



Effects of inbreeding on milk production, fertility, and somatic cell count in Norwegian Red

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Effects of inbreeding

- Unfavorable effects of inbreeding have been reported for many dairy populations:
 - Reduced milk yield (e.g. Gulisija et al. 2007; Mc Parland et al. 2007)
 - Decreased fertility (e.g. Cassell et al. 2003, Wall et al. 2005)
 - Increased SCC (e.g. Croquet et al. 2006; Miglior et al. 1995)
- Inbreeding depression for fitness traits (Falconer & Mackay, 1996)
- Have so far not been studied for Norwegian Red

Norwegian Red

- 95 % of the cows in Norway are Norwegian Red
- Population size: 240.000 cows in the recording system (96%)
- 11.000 dairy herds
- 90 % of calves have an A.I. sire
- Selected for a broad breeding objective with emphasis on functional traits like health and fertility over the last 40 years
- Effective population size ≈ 200
- $\Delta F < +0.05$ % per year



AIM

Estimate the effects of inbreeding on
milk production, fertility, and somatic cell count (SCC)
in Norwegian Red



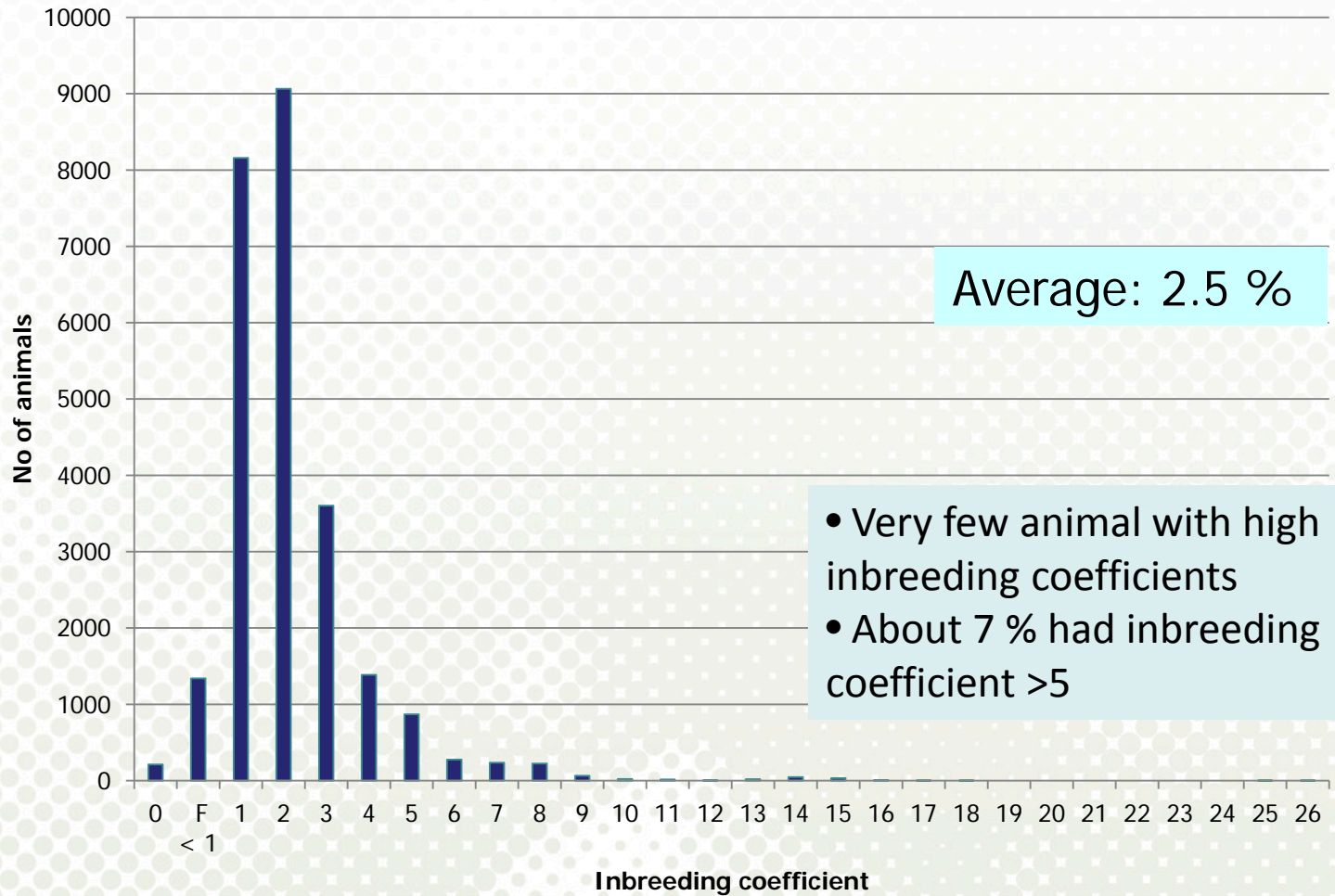
Data

- Data from relatively large herds
 - mainly Norwegian Red cows (>95 %)
 - high use of AI (>95%) over the last 10 years
- Ensure complete pedigree many generations back for each animal

Dataset: 21,608 cows from 62 herds

Pedigreefile: 78,446 animals

Distribution of inbreeding coefficients



Traits

- Milk production
 - 305 days lactation yield for kg milk, kg fat, and kg protein, fat % and protein %
- SCC
 - lactation mean somatic cell score (LSCS)
- Fertility
 - non-return within 56 days (NR56) after first insemination for heifers, first- and second/third lactation cows
 - interval from calving to first insemination (CFI) for first and second/third lactation cows

Model

- Animal models
 1. Same model and genetic parameters as used in Geno routine genetic evaluation
 2. + Linear regression of inbreeding coefficient
 3. + Quadratic regression of inbreeding coefficient
- Repeatability model for lactation 1-3 for milk production- and SCC traits
- Multitrait model for fertility traits
- Analyzed using DMU (Madsen and Jensen, 2007)

Results - milk production traits

Linear regression coefficient: effect of 1 % increased inbreeding coefficient on 305 day lactation yield for protein- and fat percentage, kg protein, kg fat, and kg milk

	Protein %	Fat %	Kg protein	Kg fat	Kg milk
Regr. coeff	-0.0002	-0.0005	-1.16	-1.29	-34.2
p-value	0.42	0.41	<0.0001	<0.0001	<0.0001

Inbreeding had significant unfavorable effect on milk yield traits and no effect on fat- and protein percentage

Results – Somatic Cell Count

Linear regression coefficient: effect of 1 % increased inbreeding coefficient on lactation mean somatic cell score (LSCS)

	LSCS
Regr. coeff	-0.0083
p-value	<0.05

Equivalent to H1000 cells lower lactation mean SCC

Inbreeding had a significant favorable effect on LSCS



Results – fertility traits

Linear regression coefficient: effect of 1 % increased inbreeding coefficient on non-return within 56 days (NR56) for heifers, first- and second/third lactation cows and interval from calving to first insemination (CFI) for first and second/third lactation cows

	NR56 heifers	NR56 1 st lact	NR56 2 nd and 3 rd lact	CFI 1 st lact	CFI 2 nd and 3 rd lact
Regr. coeff	0,0007	0.002	0.002	-0.02	0.05
p-value	0.36	0.30	0.23	0.44	0.37

No significant effects of inbreeding for any of the fertility traits

Results

- Quadratic regression not significant for any trait
- Rank correlations > 0.99 between EBVs from models with and without inbreeding
 - Some re-ranking of imported sires

Assumptions and limitations

- Few animals with high inbreeding level
 - About 7 % had inbreeding coefficient >5
- Fertility traits with low heritability
 - Relatively small dataset

Summary

- Inbreeding had significant unfavorable effect on milk yield

In a 305 day lactation will an offspring of half-sibs produce

427.5 kg less milk,

16 kg less fat, and

14.5 kg less protein

and have \approx 12 500 cells lower lactation mean SCC

than a non-inbred cow, under otherwise equal conditions

- No significant effects of inbreeding were found for any of the fertility traits or for fat- and protein percentage



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