Genetic evaluations, genetic trends and inbreeding in Scandinavian trotter populations

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Introduction

- Trotting harness racing is a popular sport and a big industry in Scandinavia
- In Norway and Sweden there are two main breeds of trotters: Standardbred trotter (ST) and Nordic trotter (NT)
- 6000 ST foals and 1300 NT foals born annually in both countries

Genetic evaluations

- Genetic evaluations by MT-AM-BLUP have been practiced in Swedish Standardbred Trotters (SST) and Nordic Trotters (NT, common evaluation in Norway and Sweden) since 1992
- Accumulated annually summarized racing records for 3-5-year-olds in SST and for 3-6-year-olds in NT

Traits, transformations and heritabilities

In SST:	h^2
1) (Number of races)$^{0.2}$	0.18
2) Racing status (0/1)	0.40
3) (Percentage ranked 1-3 in races)$^{0.8}$	0.35
4) Ln(Earnings + 1000)	0.44
5) Ln(Earnings + 1000)/number of races	0.39
6) Ln(Best racing time per km – 68.2 sec)	0.38

In NT:	
1) Racing status (0/1)	0.20
2) (Percentage ranked 1-2 in races)$^{0.5}$	0.25
3) (Standardized earnings)$^{0.25}$	0.30
4) (Best racing time per km)$^{0.5}$	0.35

Material for genetic evaluations (2010)

In SST:
Pedigree file: 236,059 animals
Records on racing status: 143,216
Records with racing results: 85,848 (59.9%)

In NT:
Pedigree file: 102,923 animals
Records on racing status: 57,046
Records with racing results: 25,669 (45%)

Statistical models

In SST:
Y = Genetic base group + Fixed effects of sex/birth-year + animal + e

In NT:
Y = Fixed effects of country/sex/birth-year + animal + e

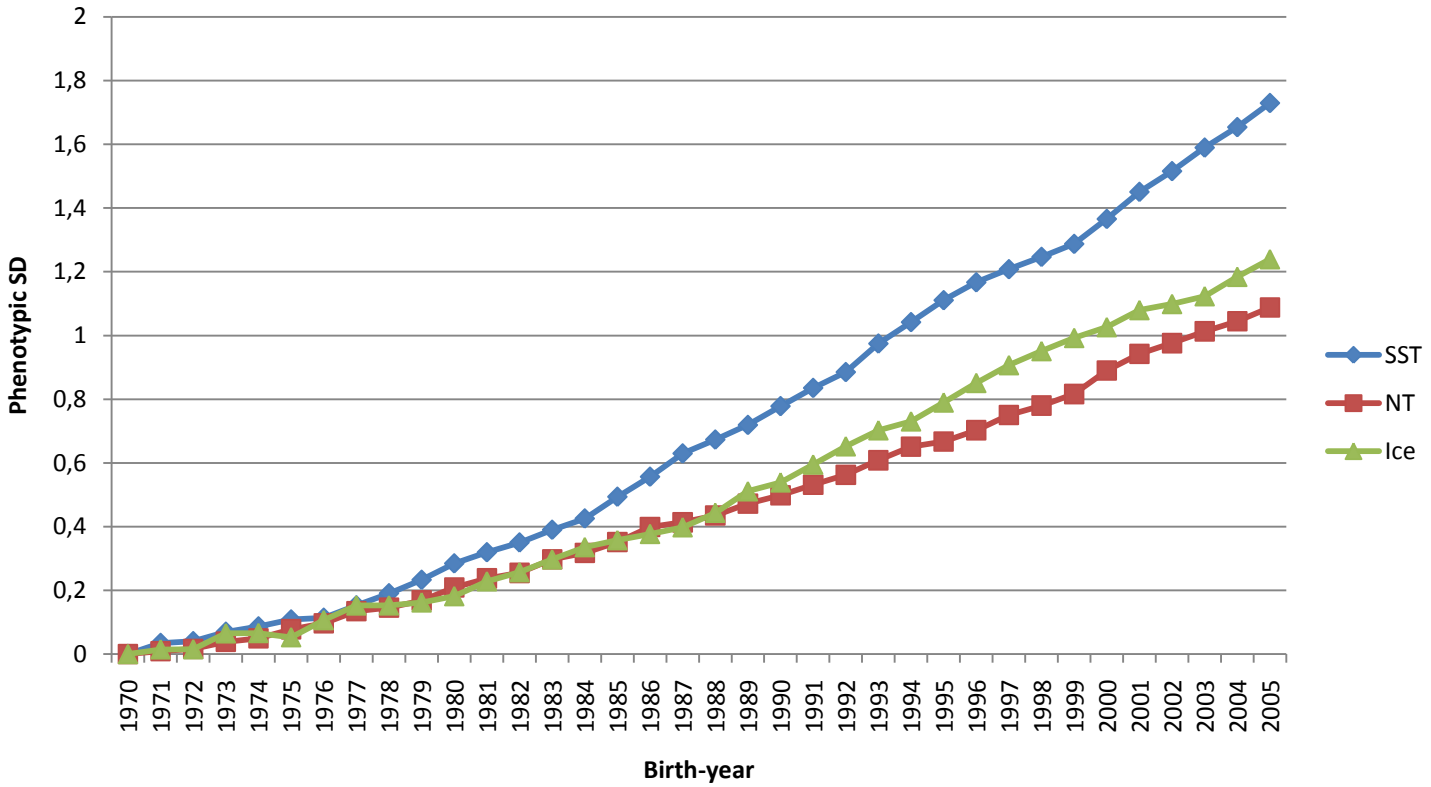
Aggregate genotype, scale and presentation of index in SST

- **Scale**: Horses born in Sweden last ten years build a reference base with mean of 100. The distribution in index for each trait is scaled such that 10 index units correspond to 1 σ_A
- **A racing performance index** is published as an average of indices for rank 1-3, earnings and earnings per race. Indices for number of races and racing status also published
- **An aggregate total index** is computed as: 0.05(number of races) + 0.75(racing performance) + 0.20(racing status)

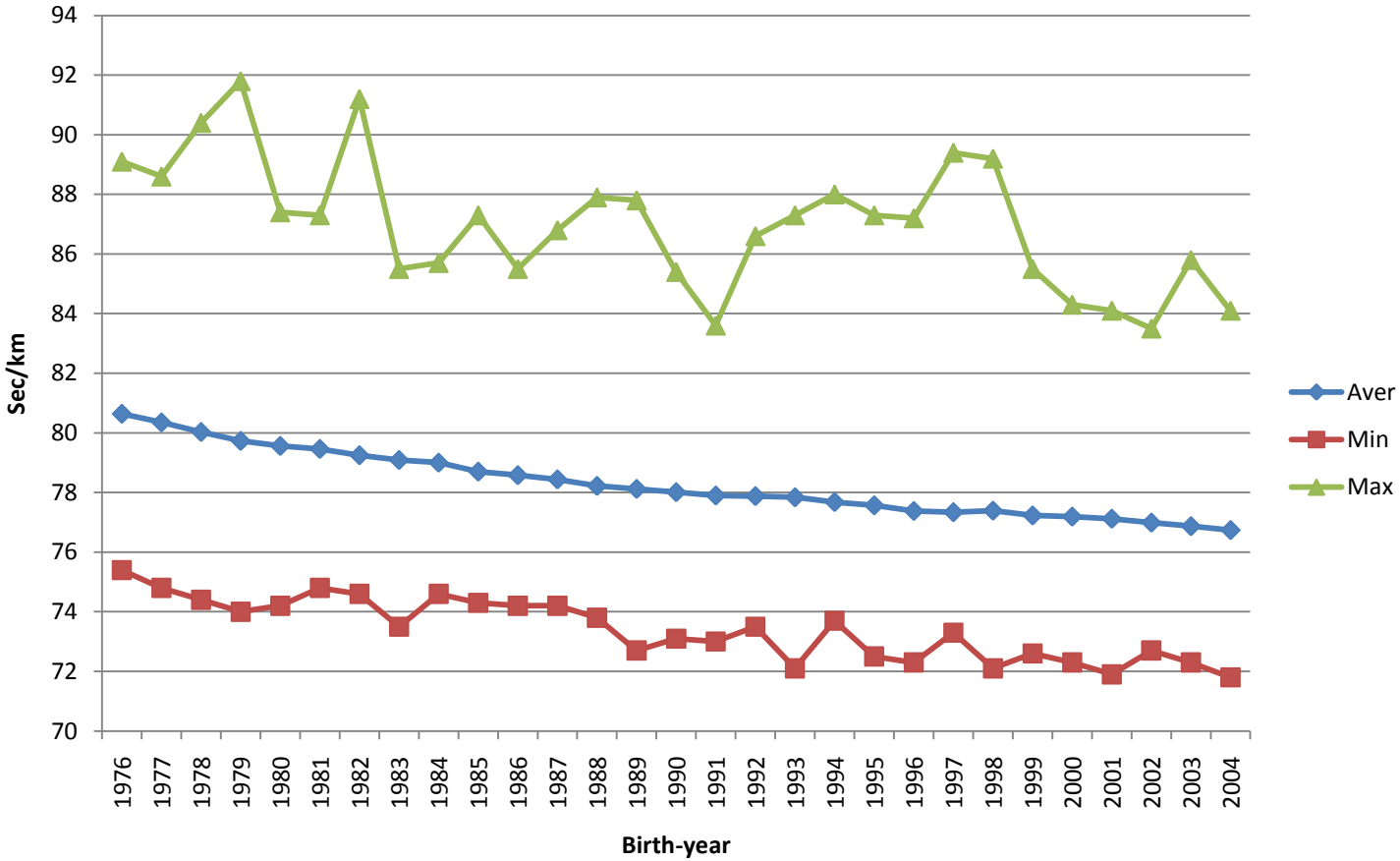
Aggregate genotype, scale and presentation of index in NT

- **Scale**: All horses with records on racing status (born 1971-2007) build a reference base with mean of 100. The distribution in index for each trait is scaled such that 10 index units correspond to one standard deviation in the index values
- **The racing performance index** is the index for earnings standardized within birth-year and country. Index for racing status also published
- **An aggregate total index** is computed as: 0.60(racing performance) + 0.40(racing status)

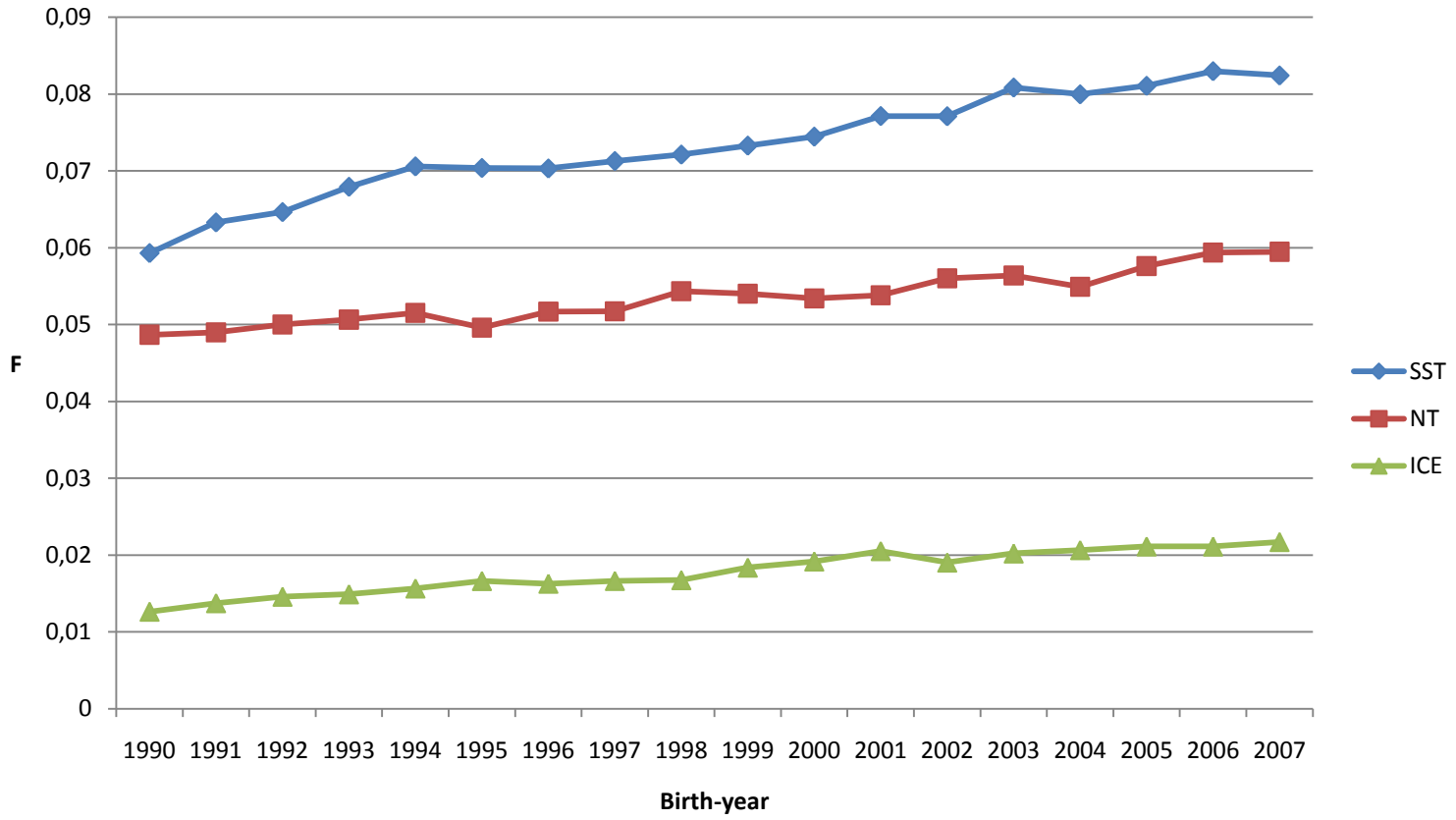
Realized genetic progress in the aggregate phenotype (σ_P)



Observed trend in best racing time records as 3-5-year-olds SST



Trends in inbreeding coefficients (F)



New analysis on records from individual races in SST

- Repeatability models (preliminary results)
- Random regression models (planned)
- Bayesian Thurnstonian models (planned)
- Comparisons with the present BLUP model, model validations

Genetic analysis by repeatability model in SST

- **Material** for estimation of genetic parameters: Year 2010: 76,306 records from 7,854 races on 10,708 animals (33,117 animals in pedigree)
- Year 1995: 86,163 records from 8,476 races on 12,496 animals (32,752 animals in pedigree)
- **Traits:** racing time per km, placing status and ln(earnings + 200)
- **Model:** y = race + age + sex + a + pe + driver + e

Results: genetic parameters

Univariate analysis:

Km time:	Placing status:	Earnings:
2010 data:		
h^2 = 0.13	0.08	0.06
t= 0.30	0.20	0.17
d*= 0.15	0.05	0.04 ($d^*=Var_{driver}/Var_P$)
1995 data:		
h^2 = 0.18	0.08	0.06
t= 0.40	0.20	0.15
d*= 0.05	0.04	0.03 ($d^*=Var_{driver}/Var_P$)

Results: genetic parameters

Bivariate analysis (2010):

Km time:	Placing status:	Earnings:
h^2 = 0.12	0.09	0.07
t= 0.30	0.22	0.19

Correlations:

$r_A \backslash r_{pe}$		
-	-0.79	-0.82
-0.99	-	0.98
-0.99	0.99	-

$r_e \backslash r_{driver}$		
-	-0.93	-0.95
-0.56	-	1.00
-0.62	0.80	-

Results: BLUP analysis

Material: Data on individual races 1995-2010. N records=1,302,811. N animals in pedigree=236,059. N animals with data=63,768. N drivers=6,979. N races=132,085

Model: y = race + age + sex + a + pe + driver + e

Corelations between BLUPs all: - (Horses born ≥ 1990):

	Km time	Placing status	Earnings
Number of races	-0.70(-0.67)	0.67(0.64)	0.69(0.65)
Racing-status	-0.71(-0.68)	0.69(0.67)	0.70(0.68)
Placing%	-0.86(-0.89)	0.84(0.89)	0.85(0.89)
Acc. Earnings	-0.85(-0.89)	0.83(0.88)	0.84(0.88)
Acc. earnings/race	-0.88(-0.91)	0.86(0.91)	0.87(0.91)
Best km time	0.85 (0.89)	-0.83(-0.88)	-0.85(-0.88)

Summary and conclusions

- The current models with accumulated racing results are robust and well accepted by the breeders
- They reflect the breeding goal well and offer the flexibility of inclusion of foreign racing results
- Genetic evaluation of racing-status valuable and adjusts for selection bias
- In SST (NT) the annual rate of genetic gain is 7% (4%) of σ_P over the last decade

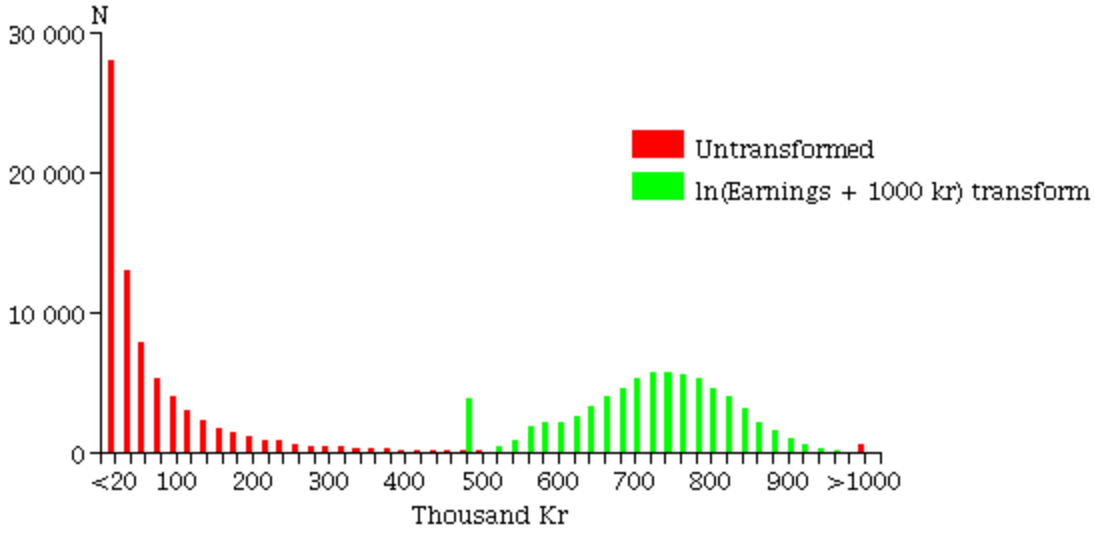
Summary and conclusions

- The high level of inbreeding and high rate of inbreeding per generations (N_e = 40 for SST, 50 for NT) is of concern and promotes use of methods for long-term genetic progress
- In SST the estimated annual inbreeding depression correspond to 0.4% of σ_P (6% of annual genetic gain)
- Analyses of results from individual races are on the way and will be validated and compared with the current model for genetic evaluations

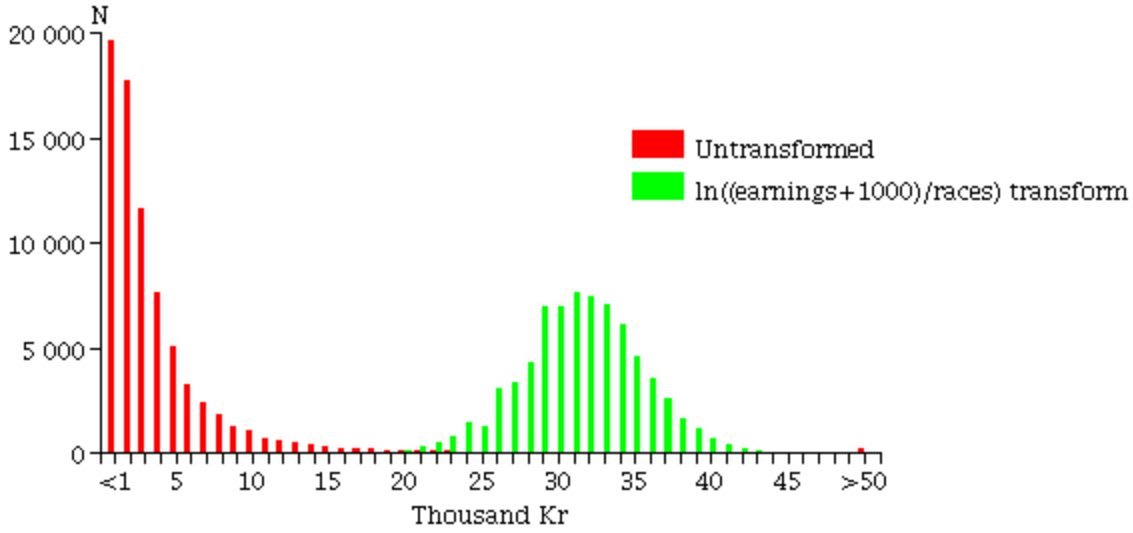
Acknowledgements

- Access to the data from the Swedish and Norwegian Trotter associations and financial founding from the former is greatly acknowledged

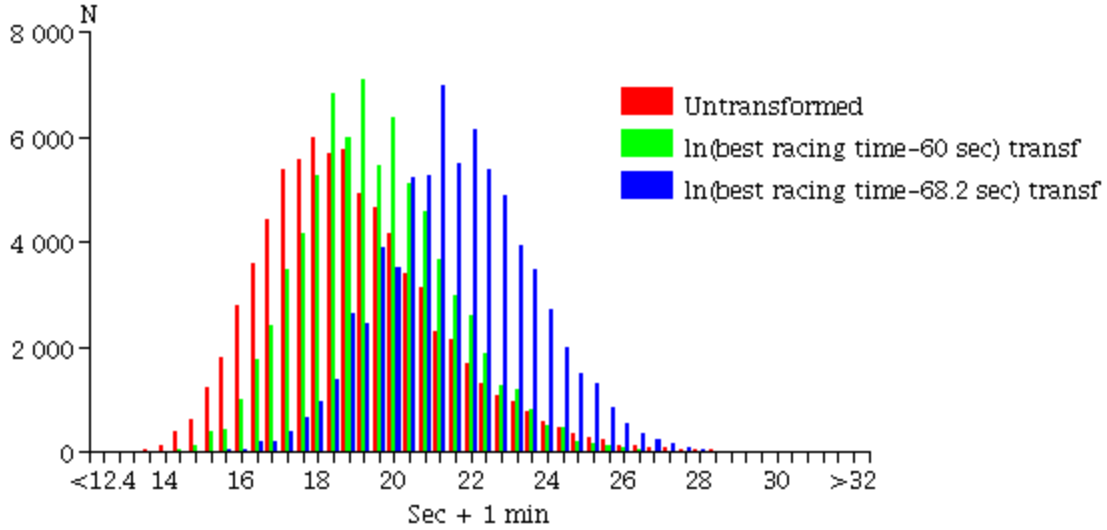
Distribution Earnings:



Distribution Earnings per race:



Distribution Best racing time:



Predicted trend in best racing time records as 3-5-year-olds SST