ prod. economy
- Labour etc
LONG TERM BREEDING GOALS THAT WILL SURVIVE SHORT TERM PROFIT TRAITS

- Healthy animals with high longevity, with low labour input
- Less resource demanding animals (food, labour etc)
- Increased focus on quality traits in the breeding goals

NB!! Too high emphasis on production efficiency traits (milk production, growth, etc) can be negative, however, international competition is often based on production efficiency traits alone.
**BREEDING GOAL:**

**Breeding goal 2006**
Norsvin Landrace

<table>
<thead>
<tr>
<th>Production</th>
<th>Carcass quality</th>
<th>Meat quality</th>
<th>Litter size</th>
<th>Reproduction</th>
<th>Maternal traits</th>
<th>Health</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 %</td>
<td>28 %</td>
<td>7 %</td>
<td>24 %</td>
<td>5 %</td>
<td>17 %</td>
<td>6 %</td>
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<tr>
<td>- Feed consumption,</td>
<td>- Yield</td>
<td>- pH_2</td>
<td>- Live born:</td>
<td>- Age, first</td>
<td>- Teats (number)</td>
<td>- Conformation</td>
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<tr>
<td>25–100 kg (kg)</td>
<td>- Lean meat (%)</td>
<td></td>
<td>- first litter</td>
<td>service (d)</td>
<td>(number)</td>
<td>(score)</td>
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<tr>
<td>- Age at 100 kg (d)</td>
<td>- Bacon quality (score)</td>
<td></td>
<td>- interval,</td>
<td>- Litter weight:</td>
<td>- OCD, front leg (score)</td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td>weaning – service (d)</td>
<td>- first litter (kg)</td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>- second litter (kg)</td>
<td>- OCD, hind leg (score)</td>
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</tr>
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<td></td>
<td></td>
<td></td>
<td></td>
<td>- third litter (kg)</td>
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</tbody>
</table>

2007: + 3-weeks wt, IMF, + health disorders
Criteria for sustainable breeding

- The main breeding organisations in Norway have all documented- in their yearly reports- that their breeding is sustainable according to the following factors:
  - Documentation of inbreeding development
  - Genetic progress for other traits than production efficiency (health, fertility etc)
Criteria for sustainable animal breeding
(Vangen 2006)

At the breed level:

Breeding for more traits than production efficiency-
crucial for a balanced biology of the animals

Breeding in a long term perspective is important for a
balanced biology of the animal

Recording of traits in the natural production
environments (= “field”, ”on-farm”) ensures
adaptation to the production environments

Be aware of the biological limitations and non-linear
relationships between traits

Maintain a large enough effective population size

Balance breeding values with the animal’s genetic
uniqueness value.
Gene Technology Legislation in Norway (when evaluating gene modified organisms):

Only in Norway:

- Sustainable development
- Value of the product for the society

In whole Europe (Norway included):

- Ethical considerations
- Environment and health effects
Main challenge for sustainable breeding in Norwegian Red (NRF)

- Minimum inbreeding
- Maintaining genetic variance
- Genetic gain

(Sehested, 2006)
## Other dairy cattle populations

<table>
<thead>
<tr>
<th>Population</th>
<th>Effective size</th>
<th>ΔF</th>
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<tbody>
<tr>
<td><strong>Weigel 2001</strong></td>
<td></td>
<td></td>
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<tr>
<td>US Holstein</td>
<td>39</td>
<td>1.28</td>
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<tr>
<td>US Ayrshire</td>
<td>161</td>
<td>0.31</td>
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<tr>
<td>US Brown Swiss</td>
<td>61</td>
<td>0.82</td>
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<tr>
<td>US Guernsey</td>
<td>65</td>
<td>0.77</td>
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<tr>
<td>US Jersey</td>
<td>30</td>
<td>1.67</td>
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<td><strong>Sørensen et al 2004</strong></td>
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<td></td>
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<tr>
<td>Danish Holstein</td>
<td>70</td>
<td>0.71</td>
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<tr>
<td>Danish Jersey</td>
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<td>RDM</td>
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<td>0.18</td>
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<td><strong>Sehested 2005</strong></td>
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<td>NRF</td>
<td>167</td>
<td>0.30</td>
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</table>
Solutions

- Optimal selection of elite bulls
- Optimal use of elite bulls

**Optimal**: Taking both total merit and bulls relationship with population into account

- Tool: "Optimal contribution"
  - GENCONT
  - EVA
  - "??"
Conclusions on Breeding strategies for long term benefits

- A long term perspective is important for long term profit
- Breeding for low heritable trait is dependant on field recordings of health, fertility and longevity. These traits are crucial for sustainable breeding in future
- Close inks between farmers, breeding organisations and science is important for equal sharing of benefits
- Norwegian animal breeding has obtained its reputation through these guide lines and they are now in demand on the international market due to these long term investments!

THANK YOU