



Correlations between linear data of foals and 3-year-old horses in the Swedish Warmblood

MSc Katarina Karlsson

Swedish University of Agricultural Sciences

Chair Young SWB

Dr Emma Thorén Hellsten

Breeding Manager

Swedish Warmblood

Dr Åsa Viklund

Senior Lecturer

Swedish University of
Agricultural Sciences



About SWB

~ 4000 mares covered 2019

~ 250 stallions are used for breeding/year

~ 4000 members

SWB-breeders have 1-3 mares in breeding

Very few have more than 6 mares in breeding





Linear description in SWB

- Introduced at Young Horse Tests (3yo) 2013
- Introduced at all tests 2014
 - ✓ Foals
 - ✓ 3yo
 - ✓ 4yo
 - ✓ Mares
 - ✓ Stallion Performance Test
- Descriptive BVs for stallions 2017
- Descriptive BVs for mares 2018
- Official BVs for ~ 150 stallions and 3000 mares
- *Descriptive BVs for traits under rider 2020*



SWB Events



Stallions

- Advisory test (November)
- Stallion performance test (February-March)

Young horses

- Young Horse Tests tests for 3-4-year-olds (April-June)
- Riding Horse Test (4 yo and older) (April-June)
- Finals: SWB Equestrian Weeks with Breeders Trophy (October)

Foals

- Regional shows (July-August)
- Elite foal auction (September)



SWB tests for foals and young horses



Young Horse Test (YHT)

3- and 4-year-olds that have not been shown at YHT before

Test conformation, gaits at hand and in freedom, free jumping, rideability (optional)

About 30 % of all born horses participates

Riding horse test (RHT)

Open for 4-year-olds, 5-year-old mares that had a foal

Test conformation, gaits under rider, jumping under rider or free (optional)

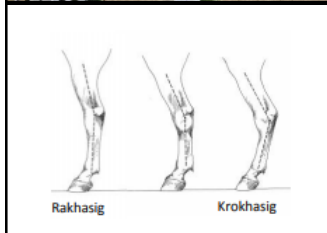
About 10 % of all born horses participates

Foals

Foals from 21 days and older

Test conformation and gaits at hand and in freedom

About 25 % of all foals participate



Evaluation & Description in SWB



Evaluation with numerical scores

Evaluation of the horse relative the breeding goal

Using numerical scale 1-10 increments of 0,5

Linear description

Description relative biological extremes and the population means

Using alphabetical scale A-I where E is in the middle

Scale A-E for foals, C in the middle

Tool for breeders, SWB and potential horse buyers



SWB - Long tradition of cooperation with science and practice



Continuous cooperation since the 70-ies with
Swedish University of Agricultural Sciences

Breeding value estimation since 1986

Integrated BVs since 2006

Linear BVs since 2017

Students master theses great resource for R&D
of the SWB breeding programme



Study of SWB foal shows

Master thesis Katarina Karlsson, SLU



- Investigating new setup (new score system, LD)
- Comparison with Young Horse Test
- Linear data for 2069 foals 2014-2017
- Linear data for 4683 3yo 2014-2018
- Age of foals at assessment 18 - 244 days
- Scale A-E transformed into 1-5 for calculations
- BLUP animal model used for the analysis
- Fixed effects of event, age (days) and sex included in model $Y_{ijkl} = \mu + \text{age}_i + \text{event}_j + \text{sex}_k + \text{animal}_l + e_{ijkl}$
- Heritabilities, correlations within test, correlations betw. Foal shows & YHT



Number of traits scored at SWB tests

Linear description

	Foals	Young horse test	Riding horse test	Stallions
Conformation	8 (14)	21 (39)	21 (39)	21 (39)
Gaits	7 (8)	15 (17)	21 (23)	21 (23)
Jumping	-	14 (16)	14/15 (16)	14/15 (16)

Total number of traits including tick boxes for binary traits within brackets

Evaluating scores

	Foals	Young horse test	Riding horse test	Stallions
Conformation	1	3	3	3
Gaits	1 (mean of 3)	3	4	7
Jumping	-	2	2	3
General impression	1	-	-	-



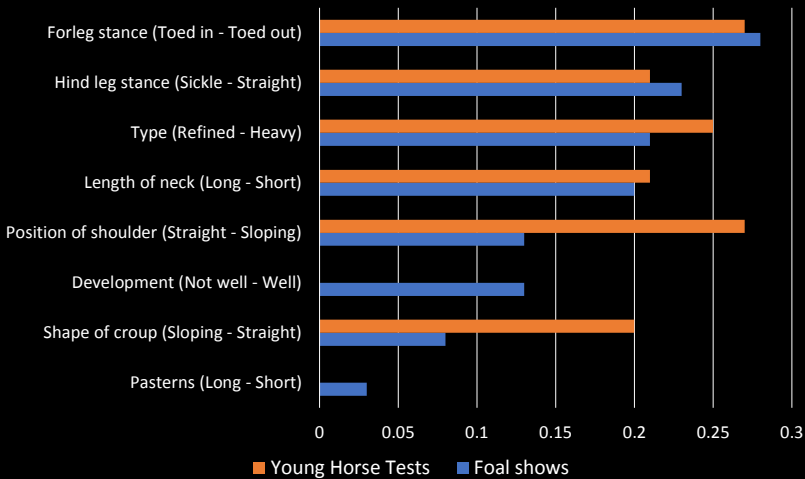
Linear protocol used at SWB foal shows

EXTERIÖR	Extremvariant	Extremvariant	Kommentar
	A B C D E		
1 Utvecklingsfas	outvecklad	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	välutvecklad
2 Typ	ädel	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	grov
3 Halsens längd	lång	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	kort
4 Bogens position	liggande	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	brant
5 Korsets lutning	stupande	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	rakt
6 Framben	intåad	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	uttåad
7 Bakben	krokhasig	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	rakhasig
8 Kotor	långa	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	korta
			<input type="checkbox"/> väl proportionerlig <input type="checkbox"/> lågt ansatt <input type="checkbox"/> djup bål <input type="checkbox"/> avvikande inskening <input type="checkbox"/> fransysk <input type="checkbox"/> veka kotor
GÅNGARTER	Extremvariant	Extremvariant	Kommentar
	A B C D E		
9 Skritt: steglängd	lång	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	kort
10 Skritt: rörlighet	rörlig	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	löst
11 Trav: steglängd	lång	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	kort
12 Trav: elasticitet	elastisk	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	oelastisk
13 Galopp: språglängd	lång	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	kort
14 Galopp: elasticitet	elastisk	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	oelastisk
15 Gångarter: balans	balanserad	<input type="checkbox"/> <input type="checkbox"/> <input checked="" type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>	obalanserad



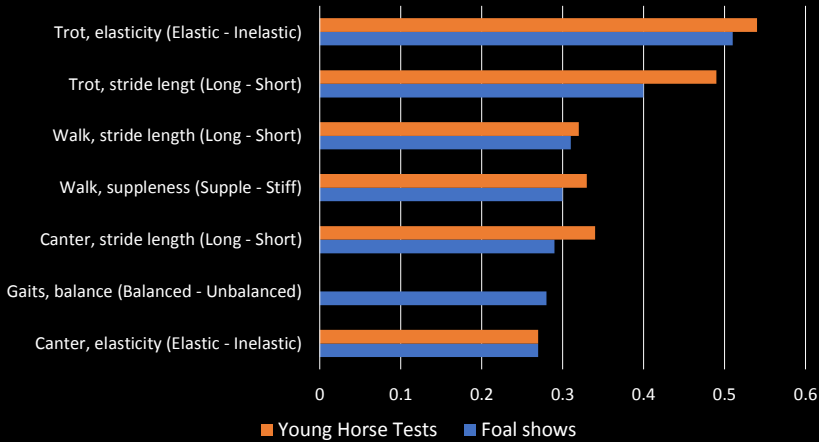
Heritabilities of linear traits


Conformation



Heritabilities of linear traits


Gaits






Genetic correlations linear traits

Between Linear traits and numeric score at foal shows





- Positive genetic correlation between conformation score and
 - Development, length of neck
- Positive genetic correlation between score for walk and
 - Length of strides, Suppleness, Balance gaits, toed in
- Positive genetic correlation between score for trot and
 - Length of strides, elasticity, balance gaits, refined type, longer neck, straight shoulder
- Positive genetic correlation between score for canter and
 - Length of strides, elasticity, balance gaits, development, sloping croup



Genetic correlations foal shows – YHT

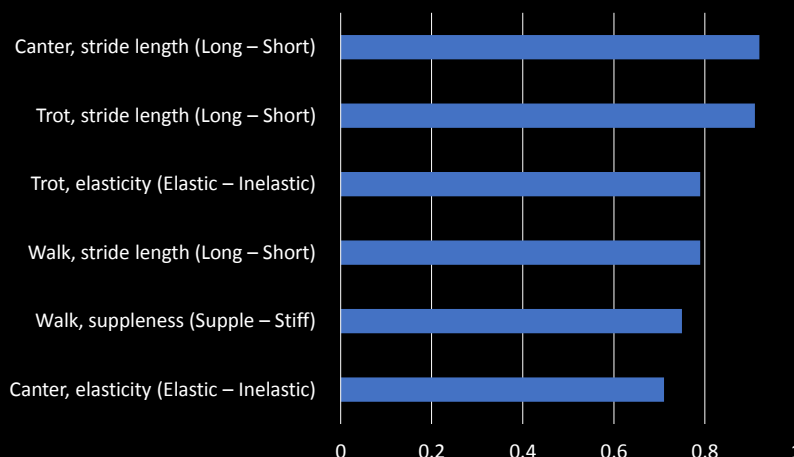
Conformation



Trait	Correlation
Type (Refined – Heavy)	0.9
Neck length (Long – Short)	0.85
Shape of croup (Sloping – Straight)	0.75
Forelegs (Toed in – Toed out)	0.75
Hind legs (Sickle – Straight)	0.75
Position of shoulder (Straight – Sloping)	0.6

Genetic correlations foal shows – YHT

Gaits



Summary - Conclusions



Summary

- Low to moderate heritabilities for linear traits
 - Similar to heritabilities for YHT linear traits
- Strong genetic correlations between linear traits assessed at foal shows and at YHT
- Medium to high heritabilities for evaluating traits

Conclusion

- Linear information from foal shows suitable for genetic evaluation
- Potentially useful in the GE of SWB to get an early prediction of stallions' inheritance for conformation and gaits



On-going activities Linear Description SWB



BVs including information on ridden horses. Data from:

- Young horse test for 4- and 5-year-old horses
- Performance test for stallions



Photos by Roland Thunholm



Genome-wide Association Study (GWAS) of Young Horse Test Traits in SWB Horses



Aim

To find genomic regions associated with conformation and performance traits in Swedish Warmblood (SWB)





Thanks to

Swedish University of Agricultural Sciences

MSc Katarina Karlsson

Dr Åsa Viklund

