Session 19 – Horse genetics-behaviour traits

GENETICS OF BRACHYGNATHISM IN PERUVIAN PASO HORSE

Roberto Mantovani, Linda Giosmin, Enrico Sturaro, Alessio Cecchinato, and Luis Robin Wong Ponce(*)

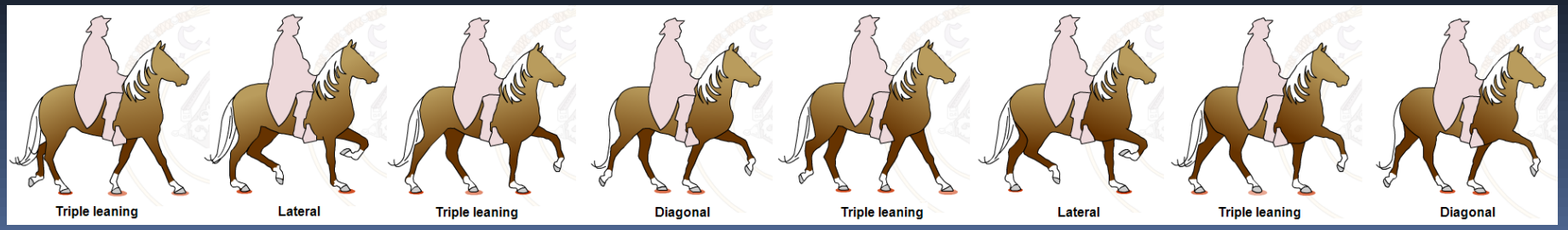
Department of Animal Science, University of Padova – Italy

(*)Registro Genealógico – Asociacion Nacional de Criadores y Proprietarios de Caballo Peruano de Paso (ANCPCPP) – Lima – Perù

roberto.mantovani@unipd.it

THE PERUVIAN PASO HORSE

- Light pleasure saddle horse known for its smooth ride
- National "horse" of Peru
- Originated from Spanish Jennet and Andalusian (but also Barb)
- Introduced in South America during the Spanish Conquest (i.e., after the arrival of Pizarro in 1531)
- Horse breed developed to travel long distances and oversee the vast sugar and cotton plantations of Peru
- Natural ambling four beat gait between the walk and the canter called "paso llano"
- It is a lateral gait with 4 equal beats (8 movements) performed laterally (termino) and diagonally



MAIN DEFECTS

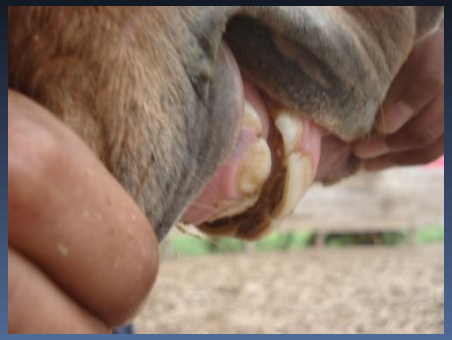
Two main defects have been observed to increase in frequency over years in the Peruvian Paso horse:

- Fallen crest (Cuello volteado)

  Crest that fall to one side

- Brachygnathism

  Also called Parrot Mouth, it refers to uneven alignment of the upper and lower teeth due to a maxillary or mandibular protrusion



AIM OF THE STUDY

1. Develop an evaluation chart for different grade of brachygnathism
2. Analyze the prevalence of brachygnathism and of different grades of such defect
3. Investigate genetic variation of the defect

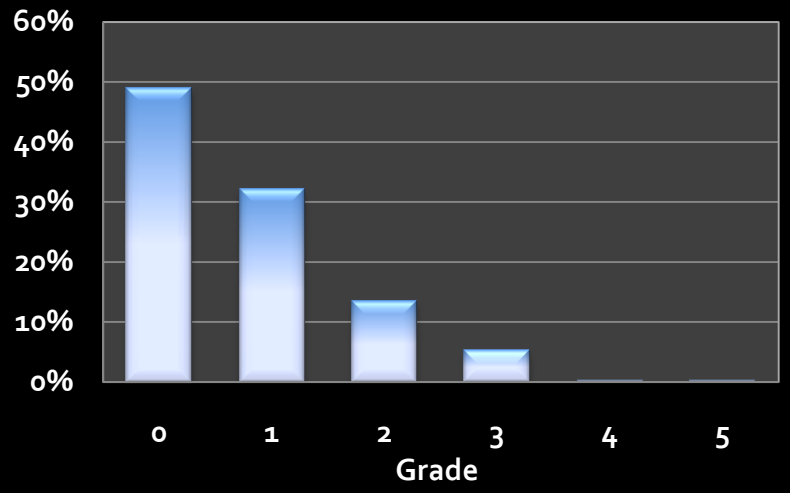
EVALUATION FORM FOR DIFFERENT GRADE OF "MOUTH CLOSING"

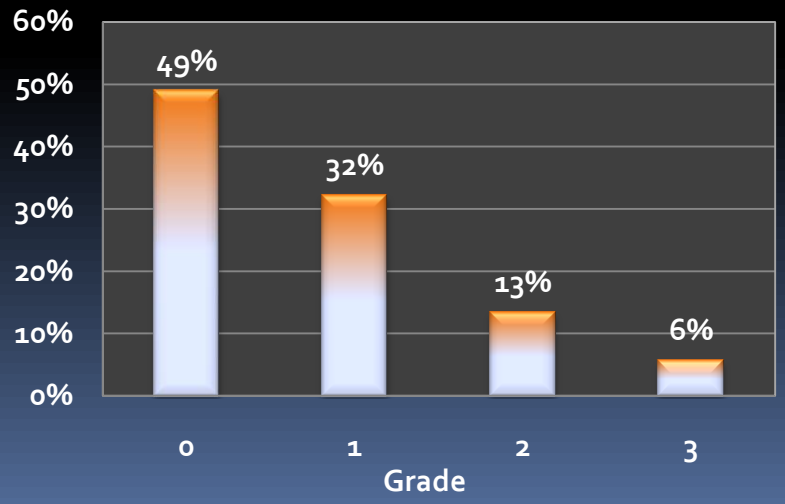
DATA COLLECTION

- 495 horses evaluated individually for grade of "mouth closing"
  - 169 stallions
  - 326 mares
- Collection of individual genealogical information from the web site of the national breeders association (ANCPCPP)
- 34 studs around Lima area
- 9 different geographical districts

DATA ANALYSIS – STEP 1

Frequency of different grades of brachygnathism



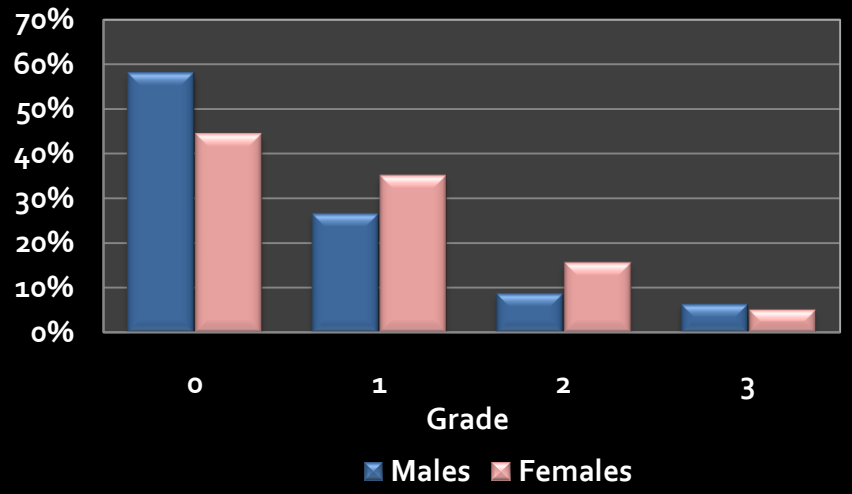


DATA ANALYSIS – STEP 2

χ^2 analysis aimed to investigate possible source of variation

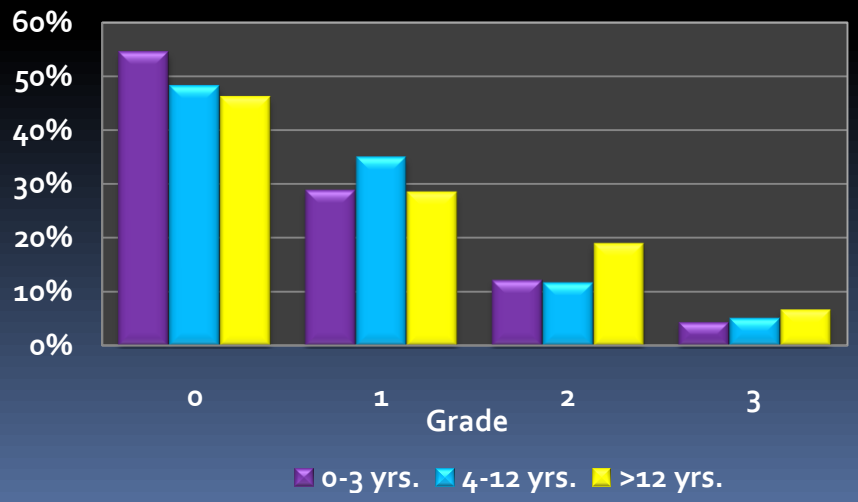
SEX Effect

P for χ^2 = 0.012 *



AGE CLASS Effect

P for χ^2 = 0.569 n.s.



GENETIC ANALYSIS

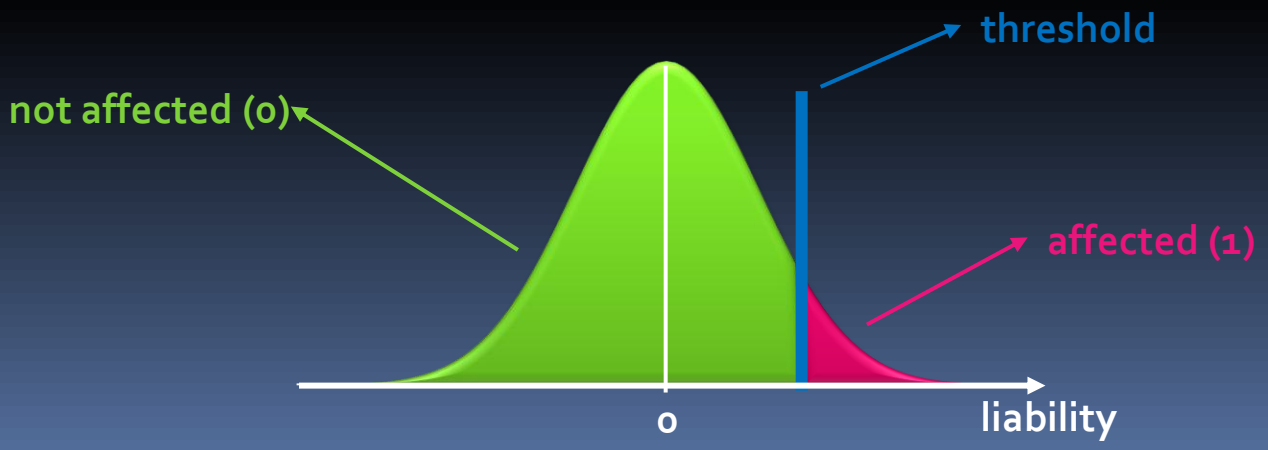
- **Gaussian Linear model (LM)**

  Two different response variable:

  - LM1: brachygnathism classified into four categories (grade 0 as absence, 1 as moderate, 2 as mild and 3, 4 and 5 as severe defects)
  - LM2: brachygnathism classified into two categories (not affected, grade 0 and 1 or affected, grade 2-5)

- **Threshold Model (TM)**

  Dichotomous classification as in LM2 (brachygnathism 0 or 1)



MODELS

Effects accounted in all models:

- Fixed effect of sex (2 levels: male or female)
- Effect of District (9 levels) alternatively considered as fixed or random
- Additive genetic effect of animals (1,314 levels) in both LM1 and LM2
- Additive genetic effect of sires (85 levels) in TM

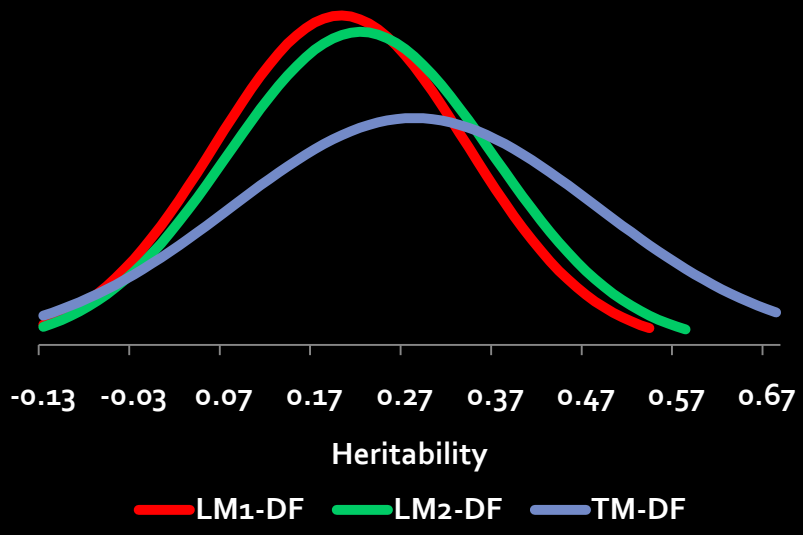
Bayesian implementation

- Gibbs sampling technique
- Flat priors used for fixed effects and variance components
- Unique Gibbs sampler chain with a length of 480,000 point, discarding the first 30,000 as burn-in and carrying out statistics on 3,000 samples (one every 150 interval point)

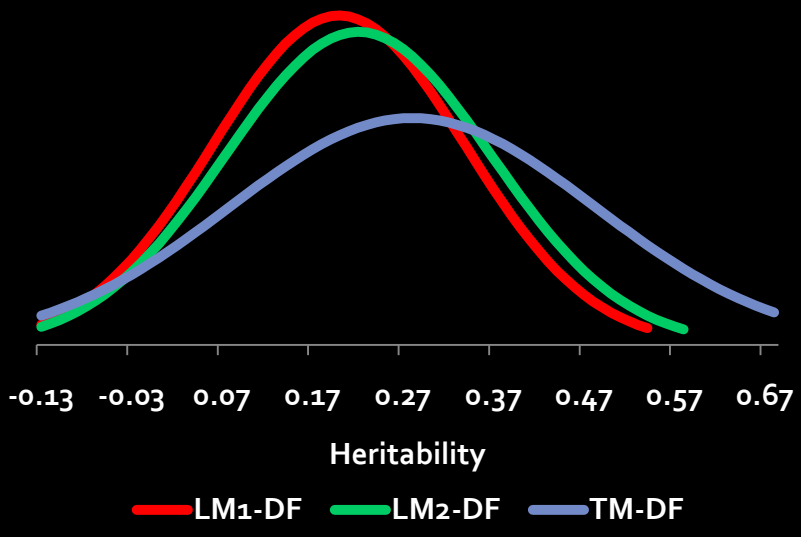
GENETIC ANALYSIS

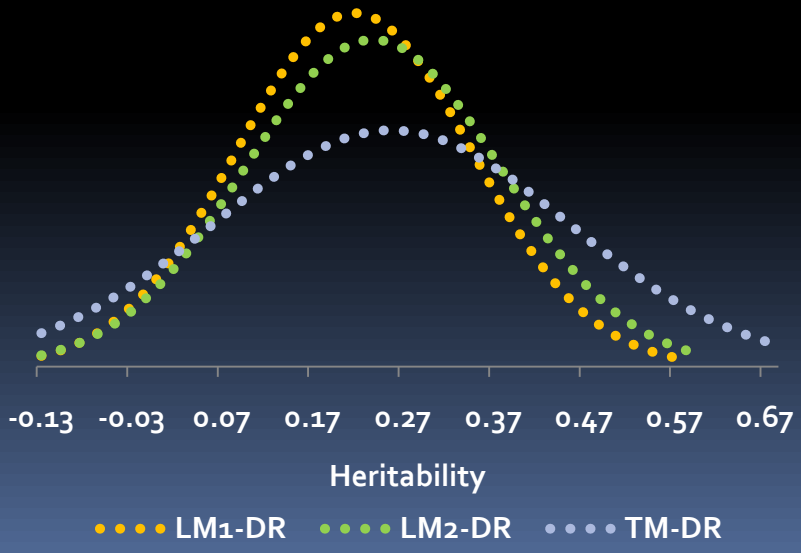
ITEM	Linear Model 1 (4 Grades) & District effect		Linear Model 2 (2 Grades) & District effect		Threshold Model (2 Grades) & District effect	
	Fixed	Random	Fixed	Random	Fixed	District
Variance:						
- Genetic	0.143	0.166	0.031	0.035	0.066	0.066
- Environmental	-	0.023	-	0.004	-	0.091
- Residual	0.634	0.611	0.119	0.115	1.021	1.015
Heritability						
- Median	0.183	0.203	0.210	0.221	0.246	0.215
- s.d.	0.140	0.131	0.147	0.142	0.203	0.196
Prob. for h^2>0.10	0.761	0.812	0.794	0.832	0.813	0.788
h^2 with Prob.>90%	0.020	0.048	0.032	0.055	0.020	0.006

HERITABILITY POSTERIOR DENSITY



HERITABILITY POSTERIOR DENSITY





CONCLUSION

1. The scale of the evaluation chart for different grades of brachygnathism can be reduced
2. The brachygnathism in the Peruvian Paso horse seems diffused in a significant part of the population (19%)
   - 6% of animals present severe form of defect
   - Female have greater incidence
3. Additive genetic variation of brachygnathism seems large enough in Peruvian Paso to be exploited in breeding programs

Bred for brachygnathism