Development and Implementation of Pulmonary Arterial Pressure EPD

Scott Speidel
Department of Animal Sciences
Colorado State University

Two Types of Animals w/ Predictions

ID	EPD	PAP (mmHg)
1	-1.3	37
2	-1.3	40
3	-1.3	43
4	-1.3	46
5	-0.1	36
6	-0.1	38
7	-0.1	49
8	-0.1	52

Similar EPD, Different PAP

ID	EPD	PAP (mmHg)
1	-3.5	36
2	-3.1	36
3	-0.5	36
4	-0.1	36
5	-1.9	43
6	-1.8	43
7	1.6	43
8	1.7	43

Similar PAP, Different EPD

Pulmonary Arterial Pressure

- Two options for use in a selection program:
- Phenotype
  - Historically this is what has been done
- Genetic Prediction
  - Relatively recent innovation → Breed wide
- What should be used for selection decisions?

Why do animals perform the way they do?

Why should we select animals on the basis of their EPD and not phenotype.

The Genetic Model

A mathematical representation of phenotype.

Quantifying Phenotype

$$P = \mu + BV + E$$

- Phenotype = Mean + Genetics + Environment
  - P = Performance of an individual animal for a trait
  - μ = The average phenotypic value for all animals in the population
  - BV = Breeding value of the individual for a given trait
  - E = Environmental effect on the individual's performance.

Quantifying Phenotype – In terms of Genetic Evaluation

$$P = \mu + BV$$

Heritability quantifies the relationship between BV and Phenotype

$$P = \mu + BV + E$$

$$h^2 = \frac{\sigma^2_{BV}}{\sigma^2_P} = 0.34 \sim 0.46$$

- We know there is variability in performance.
- We know individuals are not genetically identical
  - (therefore we have variability in breeding value)

54% to 66% of the differences observed in PAP score are due to environmental influences.

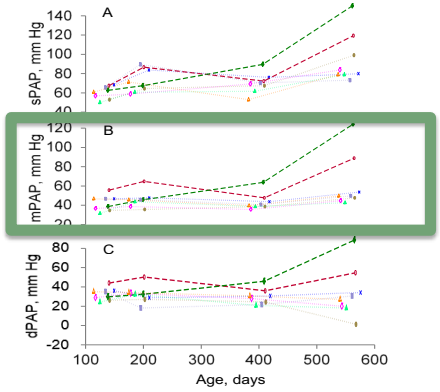
Non-Genetic Influences on PAP Score

Non-Genetic Influences on PAP

- Age ~ 18 months ideal
- Contemporary Group
- Body Condition
  - Fat thickness
- Elevation
  - PAP increases ~ 1 to 1.5 mmHG / 1000 feet
  - ~33% of individuals will increase more
- Hybrid Vigor
- Parasite load
- Ration
  - % Concentrate
  - Ionophores
- Respiratory Disease
  - Any lung damage
- Sex
- Technician
- Weather

Age influence on PAP

- Regression of PAP Score on age → 0.031mmHg



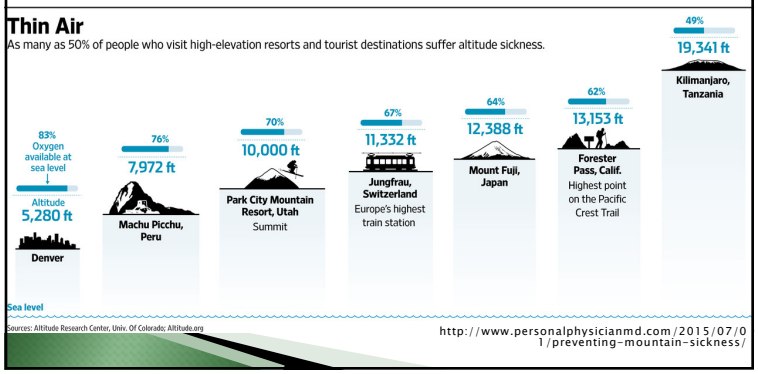
Neary et al., 2015

Contemporary Group

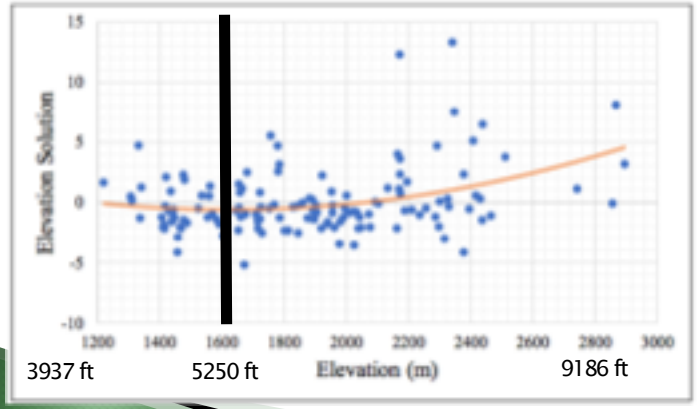
- Current Genetic Evaluation methodology compares individuals within a contemporary group
- Defined
  - Yearling management, Yearling Date, PAP date, Elevation, Ranch, Disease Status, etc.
- Range of around 33.46 mmHg
- Range of PAP observations
  - 31 mmHg to 149 mmHg

Elevation

- Genetic or Environmental influence?



Elevation and its relationship with PAP



Genetic Relationship

- Moderate Elevation versus High Elevation
  - Moderate Elevation → less than 5,250 feet
  - High Elevation → 5,250 feet or greater

	HE-PAP	ME-PAP
HE-PAP	0.34 ± 0.03	0.83 ± 0.15
ME-PAP		0.29 ± 0.09

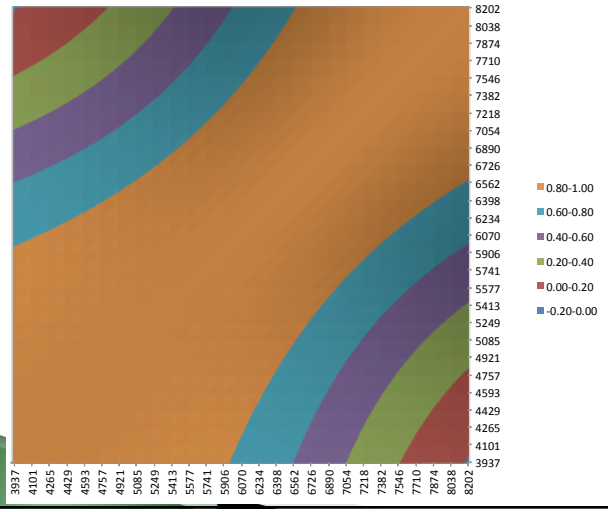
- Heritability on the diagonal.
- Genetic correlation above diagonal.

Genetic Relationship – Multi-breed dataset

	Above 5500	Below 5500
Mean	45.24	43.07
Std. Dev.	11.9	9.23
Minimum	31	31
Maximum	120	149

- High elevation heritability → 0.37 ± 0.10
- Moderate elevation heritability → 0.26 ± 0.08
- Genetic correlation → 0.79 ± 0.23

Genetic Relationship Between Elevations



How is this information used?

- Phenotypic PAP is dependent on elevation at which it was measured.
- Low elevation PAP can be used as an "indicator" of high elevation EPD or EBV
- Multiple trait model
  - Similar to the relationship between carcass and ultrasound
  - Genetic relationship dependent upon the distance in elevation between measurements.

Back to the Animals….

ID	EPD	PAP (mmHg)
1	-1.3	37
2	-1.3	40
3	-1.3	43
4	-1.3	46
5	-0.1	36
6	-0.1	38
7	-0.1	49
8	-0.1	52

Similar EPD, Different PAP

ID	EPD	PAP (mmHg)
1	-3.5	36
2	-3.1	36
3	-0.5	36
4	-0.1	36
5	-1.9	43
6	-1.8	43
7	1.6	43
8	1.7	43

Similar PAP, Different EPD

How should selection decisions be made….

- Association-wide EPDs for PAP soon to be released.
- Decisions need to be made that are dependent on how the animals are to be used.
- Essentially 2 different paths
  - Sire new calves via artificial insemination
    - Semen purchased through AI companies
  - Sires purchased and moved to elevation OR
  - Sires born and raised at elevation

Sires used via AI with semen purchased

- Remember → P = μ + BV + E
- Use published EPD
- EPD is a prediction of the genetic merit ("transmittable") of an individual
- Significant effort is made to reduce environmental variability that is not transmitted from parent to offspring.
- EPD will rank individual animals according to their value as a parent.

Potential sires residing at elevation

- Remember → P = μ + BV + E
- Environmental influences on phenotype are not passed on to offspring.
- They do contribute to the individual's phenotype
- To improve chances of survival at elevation:
  - Individual phenotype cannot be ignored
- For selection to become parents, individuals should be selected based on their EPD

Recommendations

- At elevation
  - Need acceptable PAP EPD AND
  - Need acceptable PAP observation
- EPD
  - Positive EPD → caution with use
  - Zero or below → Good
  - Less than -0.70 → Will improve problems

Questions?