

Genetic composition of Nordic riding horse populations and joint breeding value of stallions

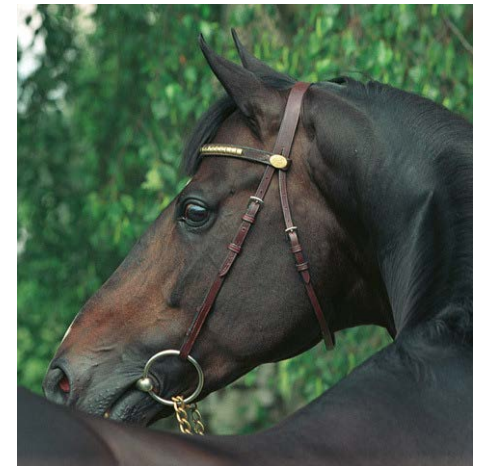
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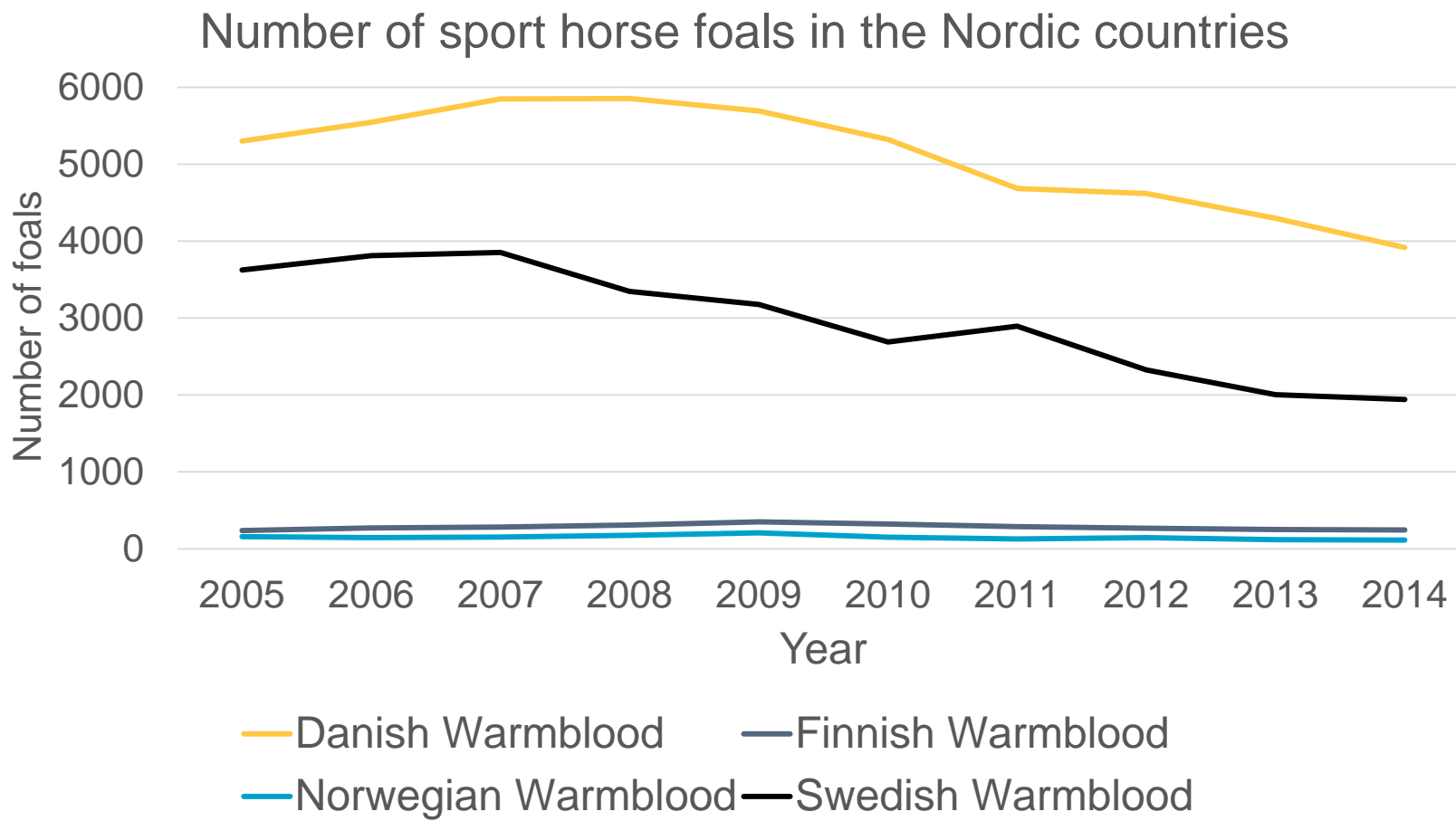
Background and motivation

- Sport horses are bred to perform at international level in dressage, jumping and eventing
 - 63 800 horses in FEI database in 2013

- 62 000 sport horse foals born in Europe in 2003
 - 9 500 in the Nordic countries



Background and motivation

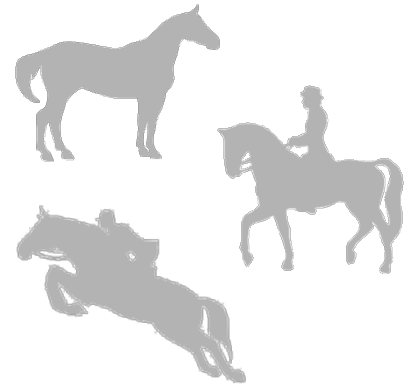


Background and motivation

- ❑ Breeding programmes using information from national
 - ✓ Young horse performance tests
 - ✓ Competitions

- ❑ Mare owners use semen from stallions all over the world

- ❑ Sport horse competition and breeding is international

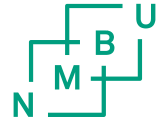


Data



- Records from young horse performance tests and pedigree information
- Competition records and pedigree information

Country (studbook)	Dressage	Jumping	Young Horse Test
Denmark (DWB)	14 608	15 141	13 436
Finland (FWB)	2 112	3 376	576
Norway (NWB)	1 873	3 094	774
Sweden (SWB)	10 768	22 992	41 507



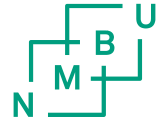
Data structure and quality

□ Young horse test- and competition data

- Danish-, and Swedish Warmblood used in yearly national genetic evaluation
- Finnish- and Norwegian Warmblood some initial genetic analyses done for YHT-data

□ Pedigree

- Pedigree-data provided by all studbooks as well as the national equestrian federations.
 - Needed editing



Building the pedigree-file

- Identifying individuals so that all available pedigree- test- and competition data were attributed to the correct horse
 - UELN, registration number, studbook number
 - Name, birth year and parent information

- Average PEC-value: 0.75
 - 0.83 for horses with YHT-records
 - 0.66 for horses with competition records

Traits

- ❑ Evaluated point scoring from Young Horse tests
 - Horses aged 3 to 4 (5 year old mares that have had foals)
 - Evaluation of a horses conformation, health, temperament, gait quality and jumping performance
 - Traits scored on a scale from 1 (poor) to 10 (excellent)

- ❑ Conformation, walk, trot, canter, rideability, jumping, attitude jumping

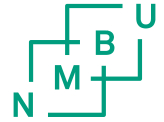
Populations

- Genetic Similarity

$$GS_{ij} = \frac{\sum_{k=1}^{N_{ij}} (n_{ik} + n_{jk})}{\sum_{k=1}^{N_i} n_{ik} + \sum_{k=1}^{N_j} n_{jk}}$$

- Contribution to similarity

$$\text{Contribution to GS in \%} = \frac{\sum_{k=1}^{N_i} (n_{ik})}{\sum_{k=1}^{N_{ij}} (n_{ik} + n_{jk})} \times 100$$

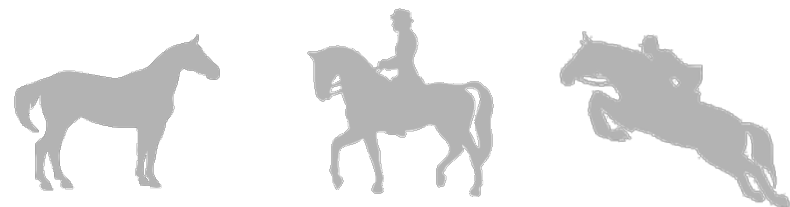


Breeding value estimation

- 1) National univariate genetic evaluation, where information only from the national YHT was used for each of the 4 populations
- 2) Joint bivariate genetic evaluation with records from DWB as one trait and records from FNS as the other
- 3) Joint univariate genetic evaluation, where the same trait from all populations was analysed as one trait.

Breeding value estimation

- a) Stallions with 15 or more progeny within a studbok
- b) Stallions with at least one progeny in two or more studbooks and 15 or more in total



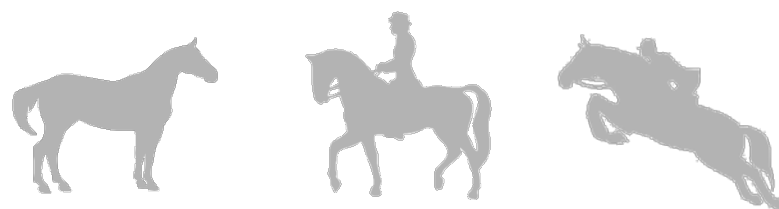
Models

- Model I (national estimates)

$$Y_{ijkl} = \text{sex}_i + \text{age}_j + \text{event}_k + \text{animal}_l + e_{ijkl}$$

- Model II (joint estimates)

$$Y_{ijkml} = \text{sex}_i + \text{age}_j + \text{event}_k + \text{country}_l + \text{animal}_m + e_{ijkml}$$



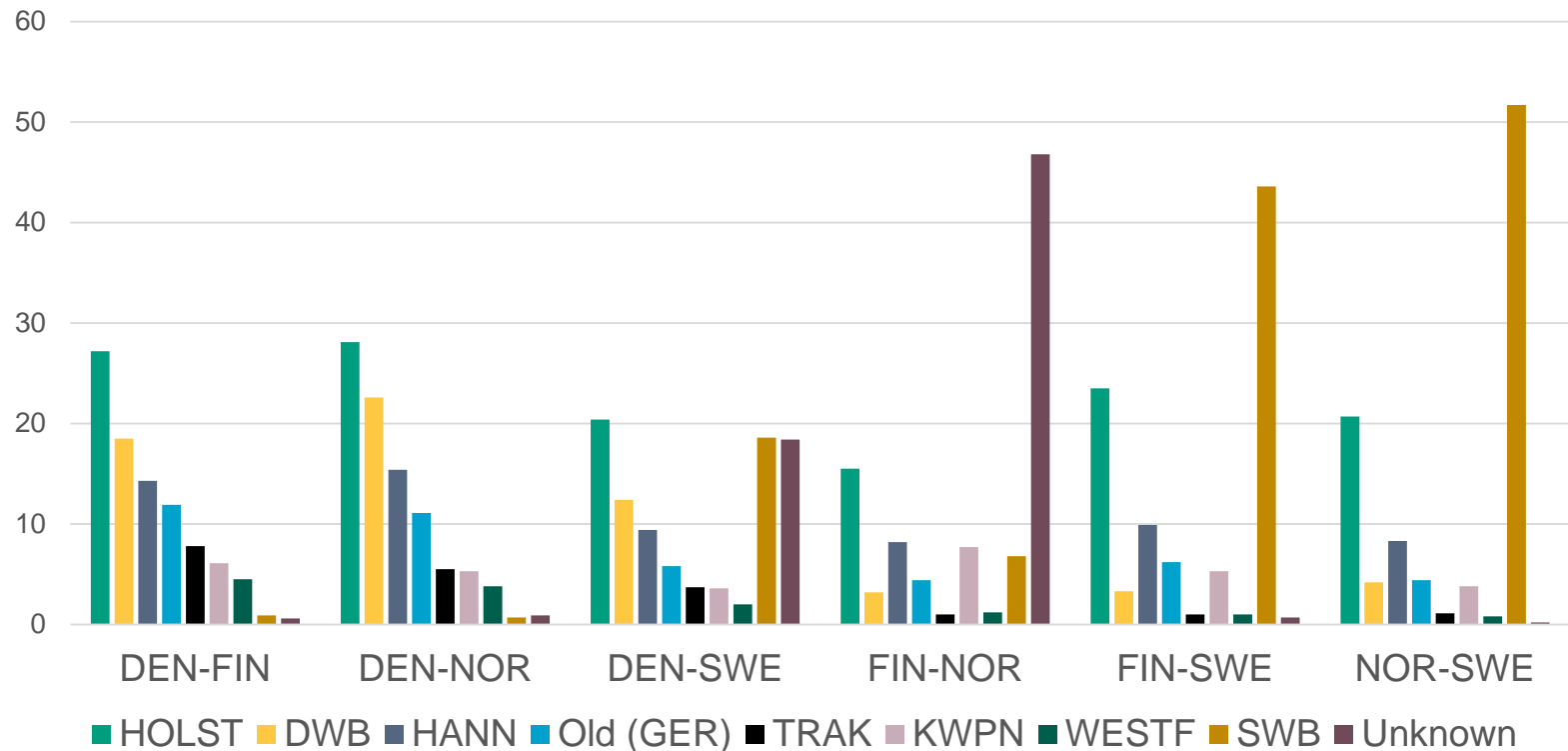
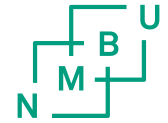
Genetic composition

Studbook(s)	DWB	FWB	NWB	SWB
ARAB	3	2	3	1
DWB	3	3	4	0
FWB	0	3	0	0
GER	14	13	6	4
HANN	13	18	11	17
HOLST	13	28	12	4
KWPN	2	3	4	1
NWB	0	0	5	0
SF	6	9	7	6
SWB	2	13	16	32
TB	32	7	23	16
TRAK	12	1	11	20
WLKP	0	1	0	0

Genetic similarity

	Stallions in common	Genetic similarity	Stallions in common	Genetic similarity
	Young Horse Test		Competition	
FIN-NOR	43	12%	342	18%
DEN-NOR	123	27%	372	37%
SWE-NOR	113	31%	445	36%
DEN-FIN	125	16%	701	40%
SWE-FIN	107	22%	866	52%
DEN-SWE	464	43%	1073	57%

Studbooks contributing to genetic similarity



Heritability

Trait	DWB	FWB	NWB	SWB
Walk	0.27	0.30	0.24	0.32
Trot	0.42	0.52	0.41	0.42
Canter	0.37	0.82	0.24	0.36
Rideability	0.22	0.19	0.24	0.32
Jumping	0.51	0.52	0.55	0.25
Attitude jumping	0.42	0.52	0.41	0.42

Genetic correlation

Trait	r_g
Walk	0.68 _{0.09}
Trot	0.86 _{0.06}
Canter	0.93 _{0.05}
Rideability	0.76 _{0.10}
Jumping	0.82 _{0.08}
Attitude jumping	0.78 _{0.13}



Stallions with EBV

Studbook	e15 offspring within studbook e15 Nordic	1-14 offspring within studbook e15 Nordic	Total no of stallions
Danish Warmblood	167	88	255
Finnish Warmblood	1	93	94
Norwegian Warmblood	3	110	113
Swedish Warmblood	175	130	305

Concluding remarks

- ✓ The Nordic riding horse populations is closely related and highly influenced by other European studbooks
- ✓ High genetic correlation between phenotypically similar traits in the studbooks
- ✓ Increase in number of stallions with, and accuracy of EBV for joint stallions with international EBV
- ✓ Joint genetic evaluation of performance traits in the Nordic populations is feasible and highly recommended.

