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Effects of different genetic components on reproductive performance in Finnhorses and Standardbred trotters

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Introduction: horse fertility

- three perspectives: stallion, mare, (expected) foal
- outcome of an individual mating: empty vs. foal; zero vs. one
- foaling rate:

  the percentage of the matings that produce a living foal
- demographic level

Introduction: genetic effects

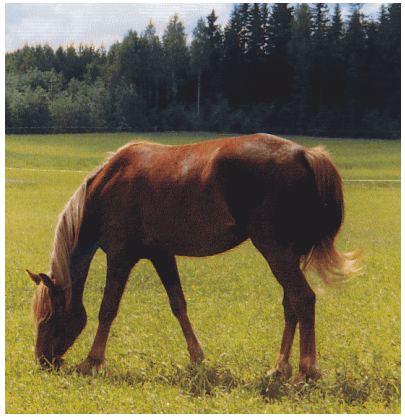
- additive genetic effect: heritability
- maternal genetic and permanent environmental effects
- stallion: permanent environmental effects
- inbreeding level of the expected foal

Introduction: breeding for fertility

- heritability is generally low for fertility traits
- but: breeding programs can be used to improve fertility
- breeding value estimates: recognizing the horses that are prone to fertility problems

Materials

- the mating database of Standardbreds (SB) and Finnhorses (FH) from 1991 to 2005 (from Suomen Hippos)
- 33 679 (SB) and 32 731 (FH) mating records
- pedigree database (Hippos)



Methods

- PEDIG -software: inbreeding coefficients
- linear mixed model
- VCE6: (REML) variance component estimates for random factors
- PEST:

  *F-test for fixed factors

  *best linear unbiased estimates (BLUE) for fixed factors

  *best linear unbiased predictions (BLUP) of breeding values

The observation and the fixed and random factors in the model

observation	= outcome of the mating, 0 or 1
stallion age group:	1-6, 7-9, 10-13, 14-16, 17-28 years
mating type:	on site AI, transported chilled, frozen, natural mating
inbreeding class:	based on inbreeding coefficient of expected foal
mare type and age class:	maiden, barren, rested or foaled within five age groups
year of mating:	1991 to 2005
month of last mating class:	1 to 3, 4, 5, 6, 7, 8, 9 to 12
stallion:	permanent environmental effect of stallion
mare:	permanent environmental effect of mare
maternal:	genetic maternal effect
animal (planned foal):	additive genetic effects
residual	

Results

- average foaling rates:
  - Standardbred 72.6%
  - Finnhorse 66.3%
- average level of inbreeding for foals born in Finland 1992-2006:
  - Standardbred 9.8%
  - Finnhorse 3.6%

Results: age group of stallion

Estimated effects of different age groups on foaling rates compared to 10 to 13 year olds

	Standardbred		**Finnhorse**	
Age group, years	n	estimate [1)]	n	estimate [1)]
1 to 6	4 006	2.29	2 609	3.64
7 to 9	8 247	2.18	6 214	1.63
10 to13	11 648	0.00	9 679	0.00
14 to16	5 244	-0.40	6 654	-0.87
17 to 28	4 521	-4.30	7 543	-2.67

[1)] difference (in %-units) from the class of comparison, 0.00

- older stallions tend to have lower fertility than younger ones

Results: mating type

Estimated effects of different classes on foaling rates compared to on site insemination

	Standardbred		Finnhorse	
Mating type	n	estimate [1)]	n	estimate [1)]
On site insemination	13 924	0.00	9 158	0.00
Transported semen	9 612	-3.69	7 073	-3.60
Natural mating	8 580	-2.26	16 468	-3.23
Frozen semen	1 550	-4.69		

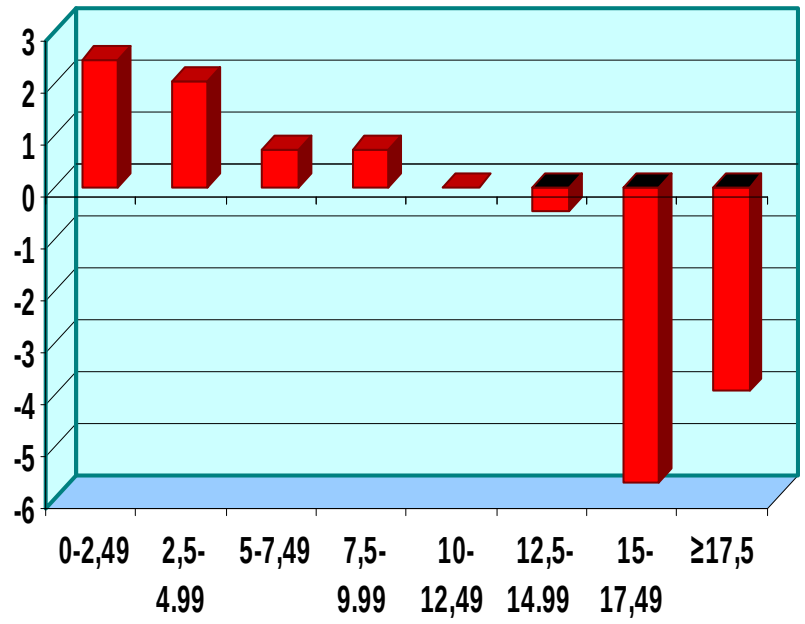
[1)] difference (in %-units) from the class of comparison, 0.00

- **on site AI was the most efficient breeding method**

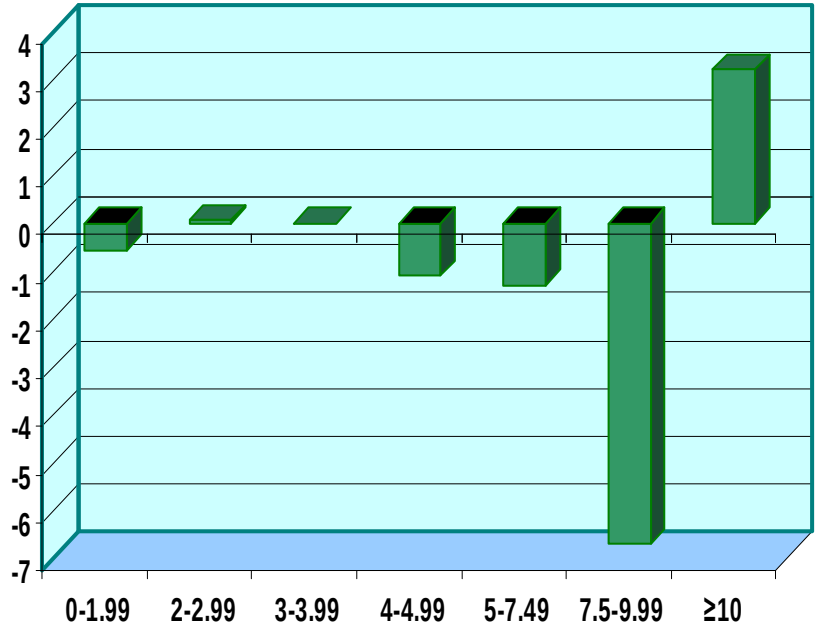
Results: inbreeding class of expected foal

- **higher level of inbreeding -> lower foaling rate**
- **but: the most inbred animals did not get the worst results**

Inbreeding class, Standardbred: difference from median class, %-units



Inbreeding class, Finnhorse: difference from median class, %-units



Results: genetic factors

Foaling rate: relative **proportions of total variance** from different models for **random effects**

Random effect		Standardbred		Finnhorse	
		Model 1	Model 2	Model 1	Model 2
additive genetic (foal), h^2-% [1)]		**3.7**	**3.4**	**5.5**	**9.8**
stallion (perm. environment) [2)]		1.4	1.7	1.5	1.3
mare	(perm. environment) [3)]	2.1	--	5.7	--
	(maternal genetic) [3)]	--	4.7	--	3.2

[1)] s.e. between 0.01 and 0.02 [2)] s.e. under 0.005 [3)] s.e. under 0.01

-- not in the model

- **heritability for Standardbred is lower than for Finnhorse**

Conclusions: genetic factors

- The stallion explained a smaller part of the total variance of foaling rate than the mare
- Maternal genetic and permanent environmental effects could not be separated from each other in the available data sets
- Model1 is more realistic than Model2

Conclusions

- Foaling rate in Standardbreds (72.6%) was better than in Finnhorses (66.3%)

  -> possibly due to differences in management, or breed specific

- Even though the general inbreeding levels were different between breeds, the effects of increased inbreeding were similar