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ESCOLA SUPERIOR AGRÁRIA

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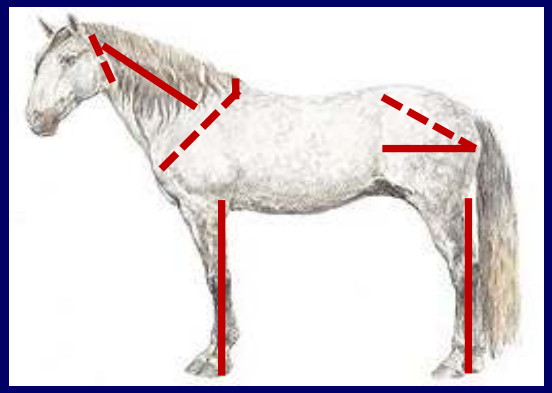
Linear profiling in Lusitano horses: genetic parameters and plans for further development

A. Vicente; M. Mateus; J. Ralão-Duarte & N. Carolino



7th International Workshop on Linear Profiling in the Warmblood Horse – Grebin / Plön GER
29-30/3/2023 António Andrade Vicente (apavicente@gmail.com)

Lusitano Horse

- Main equine native breed from Portugal
  - Others are Sorraia, Garrano and Terceira poneys;
- One of world's oldest saddle horses!
- Considered in ancient times, by Greeks and Romans as the world's best saddle horse
- Considered hotblooded horse
- Selected by the gineta combat
- Versatile, docile, agile, courageous

Lusitano Horse

- Historically very particular conditions, favorable to horse breeding, in southwest Europe:
  - Last glaciation of Würm without full effect
  - Continued contact with man husbandry

- Historical records with thousands of years confirming the presence in the Iberian Peninsula of a fine horse, light, agile, hot-blooded
  - with continuity lines, with fine head, long, dry, slightly convex, ...
- Always indicated as fast (“son of the wind")
- Skilled for superior riding and masterly fighting in the gineta type combat.

Cordeiro, 1989

Lusitano Horse

- Result of the selection of thousands years as an horse for fieldwork, hunting and fighting:
  - wars, cattle herding, fighting the gineta

- It is the archetype of the Baroque horse
  - very typical and harmonious model, endowed with extreme courage, but at the same time, docility and sociability
  - recognized long ago as one of the world's best saddle horses
- Combining good temper and mental with easy and light movements and ability to collect.

Distribution of the breed

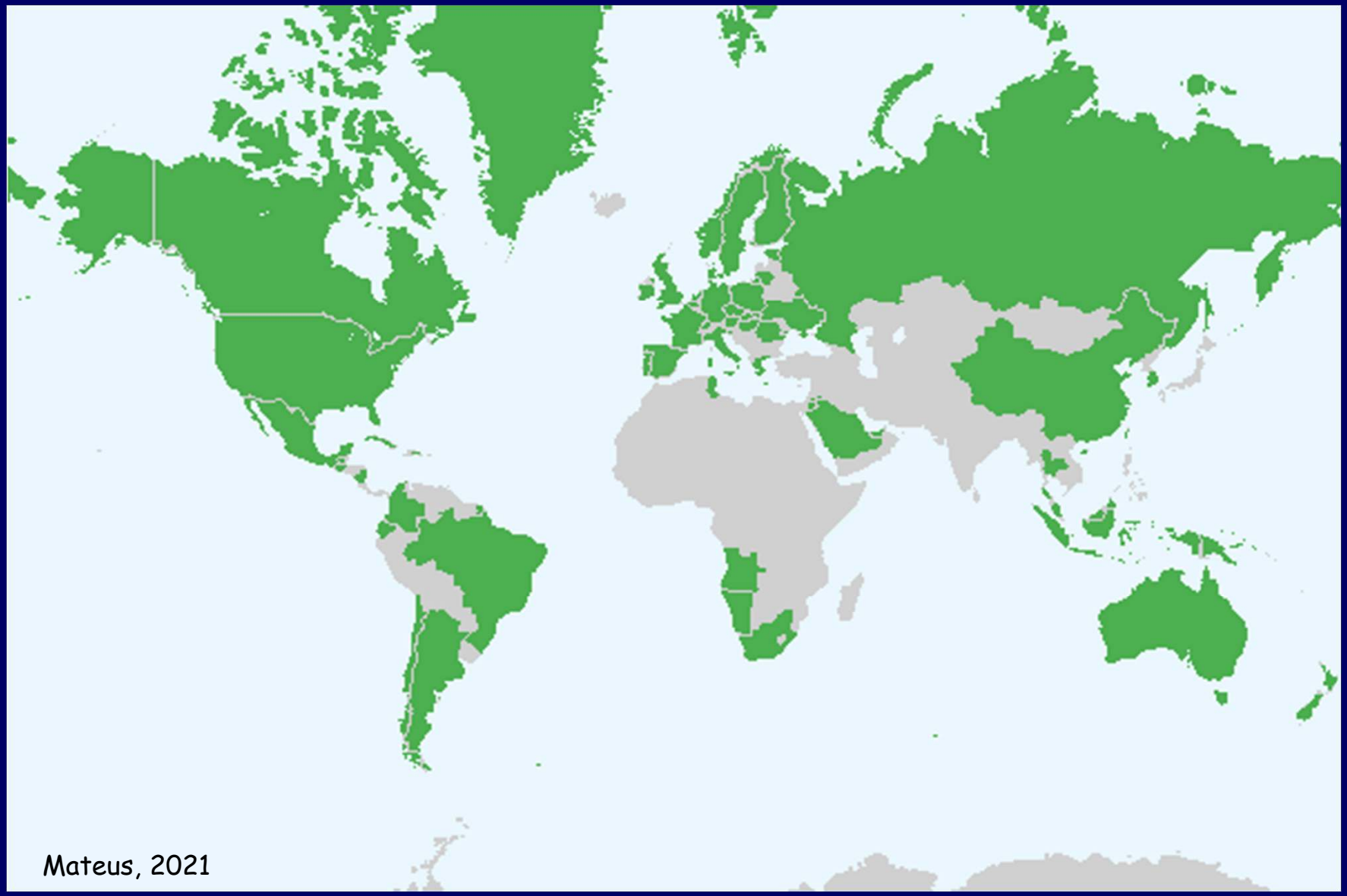
- Around 4000-4500 breeding mares all over the world, distributed by (APSL, 2022):
  - Portugal (2000-2400)
  - Brazil (750-900)
  - France (350-450)
  - Spain (300-400)
  - Remaining in several other countries (MEX, GER, ITA, ..)

- Breed considered endangered by FAO

(<5000 breeding ♀); < 3000 foals/year

- Main export and promotion product of rural areas from Portugal, alongside with wine, olive oil and cork;

Lusitano world dissemination



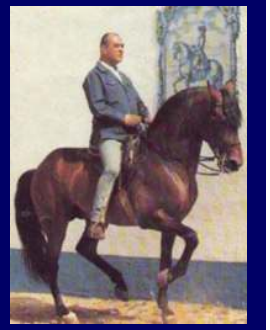
- Known presence of the Lusitano horse in 63 countries, with different owners (data up to 2020).

Functional skills of the Lusitano

- Outstanding versatility:
  - Bullfighting
  - Dressage
  - Carriage
  - Working Equitation
  - Portuguese Equitation
  - Showjumping
  - Horse-ball
  - Vaulting
  - Eventing
  - TREC
  - Equestrian art
  - Fieldwork
  - Cinema
  - Conformations comp.
  - Beauty comp. ....

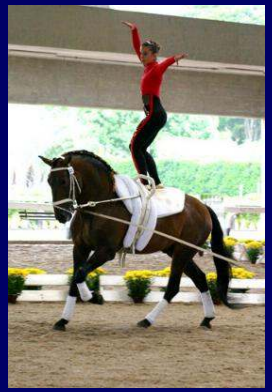










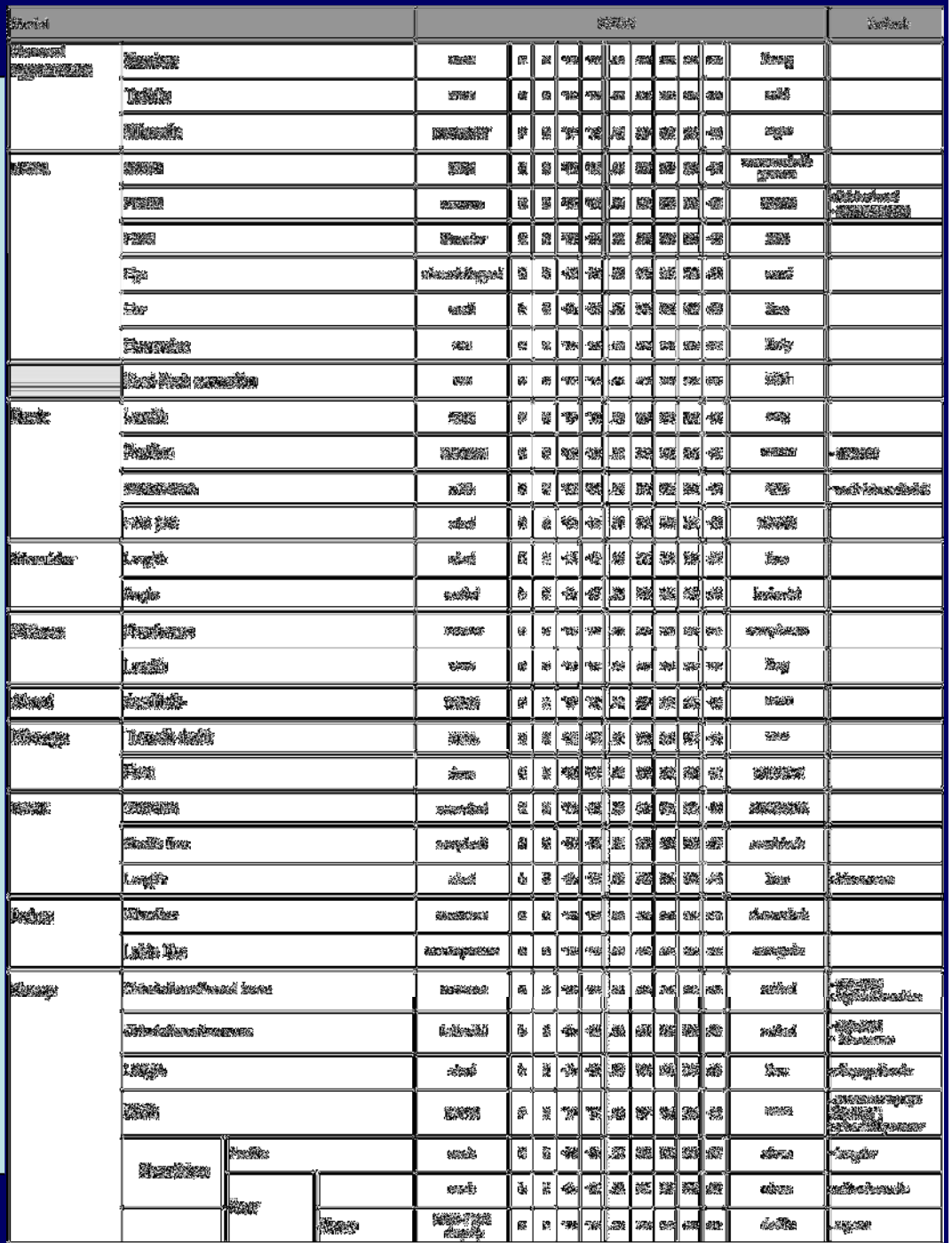

Linear Profiling

- Since 2017:

  Implementation of Linear Profiling in the Lusitano

Conformation profiling 0-40 scale (5 points interval)

Conformation



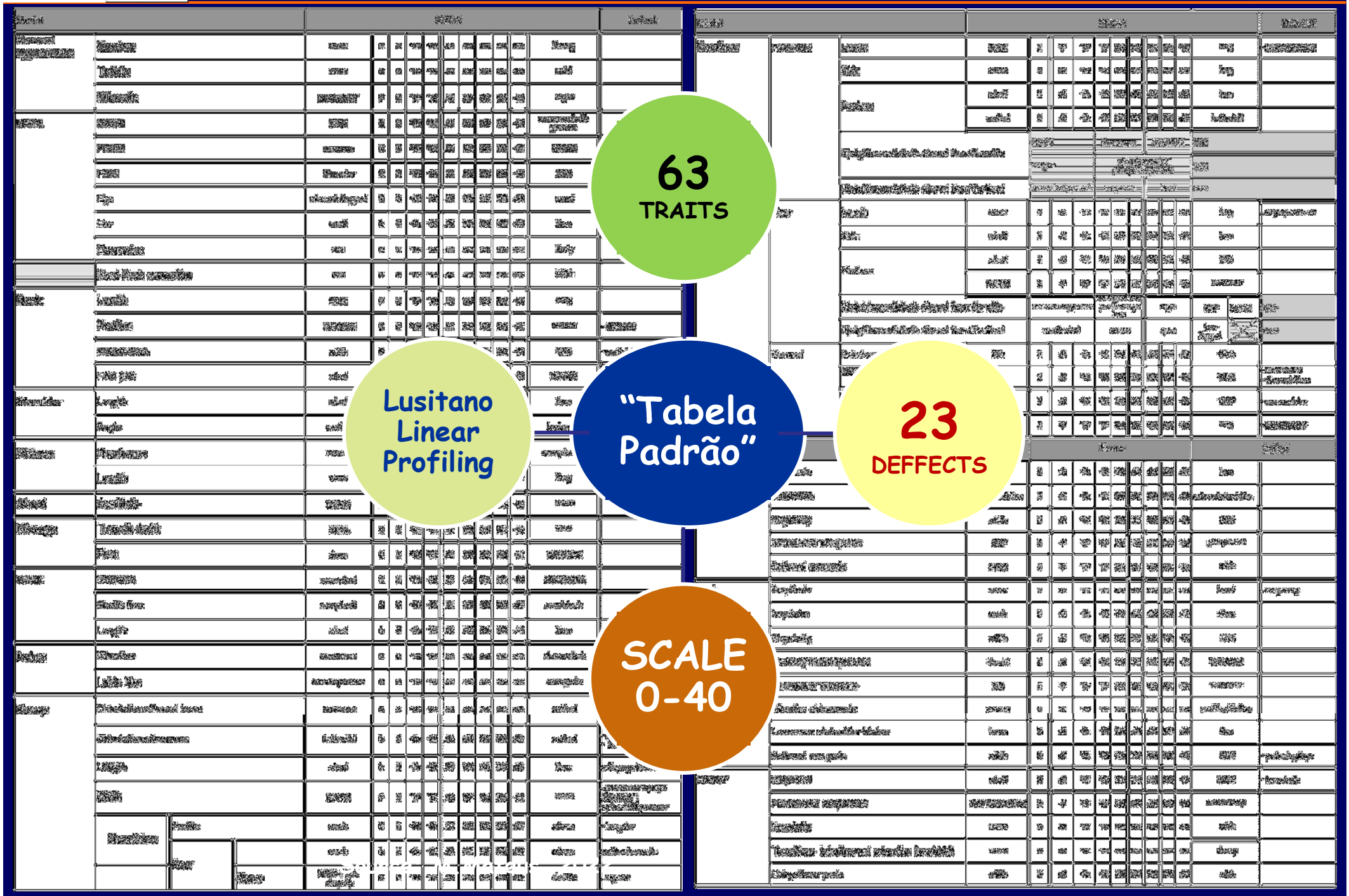
After several studies: recommendation to breeders association for more objective data

Linear Profiling in the Lusitano

Conformation profiling: LEGS

Gaits profiling: walk, trot, canter

Linear Profiling in the Lusitano



How it works in the Lusitano

- Collection of linear profiles since 2017:
  - With tablet directly to “R.campo” software from Ruralbit
  - Digital photo taken
  - When animals are being graded for Studbook approval
    - ✓ for males 3 judges in the grading and one for linear profiling. Mares only one judge

- Annual judges' meetings to homogenize scoring system
  - 23 judges worldwide (12 nat/11 int.)

Lusitano Linear Profile Example

Conformation

Modelo			Valor											Defeito
Aspecto Geral	Estrutura		ligeira	0	5	10	15	20	25	30	35	40	pesada	
	Tipicidade		pouca	0	5	10	15	20	25	30	35	40	muita	
	Silhueta		retangular	0	5	10	15	20	25	30	35	40	alta	
Cabeça	Boca		redonda	0	5	10	15	20	25	30	35	40	exageradamente em bico	
	Perfil		côncavo	0	5	10	15	20	25	30	35	40	convexo	-Fronte achatada -Perfil concavo
	Forma		triangular	0	5	10	15	20	25	30	35	40	comprida	
	Olho		rasgado	0	5	10	15	20	25	30	35	40	redondo	
	Orelha		curta	0	5	10	15	20	25	30	35	40	comprida	
	Expressão		apagada	0	5	10	15	20	25	30	35	40	viva	
	Ligação cabeça pescoço		fina	0	5	10	15	20	25	30	35	40	espessa	
Pescoço	Comprimento		curto	0	5	10	15	20	25	30	35	40	comprido	
	Posição		horizontal	0	5	10	15	20	25	30	35	40	vertical	-Golpe de machado
	Adiposidade		pouca	0	5	10	15	20	25	30	35	40	muita	-"Gato"
	Bordo ventral		côncavo	0	5	10	15	20	25	30	35	40	invertido	
Espádua	Comprimento		curto	0	5	10	15	20	25	30	35	40	comprido	
	Ângulo		vertical	0	5	10	15	20	25	30	35	40	horizontal	
Garrote	Proeminência		afogado	0	5	10	15	20	25	30	35	40	destacado	
	Comprimento		curto	0	5	10	15	20	25	30	35	40	longo	
Peitoral	Amplitude		estreita	0	5	10	15	20	25	30	35	40	larga	
Costado	Profundidade toráxica		pouca	0	5	10	15	20	25	30	35	40	muita	
	Forma do costado		estreito	0	5	10	15	20	25	30	35	40	cilíndrico	
Dorso	Orientação		ascendente	0	5	10	15	20	25	30	35	40	mergulhante	
	Linha do dorso		selada	0	5	10	15	20	25	30	35	40	encarpada	
	Comprimento		curto	0	5	10	15	20	25	30	35	40	comprido	-Sacro atrasado
Rim	Orientação		ascendente	0	5	10	15	20	25	30	35	40	mergulhante	
	Linha do rim		com depressão	0	5	10	15	20	25	30	35	40	encarpada	
Garupa	Orientação do coxal		horizontal	0	5	10	15	20	25	30	35	40	vertical	-Horizontal -Inserção da cauda alta
	Orientação do sacro		horizontal	0	5	10	15	20	25	30	35	40	vertical	-Horizontal -Saliência sacro-ilíaca atrasa
	Comprimento		curta	0	5	10	15	20	25	30	35	40	comprida	-Desproporcionada
	Largura		estreita	0	5	10	15	20	25	30	35	40	larga	-"De vaca" -Estreita piramidal
	Muscularidade	De perfil	fraca	0	5	10	15	20	25	30	35	40	forte	-Irregular
		Por trás	fraca	0	5	10	15	20	25	30	35	40	forte	-Sem calção
		Forma	em bico	0	5	10	15	20	25	30	35	40	dupla	-Quadrada

Gaits

Modelo				Valor										Defeito
Membros	Anteriores	Comprimento	curtos	0	5	10	15	20	25	30	35	40	compridos	Deproporcionados
		Canela	curta	0	5	10	15	20	25	30	35	40	comprida	
		Quartela	curta	0	5	10	15	20	25	30	35	40	comprida	
			vertical	0	5	10	15	20	25	30	35	40	horizontal	
		Defeitos do aprumo lateral		curvo			transcurvo			estacado			Nota:	
				cebruçado			desal. eixo Palat.						Nota:	
		Defeitos no aprumo visto de frente		joelho de boi			esquerdo			cravenho			Nota:	
	Posteriores	Comprimento	curtos	0	5	10	15	20	25	30	35	40	compridos	-Deproporcionados
		Canela	curta	0	5	10	15	20	25	30	35	40	comprida	
		Quartela	curta	0	5	10	15	20	25	30	35	40	comprida	
			vertical	0	5	10	15	20	25	30	35	40	horizontal	
		Defeitos do aprumo lateral		acurvilhado			desal. eixo Palat.						Nota:	
				direito			curvaças			espaçavão			Nota:	
		Defeitos no aprumo visto de trás		canejo	estreito		aberto		cambaio		zambro		Nota:	
	Genérico	Substância	finos	0	5	10	15	20	25	30	35	40	espessos	
		Definição das articulações	finas	0	5	10	15	20	25	30	35	40	espessas	-Estrangulamentos
		Amplitude dos cascos	estreitos	0	5	10	15	20	25	30	35	40	largos	-Assimetrias
		Comprimento dos talões	curtos	0	5	10	15	20	25	30	35	40	compridos	-Assimetrias

Andamentos			Valor											Defeito
Passo	Amplitude		curto	0	5	10	15	20	25	30	35	40	largo	
	Correção		desvia p/ dentro	0	5	10	15	20	25	30	35	40	desvia p/ fora	
	Regularidade		pouco	0	5	10	15	20	25	30	35	40	muito	
	Definição dos quatro tempos		lento	0	5	10	15	20	25	30	35	40	precipitado	
	Entrada dos posteriores		pouco	0	5	10	15	20	25	30	35	40	muito	
Trote	Amplitude		curto	0	5	10	15	20	25	30	35	40	largo	-Irregularidade
	Impulsão		fraca	0	5	10	15	20	25	30	35	40	poderosa	
	Regularidade		pouco	0	5	10	15	20	25	30	35	40	muito	
	Eslasticidade e suspensão		flácido	0	5	10	15	20	25	30	35	40	com tonus	
	Elevação dos anteriores		rasteiro	0	5	10	15	20	25	30	35	40	com "joelho"	
	Direção dos anteriores		tapa-se	0	5	10	15	20	25	30	35	40	certa	
	Liberdade de espáduas		tensas	0	5	10	15	20	25	30	35	40	livres	
	Estrada dos posteriores		pouco	0	5	10	15	20	25	30	35	40	muito	-Pernas fora da massa
Galope	Amplitude		curto	0	5	10	15	20	25	30	35	40	largo	-Irregularidade
	Posição e suspensão		em espáduas	0	5	10	15	20	25	30	35	40	para cima	
	Regularidade		pouco	0	5	10	15	20	25	30	35	40	muito	
	Transições (alargar-encurtar)		fracas	0	5	10	15	20	25	30	35	40	poderosas	
	Entrada dos posteriores		pouco	0	5	10	15	20	25	30	35	40	muito	

M&M – Linear Profiling analysis

Analysis model studied for the Lusitano

Linear Profiling

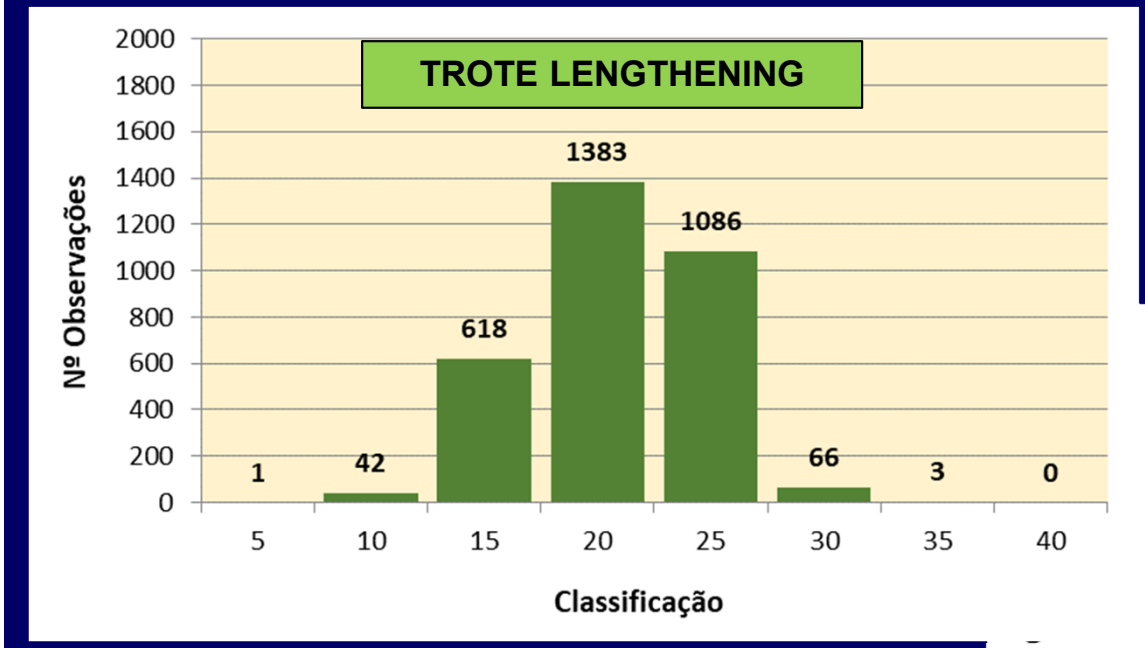
BLUP – Animal Model (REML)

- **Trait**
  - **Fixed effects**
    - Age (linear & quadratic)
    - Inbreeding (linear)
    - Year of evaluation
    - Gender/Presentation type
  - **Genetic effect**
  - **Error**

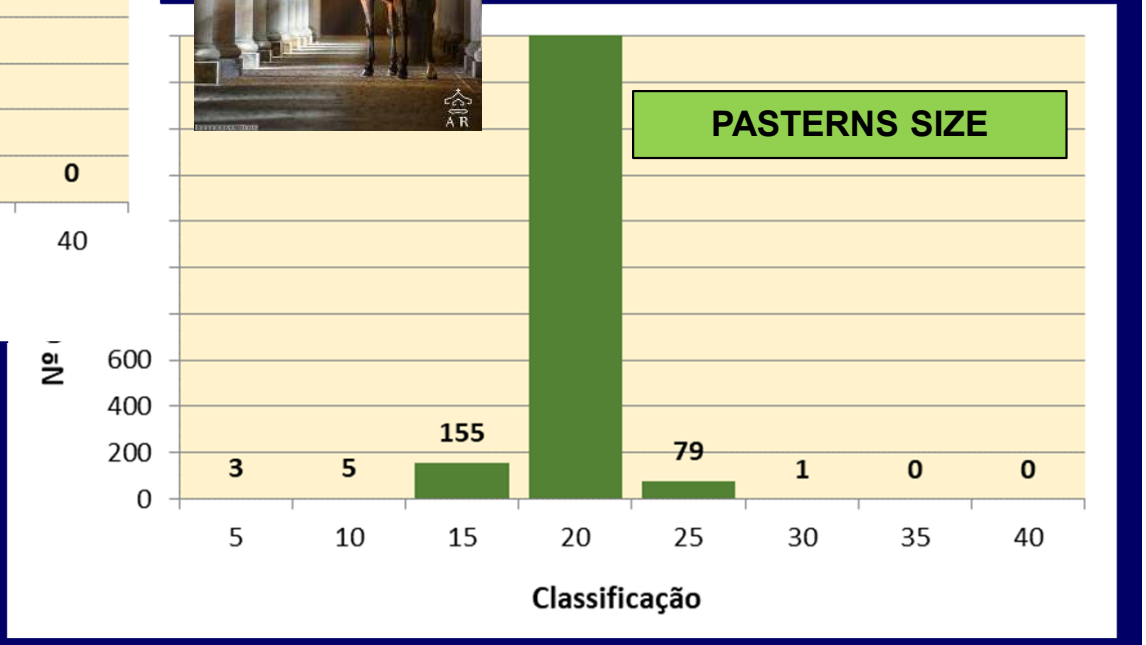
Mixed Model with single records

First results for the Lusitano

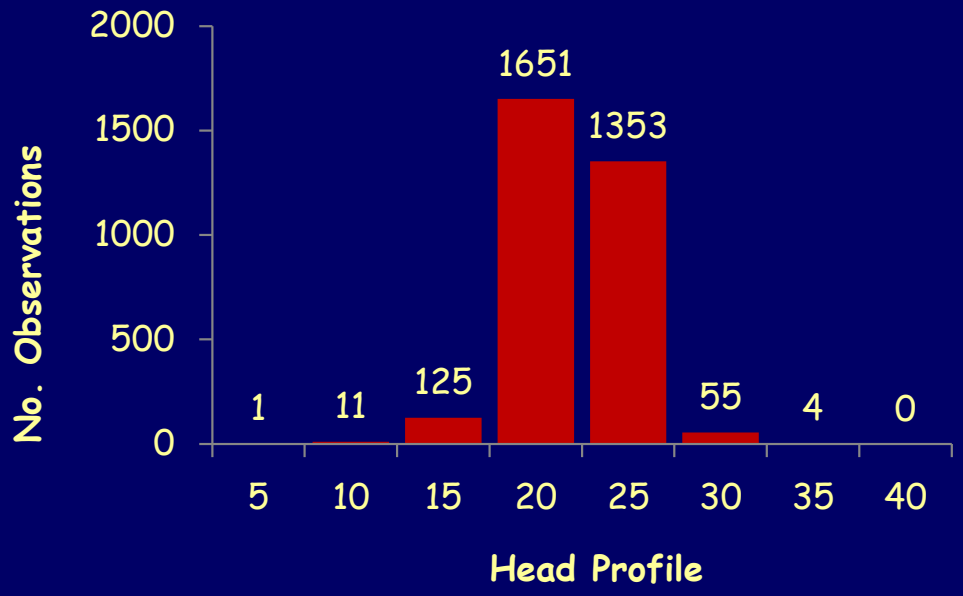
- 3200 evaluated animals - 2017 to 2021
  - 63 traits (0 a 40 pts; inter. 5pts) (in 2023 >5600 animals)
  - 23 descriptive defects; 63 judge's combinations

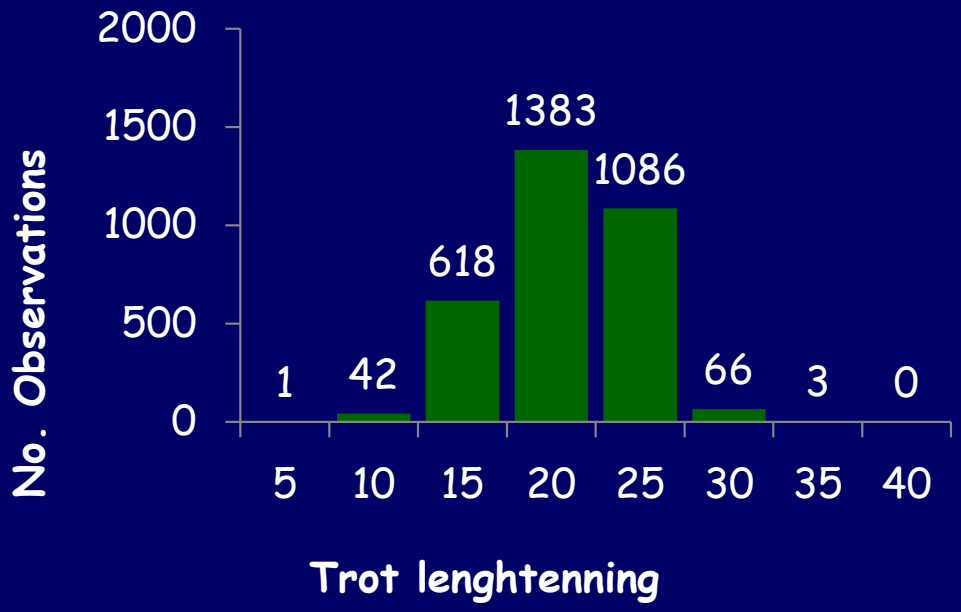


Since 2023 more than 5600 records to study



Examples of distribution of some traits

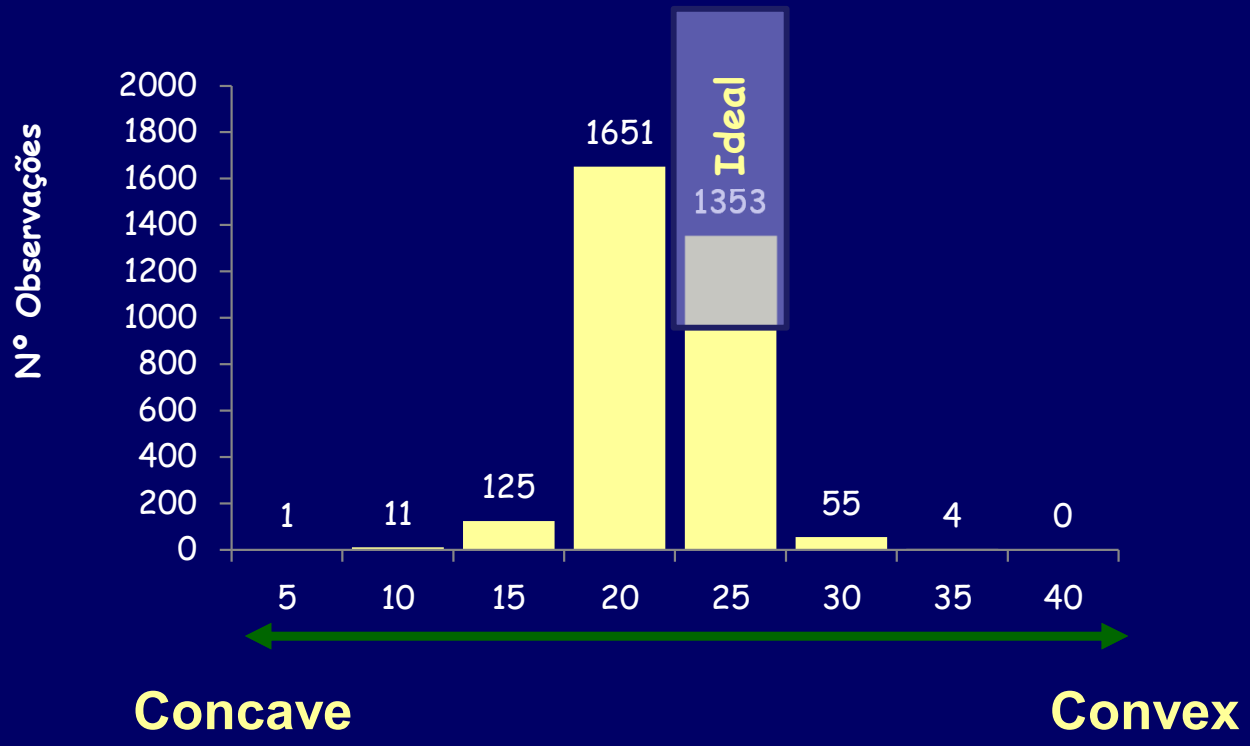




Source: M.Mateus, 2022

Optimum score?

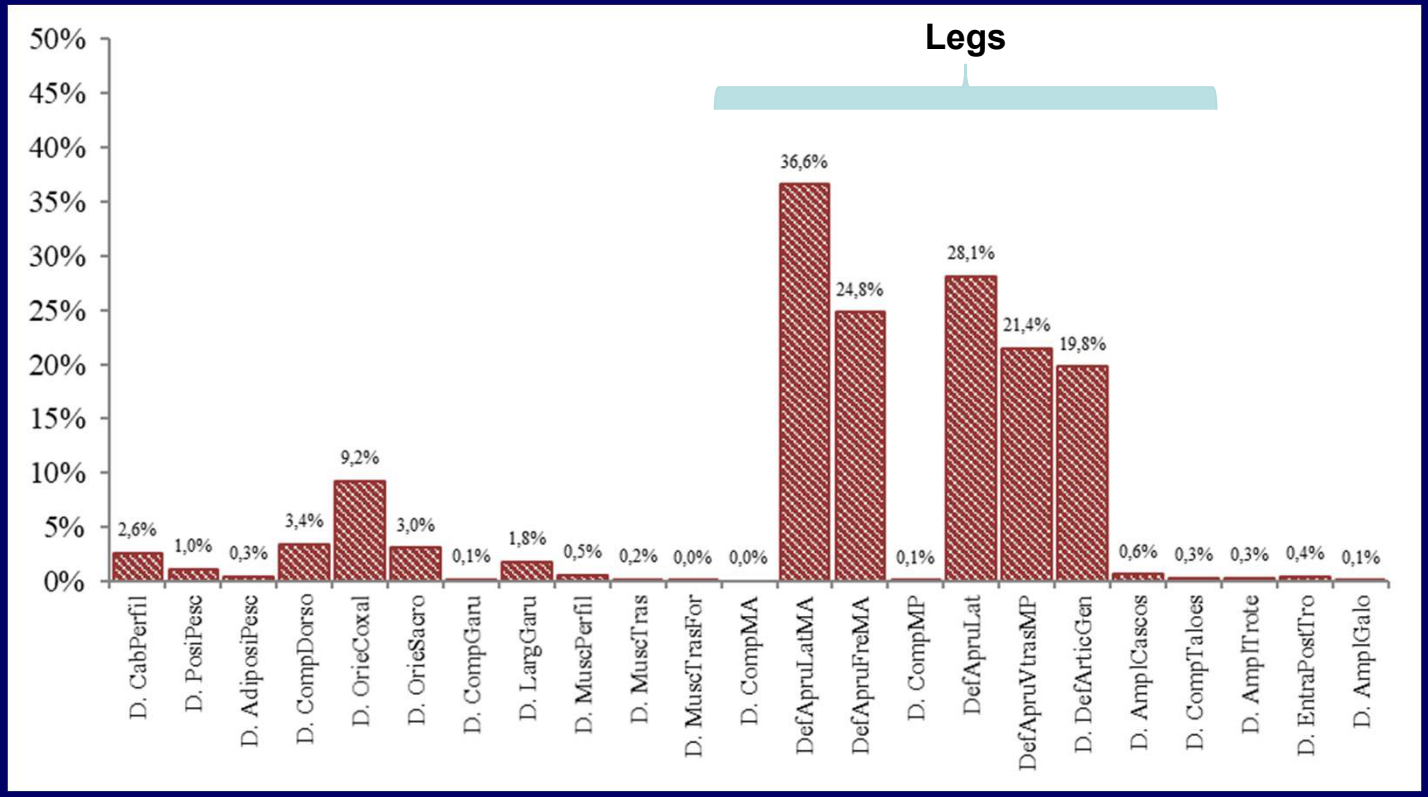
Not all traits have the ideal score of 20 pts, there are some traits where the ideal tends to one of the extremes…



Distribution of the score of the characteristic "Head Profile"

Source: M.Mateus, 2022

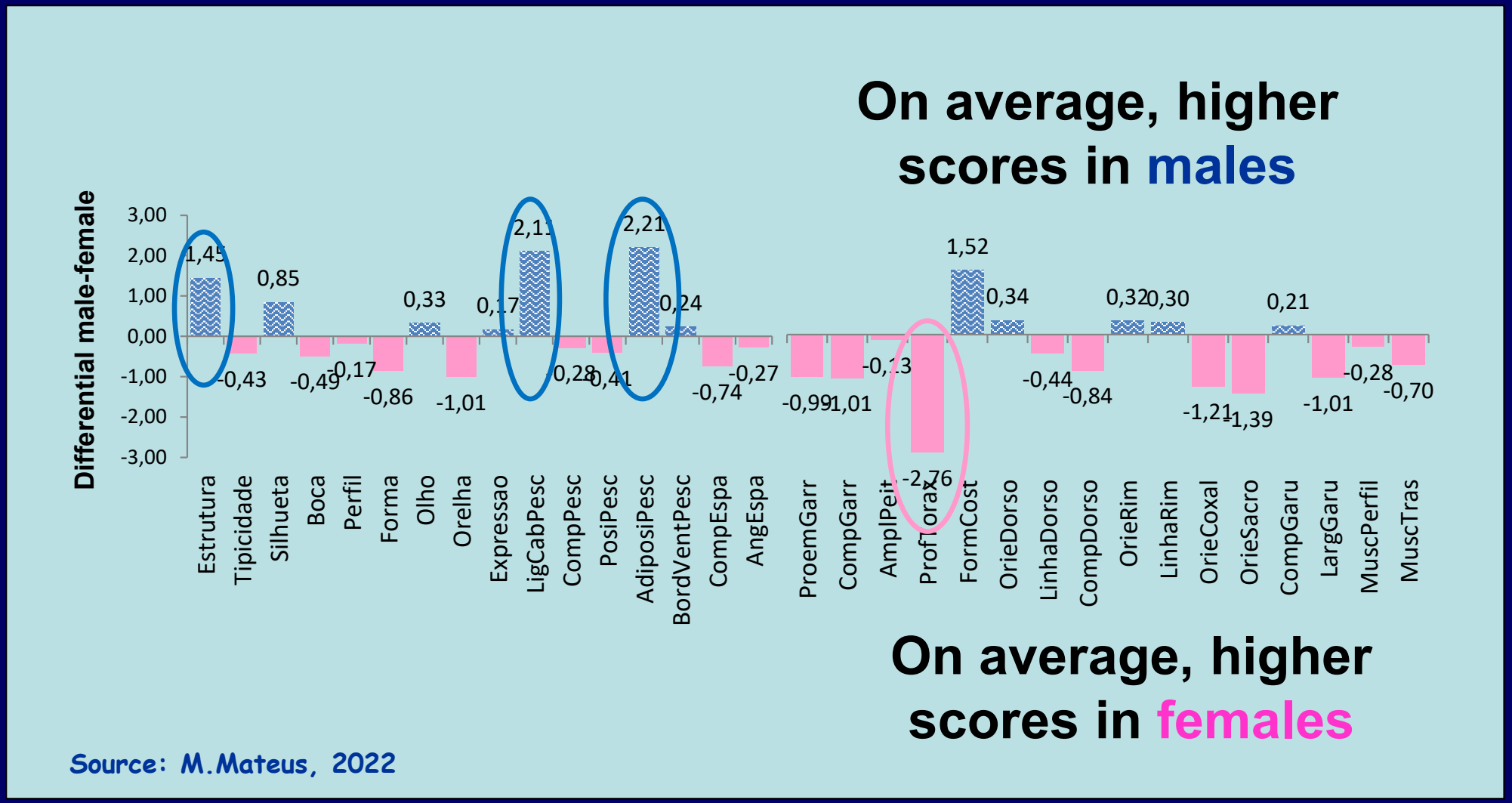
Incidence defects in the pop evaluated



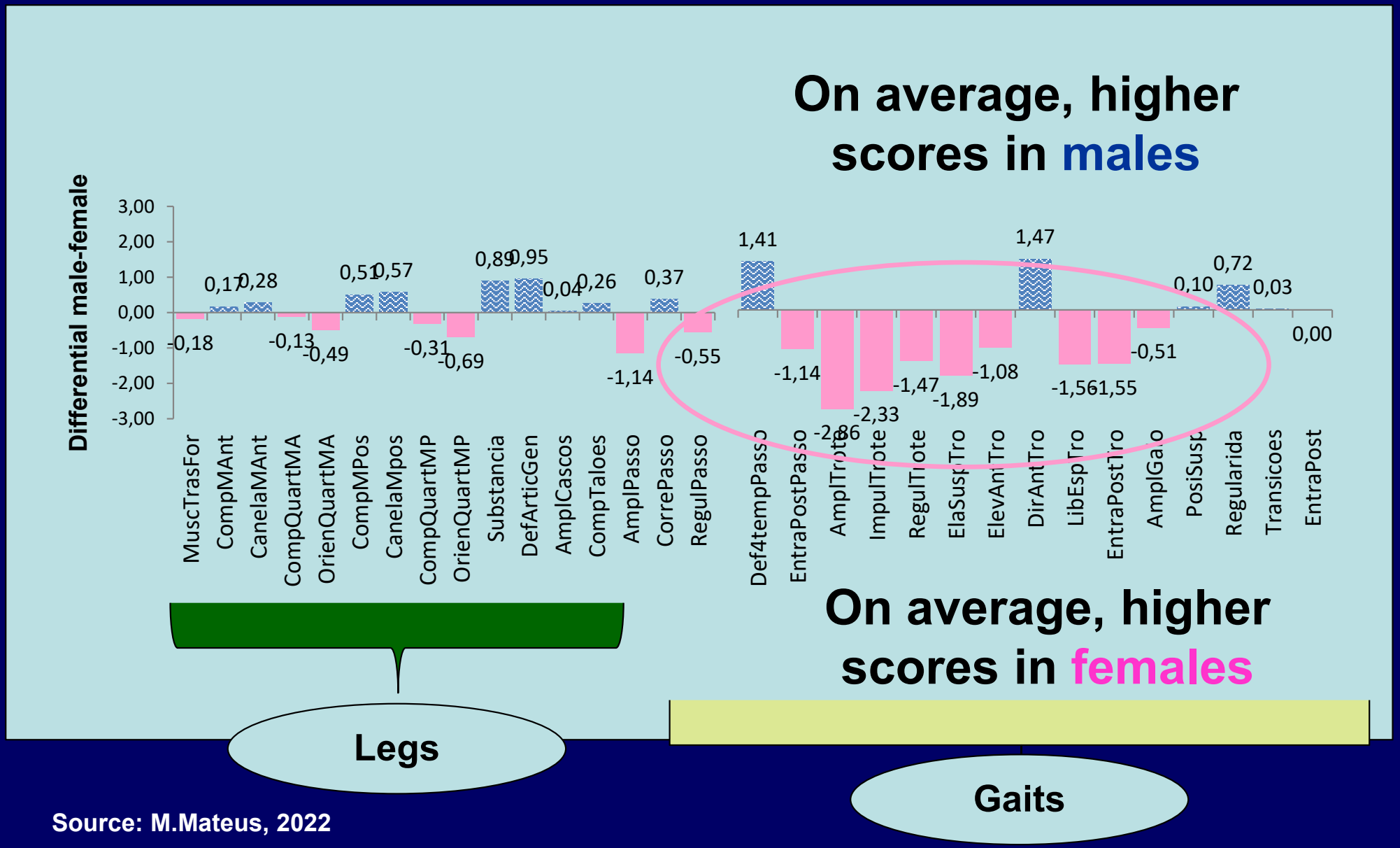
Source: M.Mateus, 2022

- Hip orientation angle defect: 9.2%
- In the limbs, the defects of the leg stances: 21.4% to 36.6% of the animals
- Defect of limb joints (strangulations): 19.8%

Gender Effect (males vs females)



Gender Effect (males vs females)



Source: M.Mateus, 2022

Average Heritabilities (h^2)

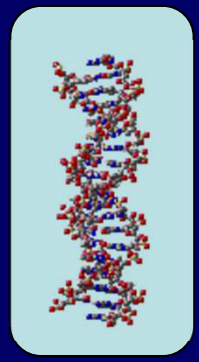
- Linear traits studied have a **low to moderate** heritability.
- There are characteristics with **moderate higher heritabilities** (0.301-0.453), as is the case of characters associated with **gaits**.
- There are also traits associated with **conformation** with **moderate** heritabilities.
- Very **low** heritabilities for linear features related to conformation, namely in the **limbs**.

Trait		n	Average (h^2)	min-máx (h^2)
Model				
Type		3	0,275	0,086 - **0,399**
Head		7	0,248	0,095 - **0,393**
Neck		4	0,225	0,156 - 0,301
Shoulder		2	0,249	0,201 - 0,297
Withers		2	0,265	0,253 - 0,277
Chest		1	0,235	0,235
Ribcage		2	0,168	0,111 - 0,224
Back		3	0,129	0,101 - 0,147
Loin		2	0,119	0,113 - 0,124
Croup		7	0,192	0,096 - **0,310**
Legs	Front	4	0,110	0,009 - 0,195
	Hind	4	0,095	0,000 - 0,189
	Generic	4	0,155	0,105 - 0,174
Gaits				
Walk		5	0,182	0,057 - 0,272
Trot		8	**0,355**	0,181 - **0,453**
Canter		5	**0,302**	0,253 - **0,343**

Source: M.Mateus, 2022

Classical gradings h^2 & σ_A

TRAIT		h^2±SE	σ_A
Height Withers		**0.61±0.015**	2.98 cms
Total Score	Coef.	0.18±0.015	1.78 pts
Head and Neck	1	**0.18±0.015**	0.32 pts
Shoulder & Withers	1	0.13±0.014	0.22 pts
Chest & Ribcage	1	0.12±0.014	*0.21 pts*
Back & Loins	1.5	0.15±0.015	0.40 pts
Croup	1	0.14±0.014	0.26 pts
Legs	1.5	*0.07±0.012*	0.24 pts
Overall Impression	1.5	0.14±0.014	0.36 pts
Gaits	1.5	0.16±0.015	**0.42 pts**



Lusitano selection strategy

- Routine genetic evaluation (2022) for:
  - Morphology and gaits – scores from breeders' approval grid
  - Linear Evaluation – for chosen traits

- Sporadic genetic evaluation:
  - Functionality in Dressage, Working Equitation and Model and Movements competitions
- Missing: genomics and phenomics

Plans for the future

- Selection and genetic improvement in horses with greater complexity
  - Need to collect more objective data!

- Breeders' guidance with selective matings
  - Using information from linear profiling
- Refine models of analysis in use
  - Alternatives?

- Estimation of genetic correlations
  - Between linear data and results from breeders gradings and functional traits (Dressage, Working Equitation)

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Lusitano Linear Profiling

7th International Workshop on Linear Profiling in the Warmblood Horse on 29th - 30th March 2023 in Grebin / Plön, Germany

with focus on practical linear description of gaits in horses of different age and on technologies which could supplement linear profiling applications for sport horses

– FINAL PROGRAM –

Wednesday, 29th March 2023
(theoretical part at Festscheune Rixdorf close to Plön, practical part at Gut Schönweide, Grebin)

10:00 - 10:30	Registration; coffee and refreshments at Festscheune Rixdorf
10:30 - 10:45	Welcome and introduction to the 7h International Workshop on Linear Profiling in the Warmblood Horse (IWSLP)
10:45 - 12:00	**Theory session I: presentations preparing for the practical part ('warm-up')**
10:45 - 11:05	*K. F. Stock (Germany) / EAAP HC, WBFSH:* Lessons learned from working with linear data – how to let the equine community benefit from collaborative initiatives
11:10 - 11:30	*A. Gmel (Switzerland) and M. Ablondi (Italy):* Using sensor technology to quantify gait quality – what to consider and how to organize measurements in the field
11:35 - 11:55	*I. Workel and P. Eitenmüller (Germany):* Linear description in the Oldenburg studbooks – overview and introduction of the routine collection of linear data
12:00 - 13:00	Lunch at Festscheune Rixdorf
13:30 - 18:00	**Practical exercises on linear description**, supplemented by practical demonstration of sensor technology for gait analysis in horses, at Gut Schönweide, Grebin, followed by a guided stud tour
13:30 - 15:45	Practical exercises part I (linear description / 4 groups)
15:45 - 16:15	Coffee break
16:15 - 17:15	Practical exercises part II (sensor technology / 2 systems)
17:15 - 18:00	Guided stud tour
18:00 - 19:00	Time to check in at accommodation
19:30	Conference dinner (optional) at restaurant 'Prinzenhuus' in Plön

Thursday 30th March 2023 (Festscheune Rixdorf close to Plön)

08:30 - 09:45	**Theory session II: linear description in sport horse breeding**
08:30 - 08:50	*L. Chapard, I. Meurrens, N. Buys, S. Janssens (Belgium):* Early life jumping traits and their genetic correlations with later success in competitions in Belgian Warmblood horses
08:55 - 09:15	*S. Bonow, S. Eriksson, E. Strandberg, E. Thorén Hellsten, Å. Gelinder Viklund (Sweden):* Linearly scored traits associated with sport performance in Swedish warmblood horses
09:20 - 09:40	*K. F. Stock, M. Wobbe, H. Alkhoder, I. Workel, A. Hahn, W. Schulze-Schleppinghoff (Germany):* Genetic and genomic correlation analyses of linear traits and their implications for targeted support of sport horse breeding

09:45 - 10:00 Coffee and refreshment

10:00 - 11:35 **Theory session III: developments in using linear data and more in horse breeding and population management**

10:00 - 10:20 *A. Vicente, M. Mateus, J. Ralão-Duarte, N. Carolino (Portugal):*
Linear profiling in Lusitano horses: genetic parameters and plans for further development

10:25 - 10:45 *V. Asti, M. Ablondi (Italy):* Objective movement assessment in horses: first results from using sensor technology in Italian horses

10:50 - 11:10 *A. Gmel et al. (Switzerland):* Shape and gaits 2.0: four seasons of objectively measuring young Swiss horses in the field

11:15 - 11:35 *A. Ricard, P. Pourcelot, B. Dumont Saint Priest, N. Crevier-Denoix, S. Danvy (France):*
Use of automatically collected data on horses in France: 3D morphology breeding values of stallions

11:40 - 11:45 Short break

11:45 - 12:45 **Summary and wrap-up: considerations for the future**

11:45 - 11:55 *W. Conlon (Ireland), I. Madsen (Denmark) / IYB:*
Linear description in education and training – potential and challenges

12:00 - 12:15 *K. F. Stock (Germany) / EAAP HC, WBFSH:*
Summary of the practical exercises and key points from the presentations

12:15 - 12:45 *all speakers and audience:*
General discussion; further plans for the IWSLP event series and activities around linear profiling

12:45 - 13:45 Lunch

How to get to the workshop venue?
The 7th IWSLP is held at **Festscheune Rixdorf** (Gut Rixdorf; http://www.festscheune-rixdorf.de/). From Plön city centre it takes about 10 minutes by car to get there. The larger number of workshop participants travelling by their own cars or having rental cars should allow that those without cars can be picked up. Coordination of transfers (airport to Plön, Plön to conference venue and stud) is ongoing.
Street address: Alte Schmiede Rixdorf, 24306 Rixdorf
The practical part is organized at the nearby stud **Gut Schönweide** (https://www.schoenweide.de), and we are very grateful that we will be welcomed in these beautiful surroundings. From the venue, it is approximately 10 km by car, and again, nobody needs to be worried about how to get there. We will be enough people with cars, implying that there will be someone who can give you a ride.
Street address: Gut Schönweide, 24329 Grebin
The conference diner (optional) will give the opportunity to continue the talks in relaxed atmosphere. It will be at the restaurant 'Prinzenhuus' in Plön. Please be prepared to pay by your own; diner is not included in the conference fee. Street address: Markt 14, 24306 Plön

Conference fee
Invoices have been issued using the billing address entered in the registration form. Payment is possible either cash (not by card!) at the registration desk on 29 March 2023 or online via Paypal (to: iwslp.eaaphc@email.de; indication of event title 'IWSLP2023' plus first name and surname of the registrant or of all registrants paid for). Receipts will be sent by e-mail and handed over on-site.

If you have any questions concerning the workshop, please do not hesitate to contact the organization team of the 7th IWSLP, reached through the representative of the EAAP Horse Commission, Kathrin F. Stock (E-mail: friederike.katharina.stock@vit.de; phone: +49 4231 955623).