

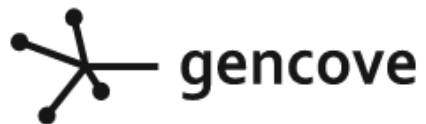


# Bovine Congestive Heart Failure

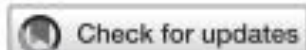
Justin Buchanan, PhD & Randall Raymond, DVM

Simplot Livestock

BIF July 2023



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#### OPEN ACCESS

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Nilles AR, Hoff JL, Pickrell JK and  
Raymond RC (2023), Variance

# Variance component estimates, phenotypic characterization, and genetic evaluation of bovine congestive heart failure in commercial feeder cattle

Justin W. Buchanan<sup>1</sup>, Lex E. Flagel<sup>2</sup>, Michael D. MacNeil<sup>1,3,4</sup>,  
Ashley R. Nilles<sup>1</sup>, Jesse L. Hoff<sup>2</sup>, Joseph K. Pickrell<sup>2</sup> and  
Randall C. Raymond<sup>1\*</sup>

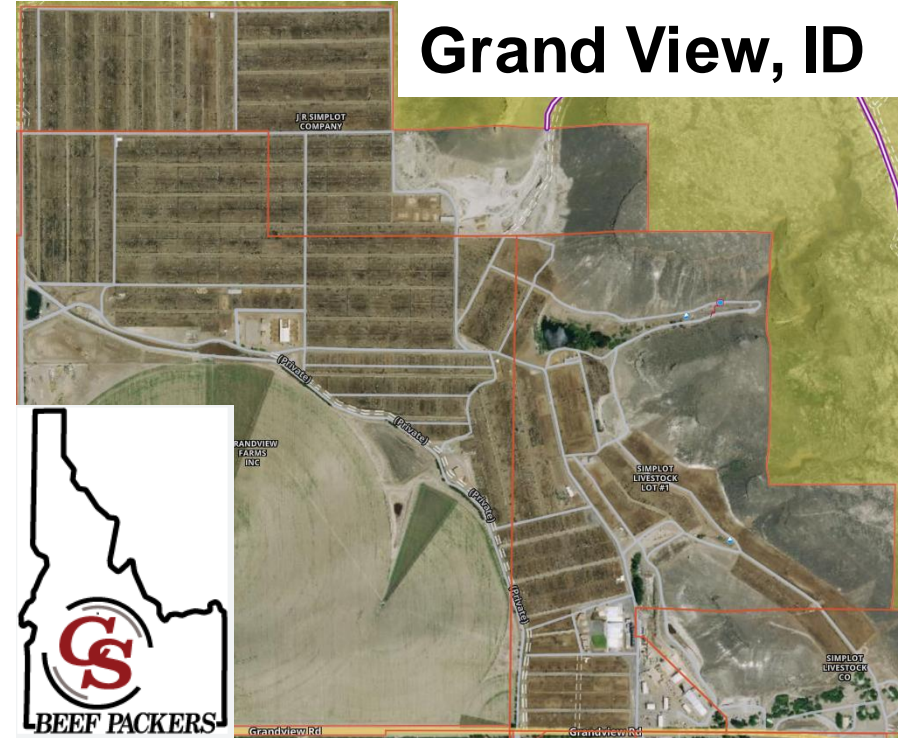
<sup>1</sup>Simplot Livestock Co., Grand View, ID, United States, <sup>2</sup>Gencove Inc., New York, NY, United States, <sup>3</sup>Delta G, Miles City, MT, United States, <sup>4</sup>Department of Animal, Wildlife and Grassland Sciences, University of the Free State, Bloemfontain, South Africa



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# Grand View, ID



# Pasco, WA

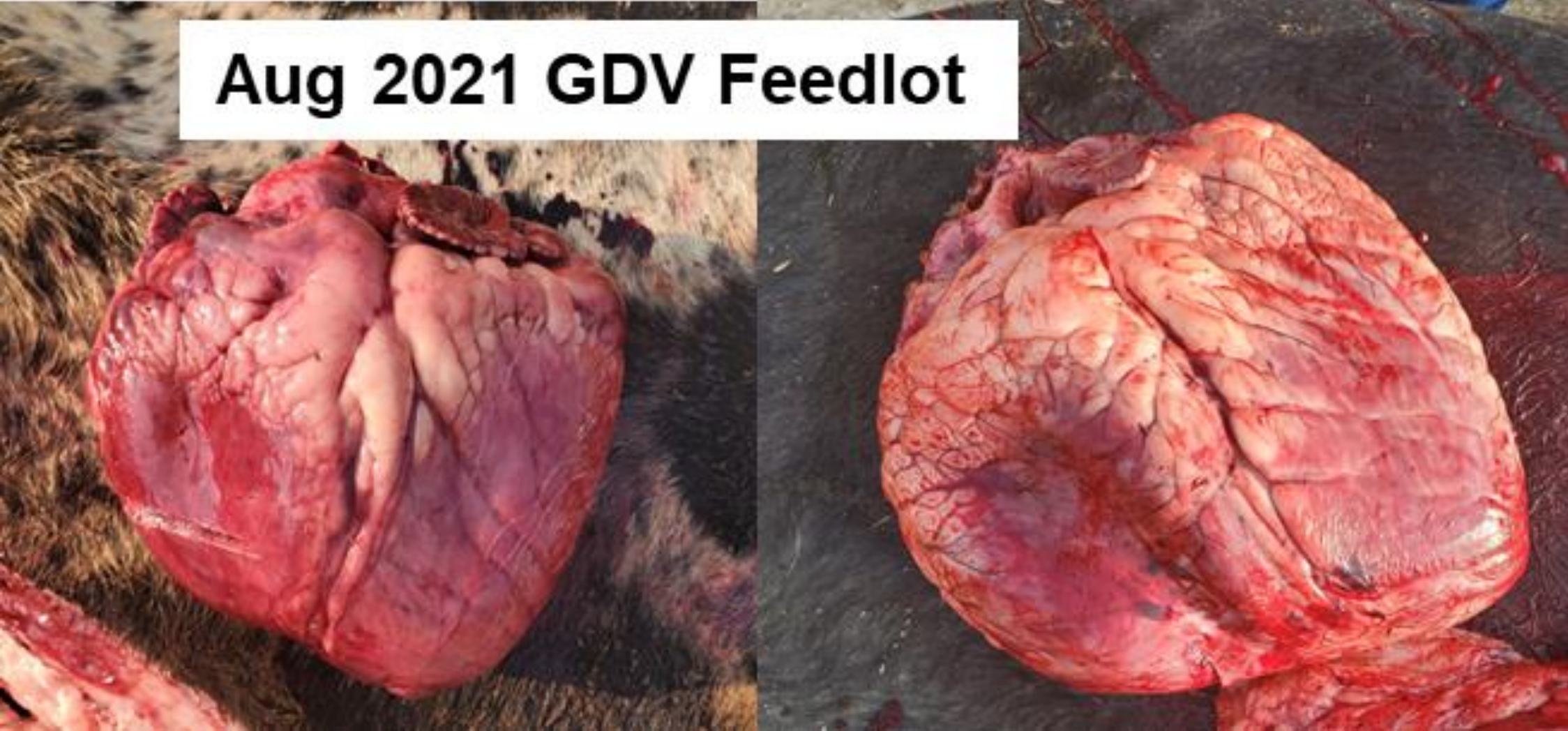


Offering the Highest Quality Beef from Farm Gate to Dinner Plate!

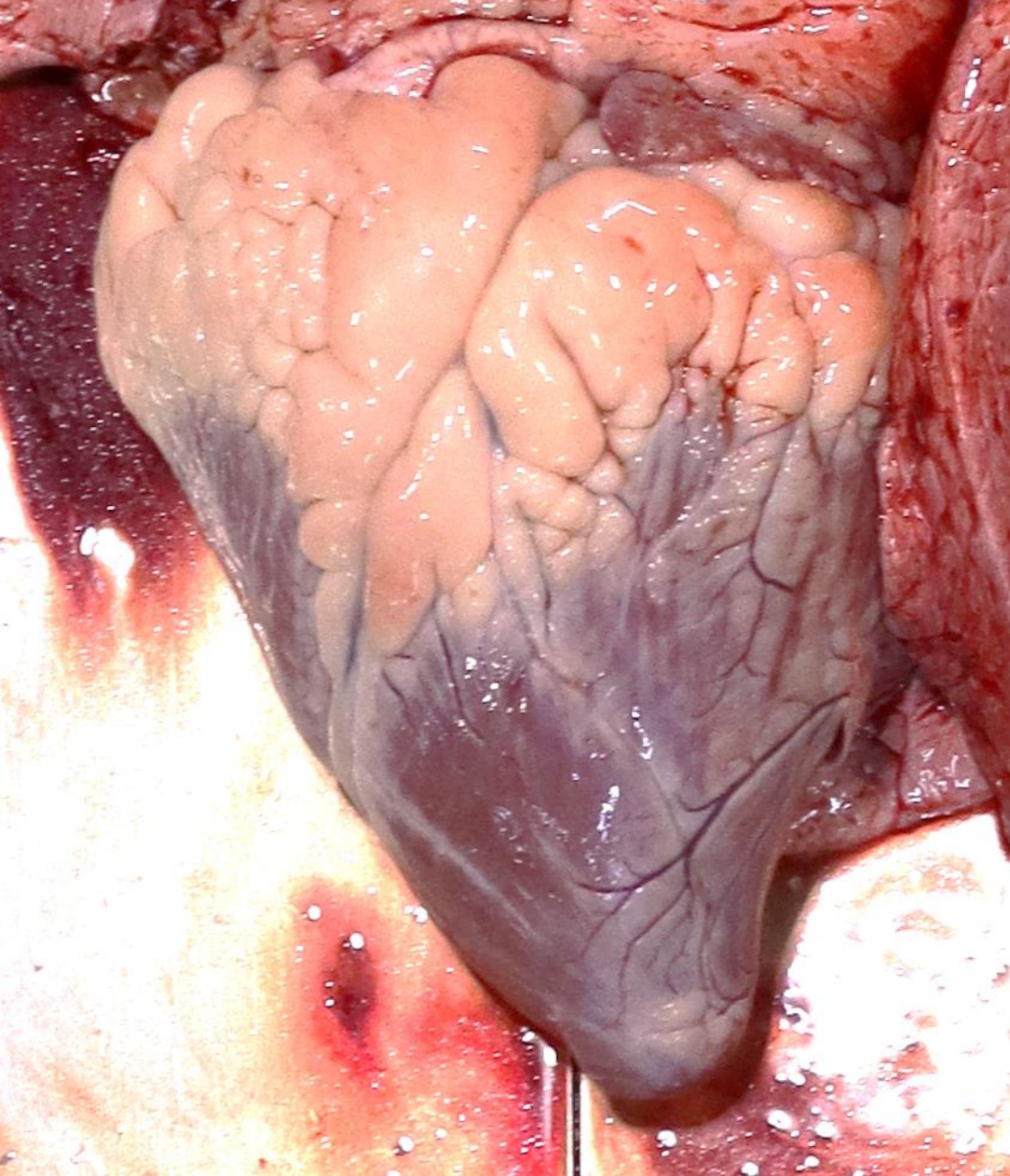
BEEF HARVEST | FABRICATION | GROUND BEEF | RENDERING | HIDES PROCESSING  
KUNA, ID

# Feedlot Cardiac Mortality

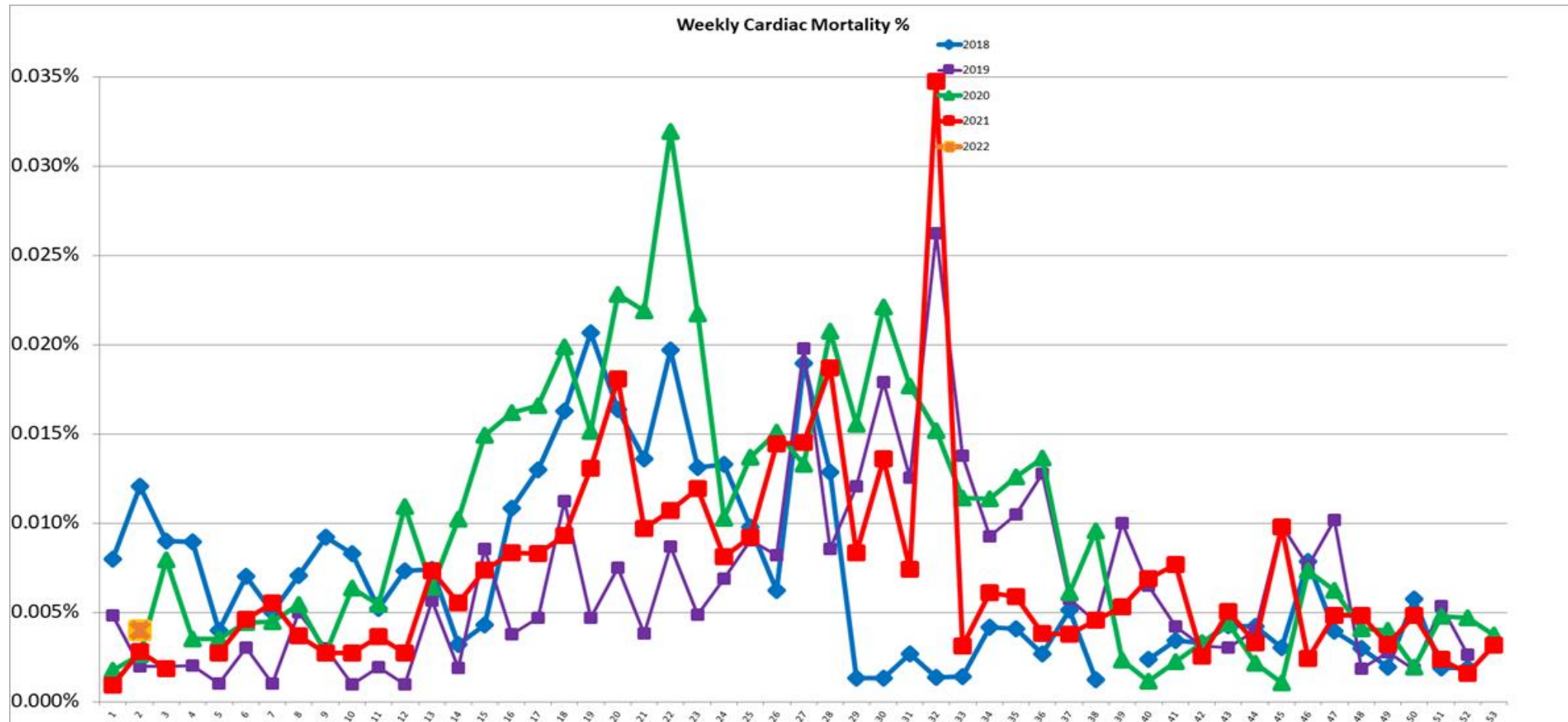
**Aug 2021 GDV Feedlot**



# Feedlot Cardiac Mortality



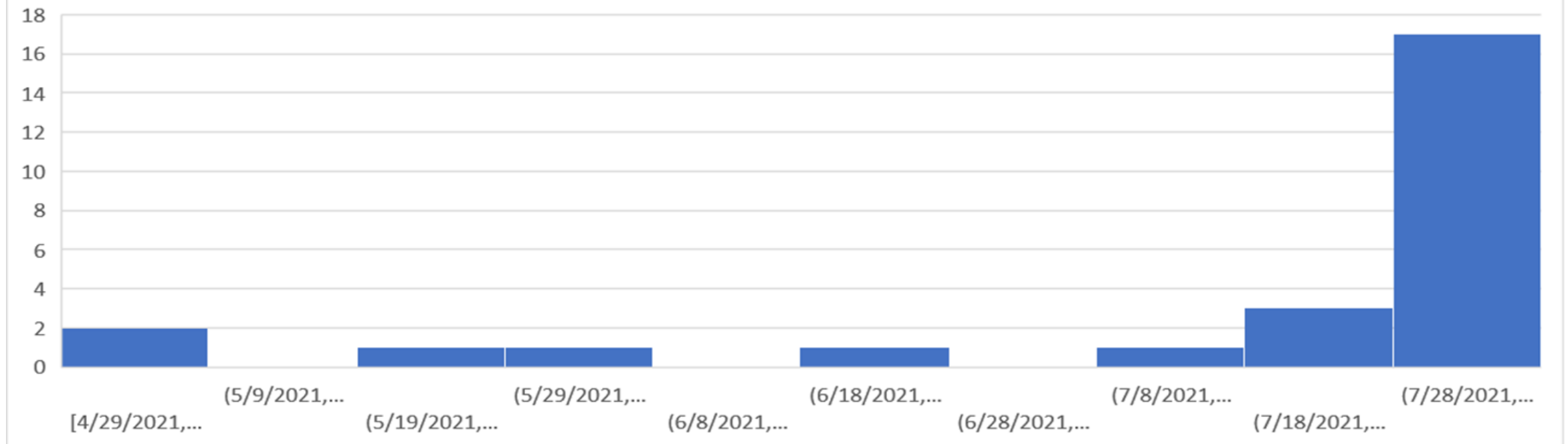
# Seasonality of Feedlot Cardiac Mortality



# ZX Ranch Calves

- Lot V206085 Angus and Angus x Hereford Cross single ranch origin heifers
- 988 hd received December 2020
- Shipped August 3, 5, 6, 9 2021
- Mortalities- total 32 (3.2%)
  - All other causes 6 (0.6%)
  - BCHF 26 (2.6%)

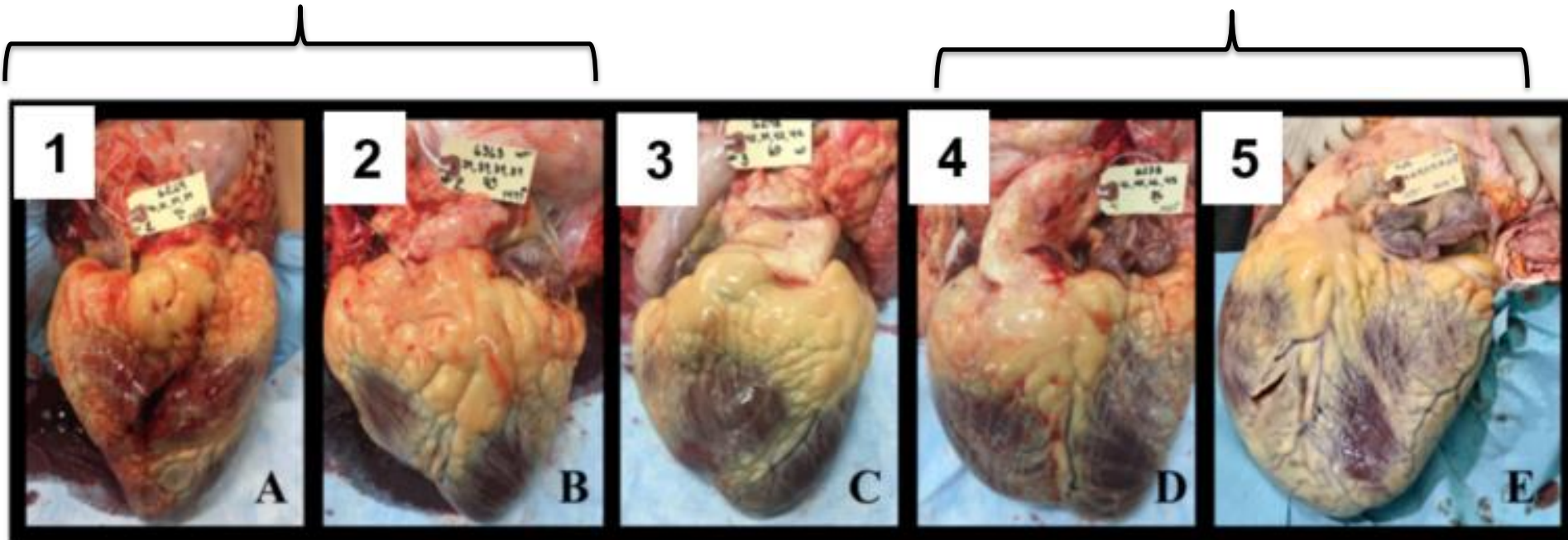
BCHF mortality timeline



# Phenotype Observation – CSU Guidelines

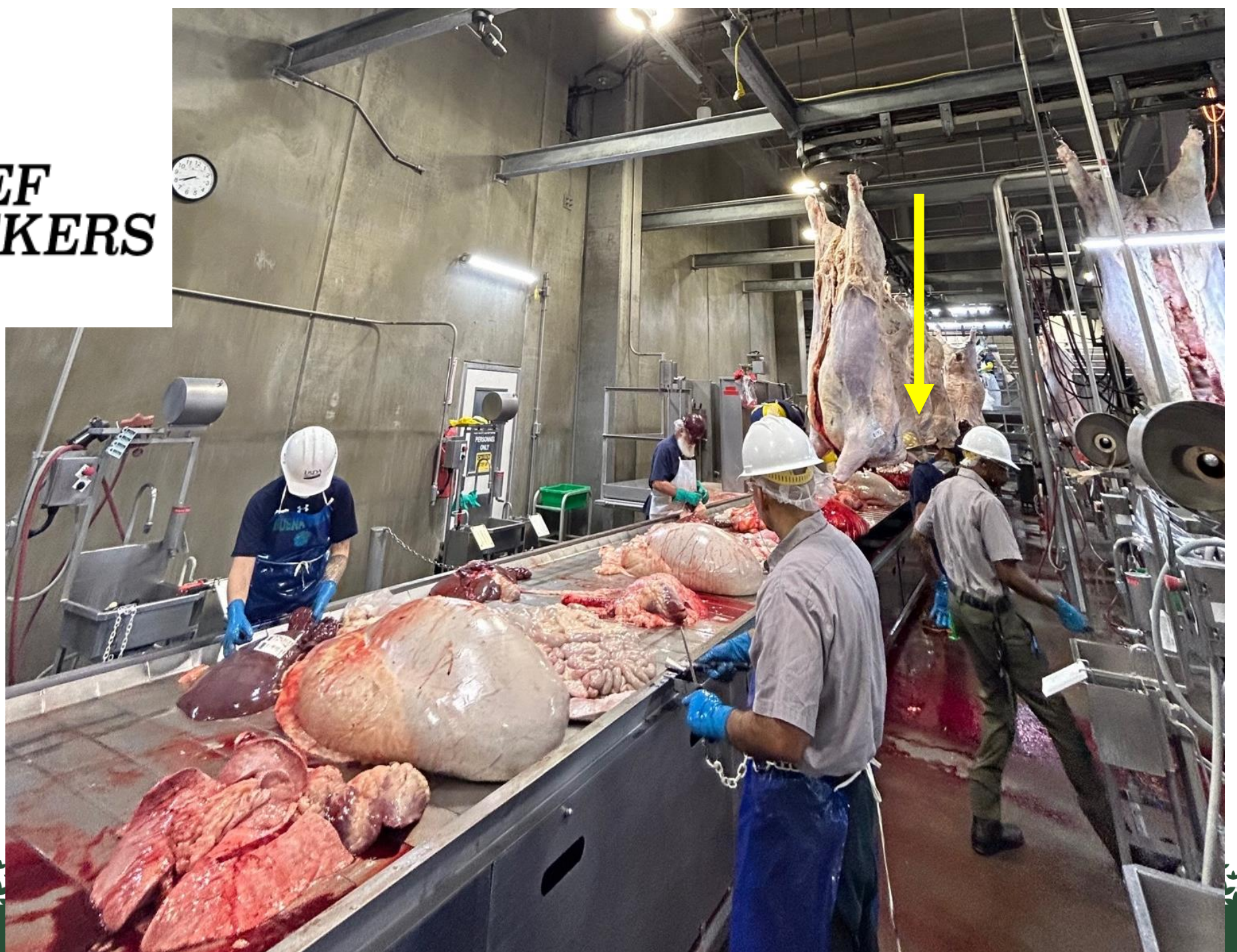
Normal Phenotype

BCHF Case

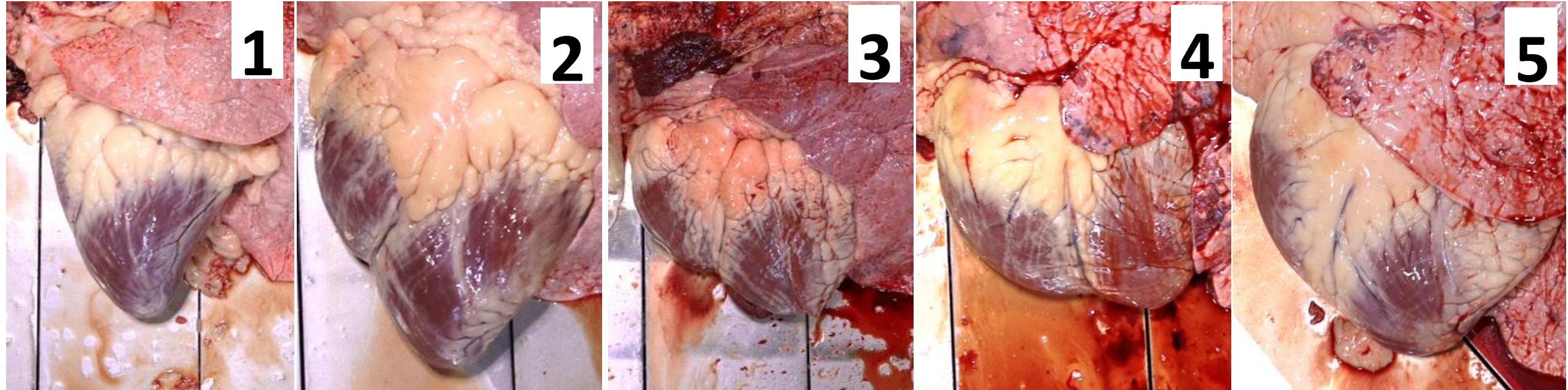


**Genetic Analysis of binary Case/Control from 5 categories of heart scores**





# Phenotype Observation – CS Beef



# Phenotype Collection – CS Beef

Heart Score		2020	2021	2022	2023	Grand Total	Percent
Normal	1	7,642	4,090	14,546	10,558	36,836	59.2%
Mild Change	2	2,674	1,158	11,007	3,423	18,262	29.3%
Moderate Change	3	1,228	567	2,189	466	4,450	7.1%
Severe Change	4	346	177	517	204	1,244	2.0%
Severe Change Flaccid	5	230	120	506	619	1,475	2.4%
Grand Total		12,120	6,112	28,765	15,270	<b>62,267</b>	

- **Scores 4+5 at Harvest = 4.4%**
- **Fat cattle only – GDV Feedlot**

# Low-Pass Sequencing - GWAS

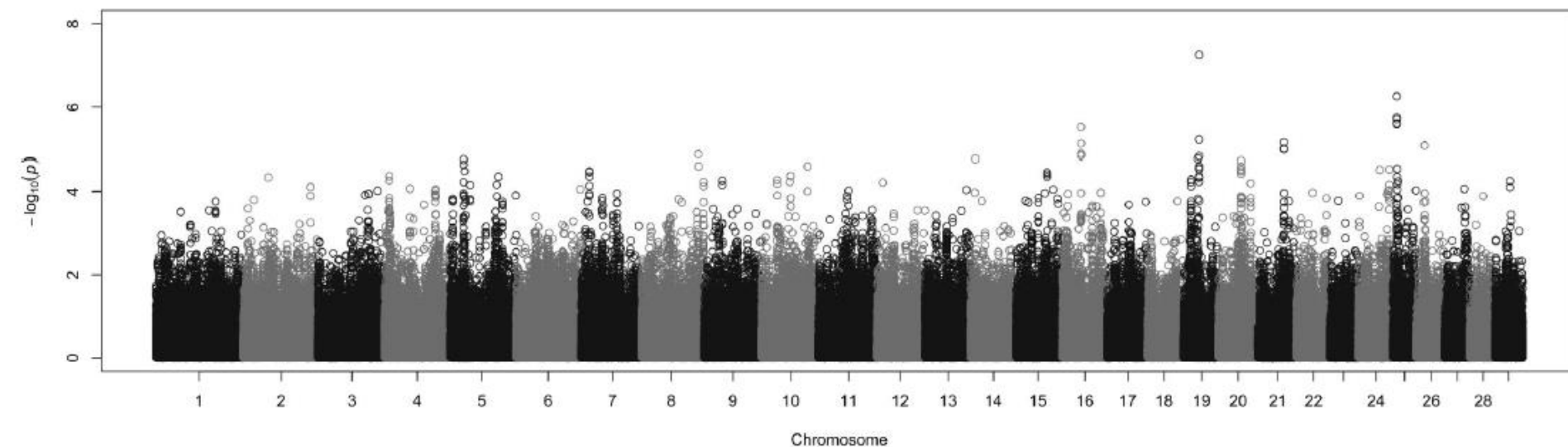
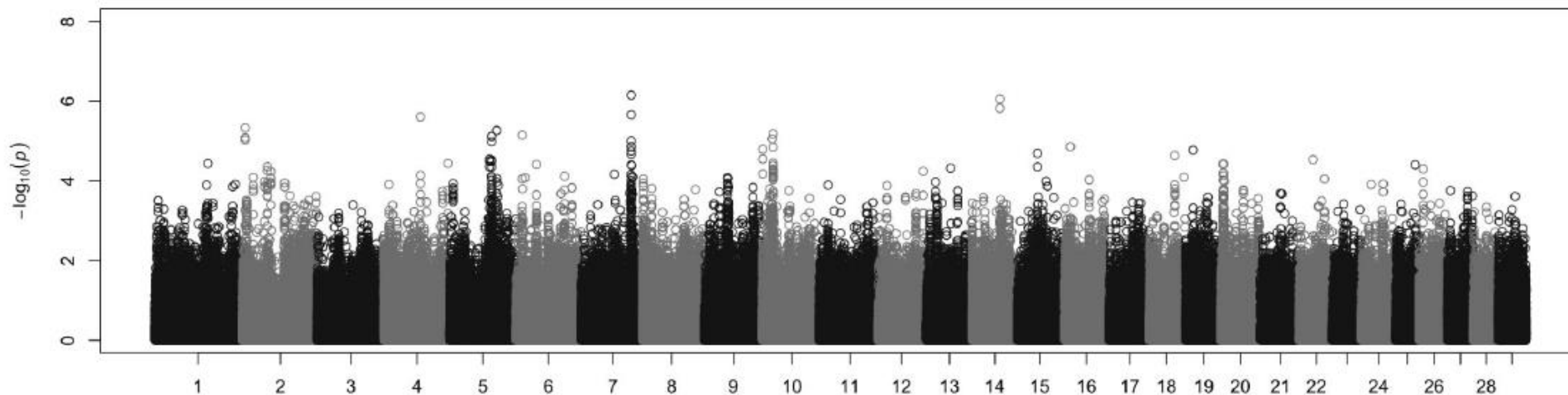
- Selected 5,713 contemporary grouped individuals with data captured from feedlot entry to harvest.
  - Heart Score 3's were excluded
- Genotyped using Low-Pass sequencing platform – Gencove, Inc.
  - ~12 Million useful SNP markers per individual, filtered to 1 Million

Heart Score	Count
1 or 2	4817
4 or 5	896

15.7% cases defined as 4 or 5

# Heart Score Case/Ctl Manhattan Plot

~1 Million Markers, no evidence of large effect genes



No Contemp Grp  
chip  $h^2 = 0.423$   
case/ctl = 373/4266

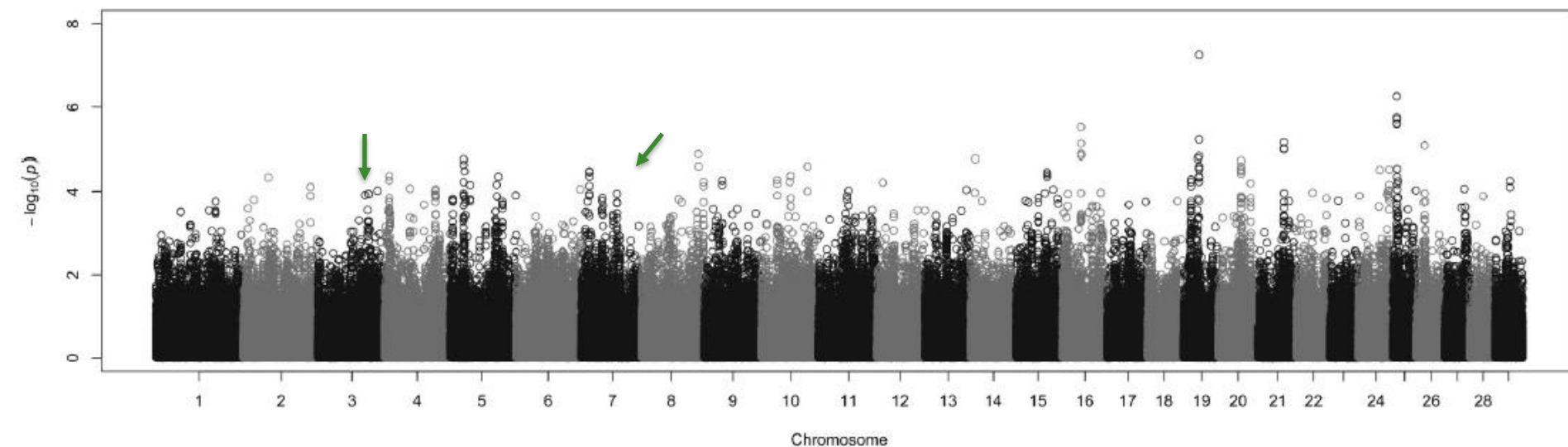
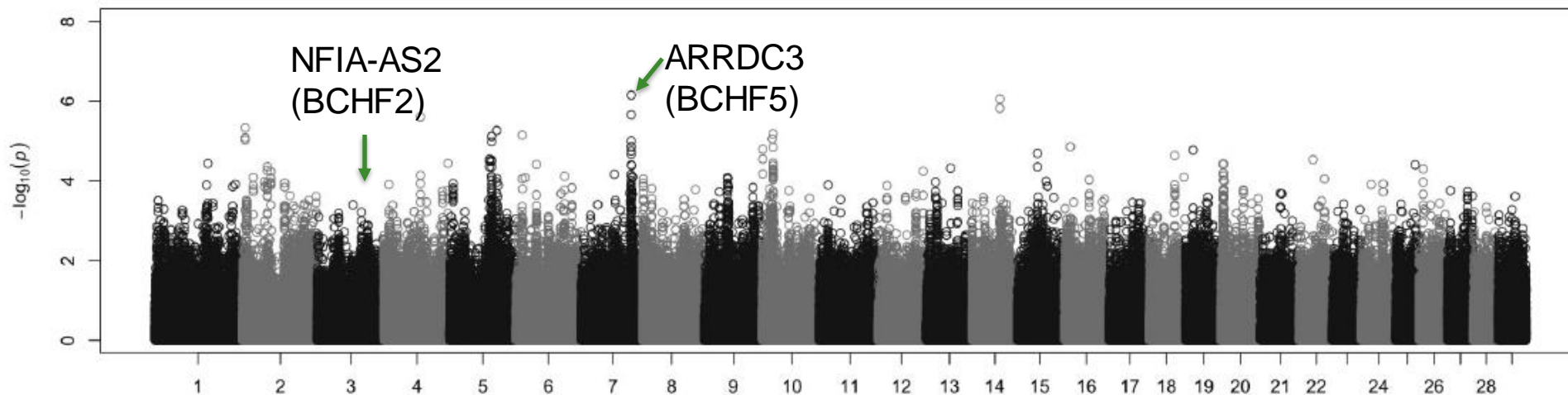


True  
heritability  
range

Contemp Grp  
chip  $h^2 = 0.306$   
case/ctl = 187/4173

# Heart Score Case/Ctl Manhattan Plot

~1 Million Markers, no evidence of large effect genes

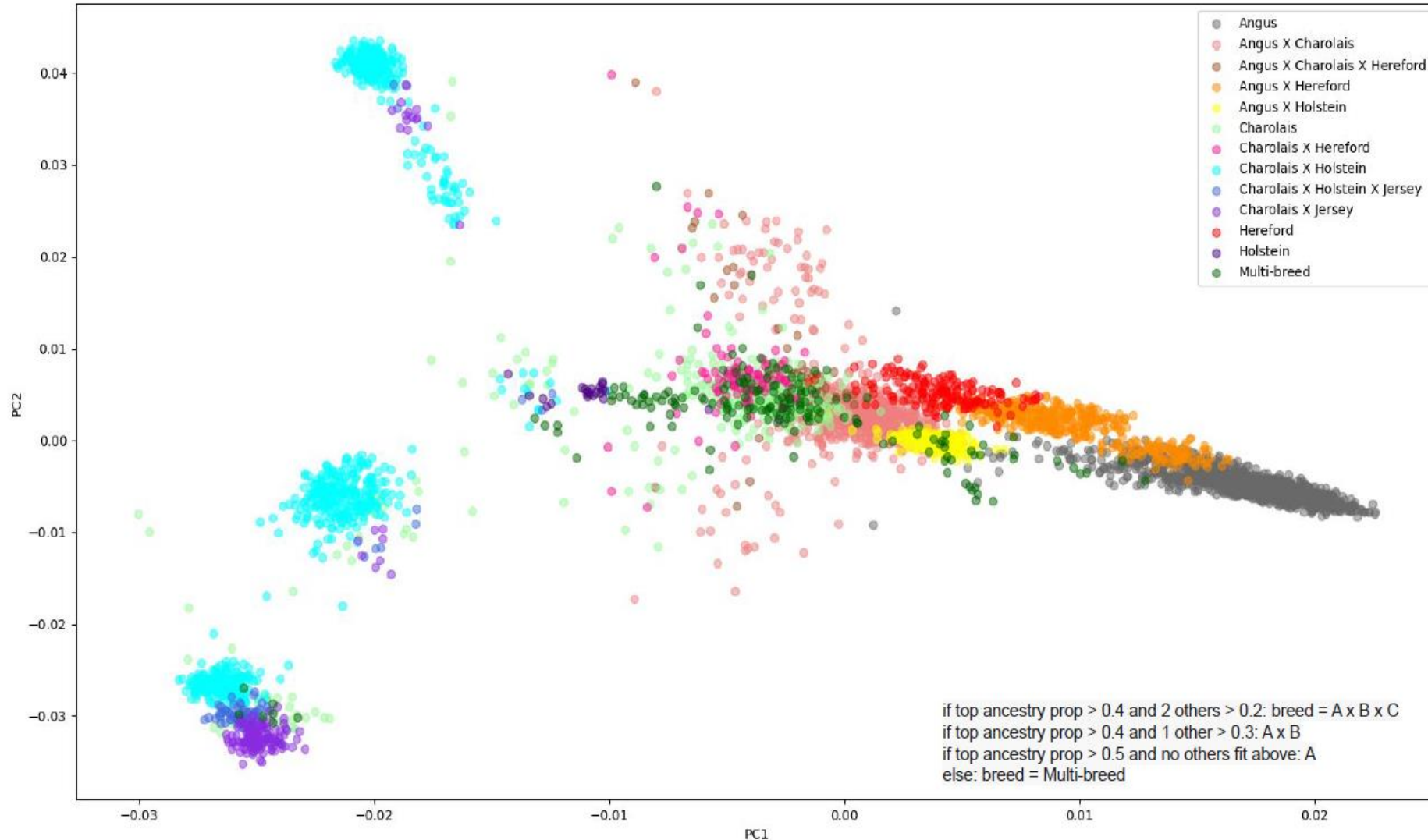


No Contemp Grp  
chip  $h^2 = 0.423$   
case/ctl = 373/4266

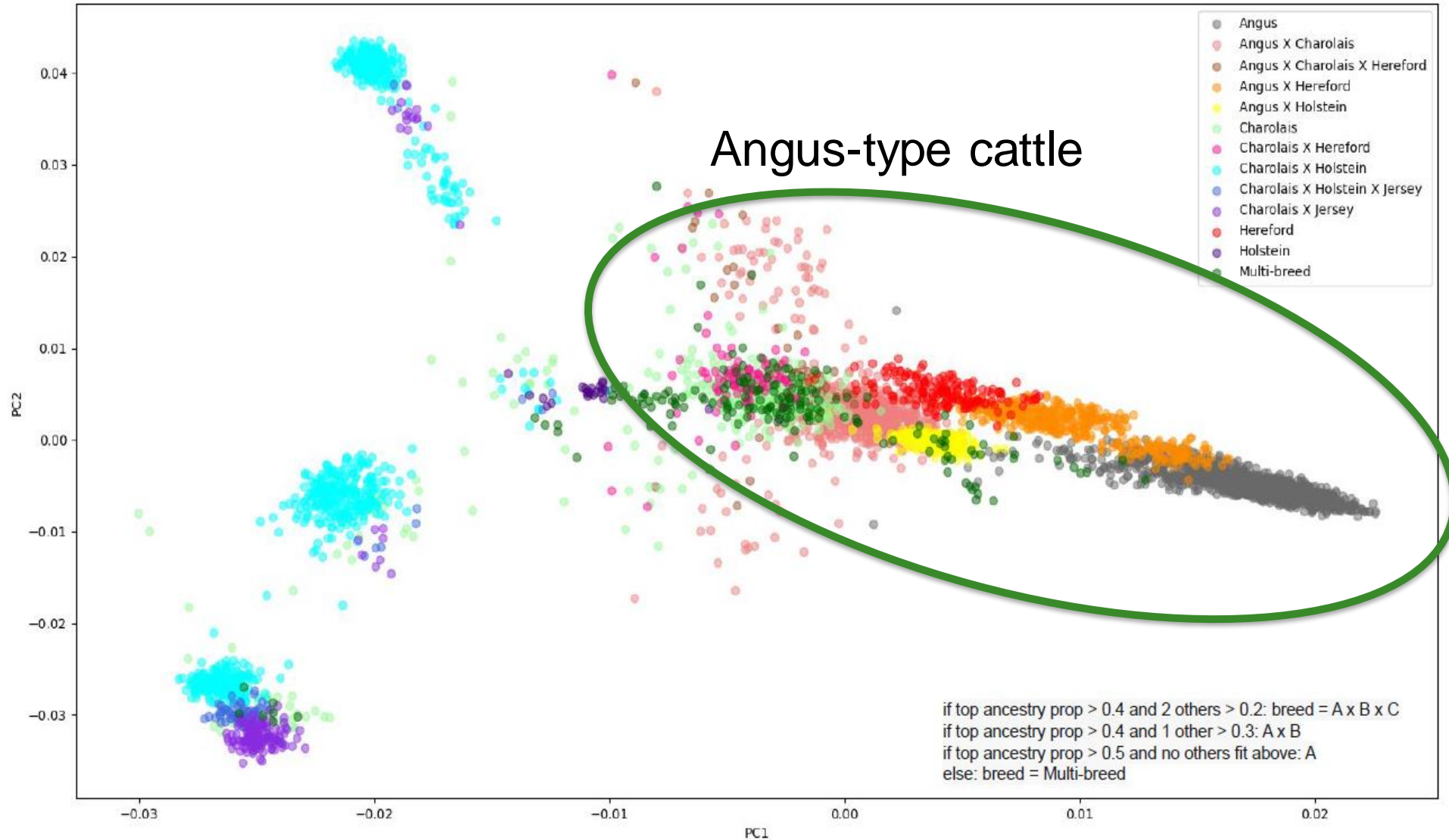
True  
heritability  
range

Contemp Grp  
chip  $h^2 = 0.306$   
case/ctl = 187/4173

# Population Structure by Breed - Gencove

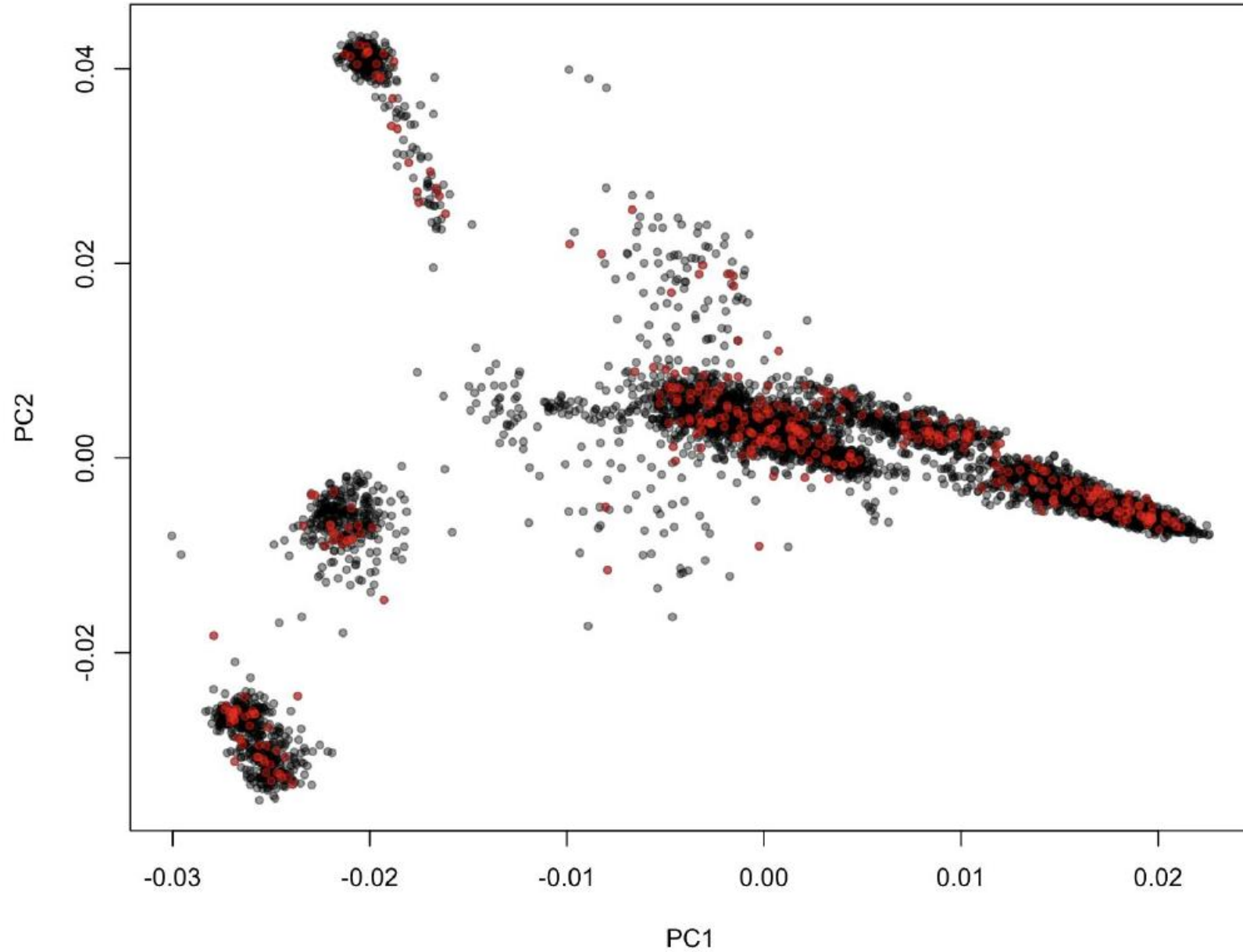


# Population Structure by Breed - Gencove



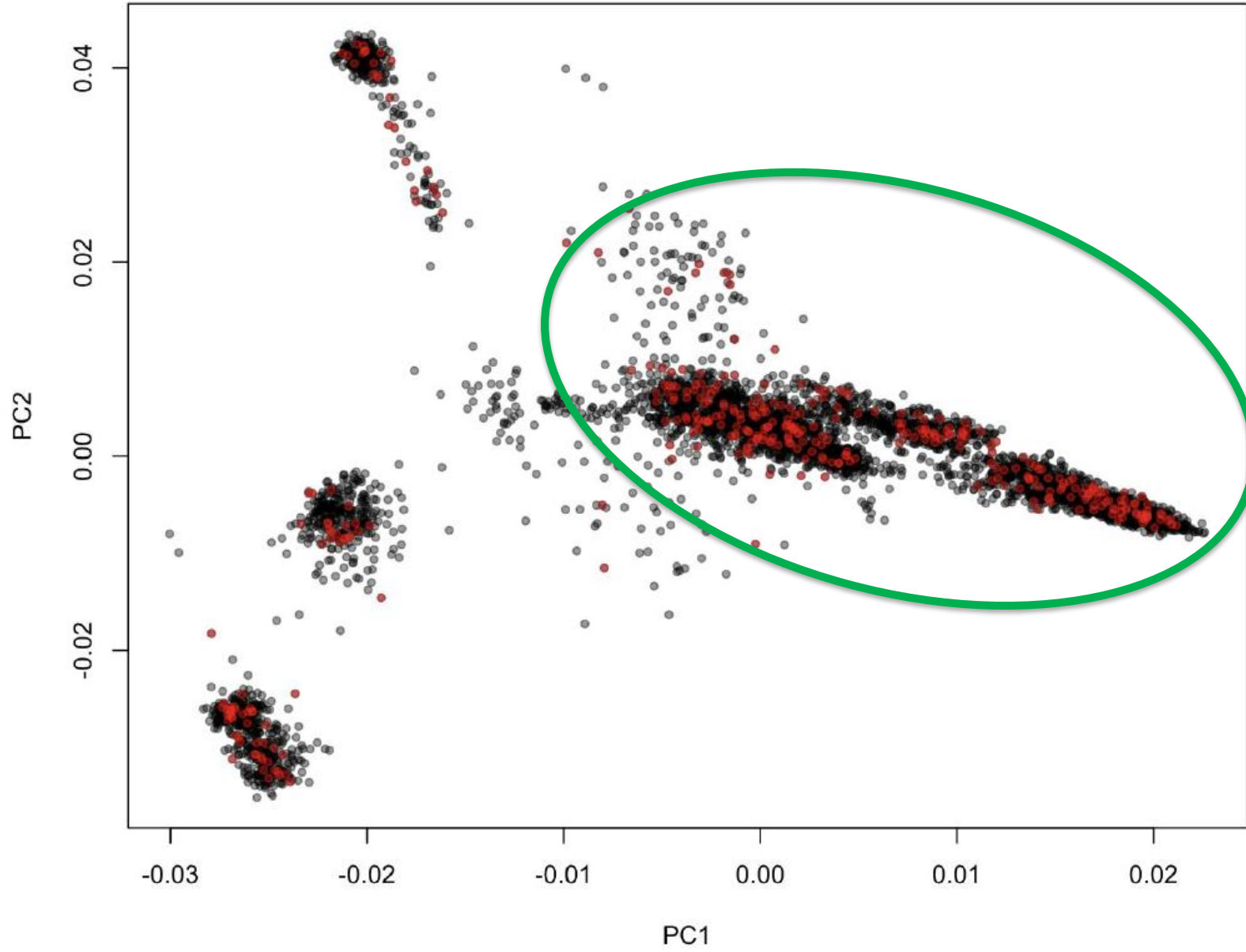


# Cases on PC1 and PC2



- BCHF Case
- Control

# Cases on PC1 and PC2



- BCHF Case
- Control



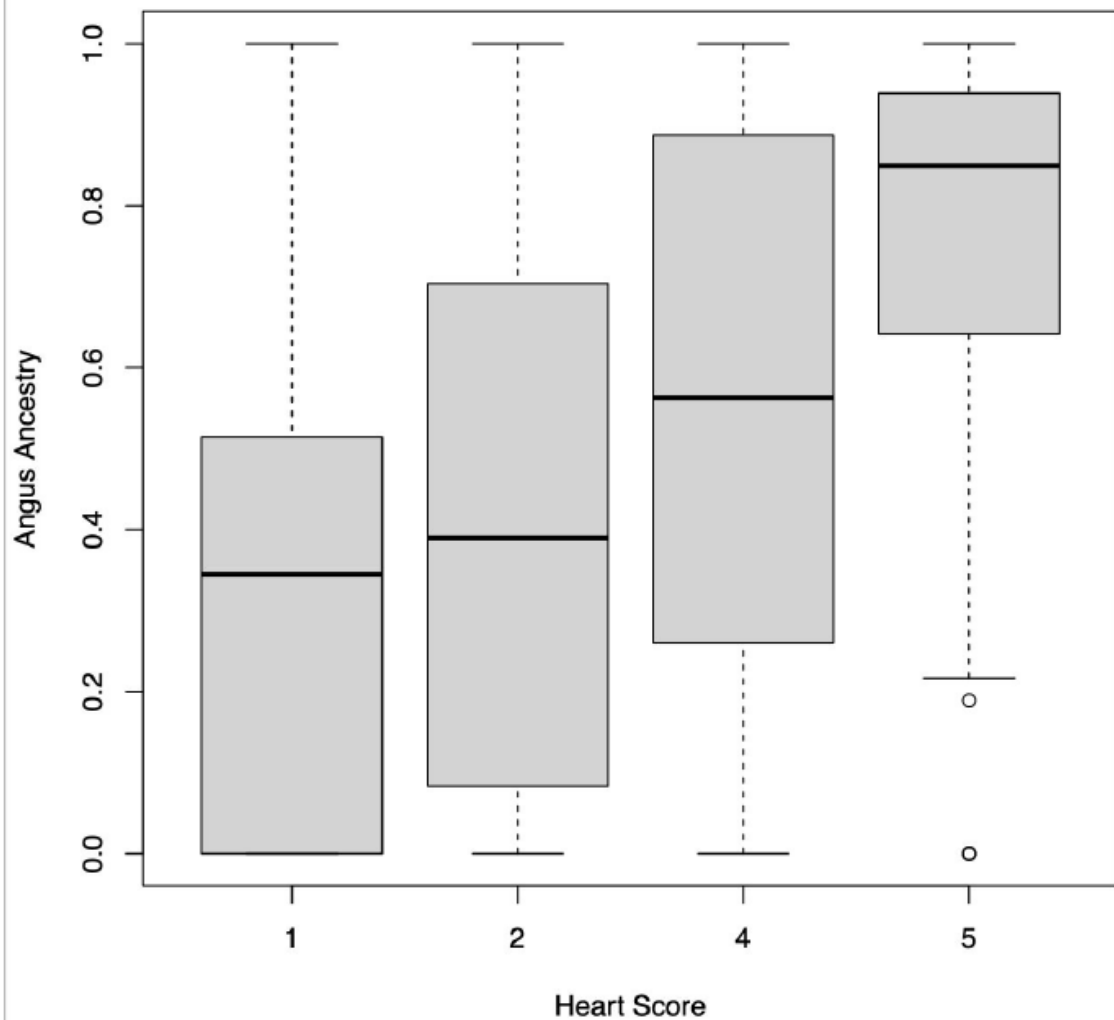
# Observed Breed Incidence %

Breed Type	1	2	3	4	5	%4&5
English/Cross	60.34%	24.94%	9.44%	3.24%	2.04%	5.28%
Holstein/Beef-Black	69.35%	25.28%	4.17%	0.79%	0.41%	1.21%
Holstein/Beef-Charolais	62.57%	30.76%	5.73%	0.70%	0.24%	0.94%
Smokie	63.86%	25.51%	8.69%	1.39%	0.55%	1.94%
Holsteins	73.62%	19.88%	5.51%	0.64%	0.34%	0.98%



# Breed Assoc with Heart Score Trait

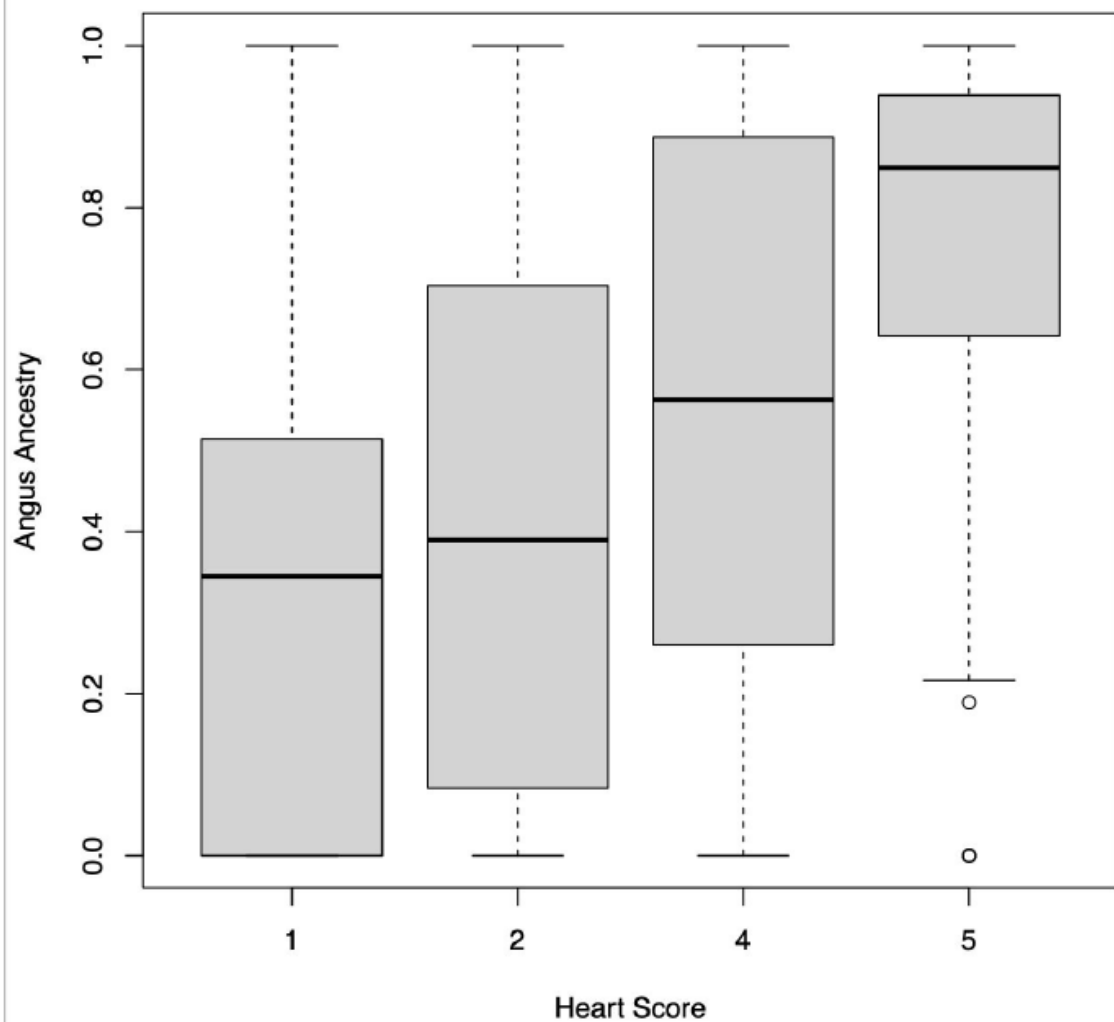
Raw Trait Values





# Breed Assoc with Heart Score Trait

Raw Trait Values



Case/Ctl (4&5 case, 1&2 ctl)  
logistic regression

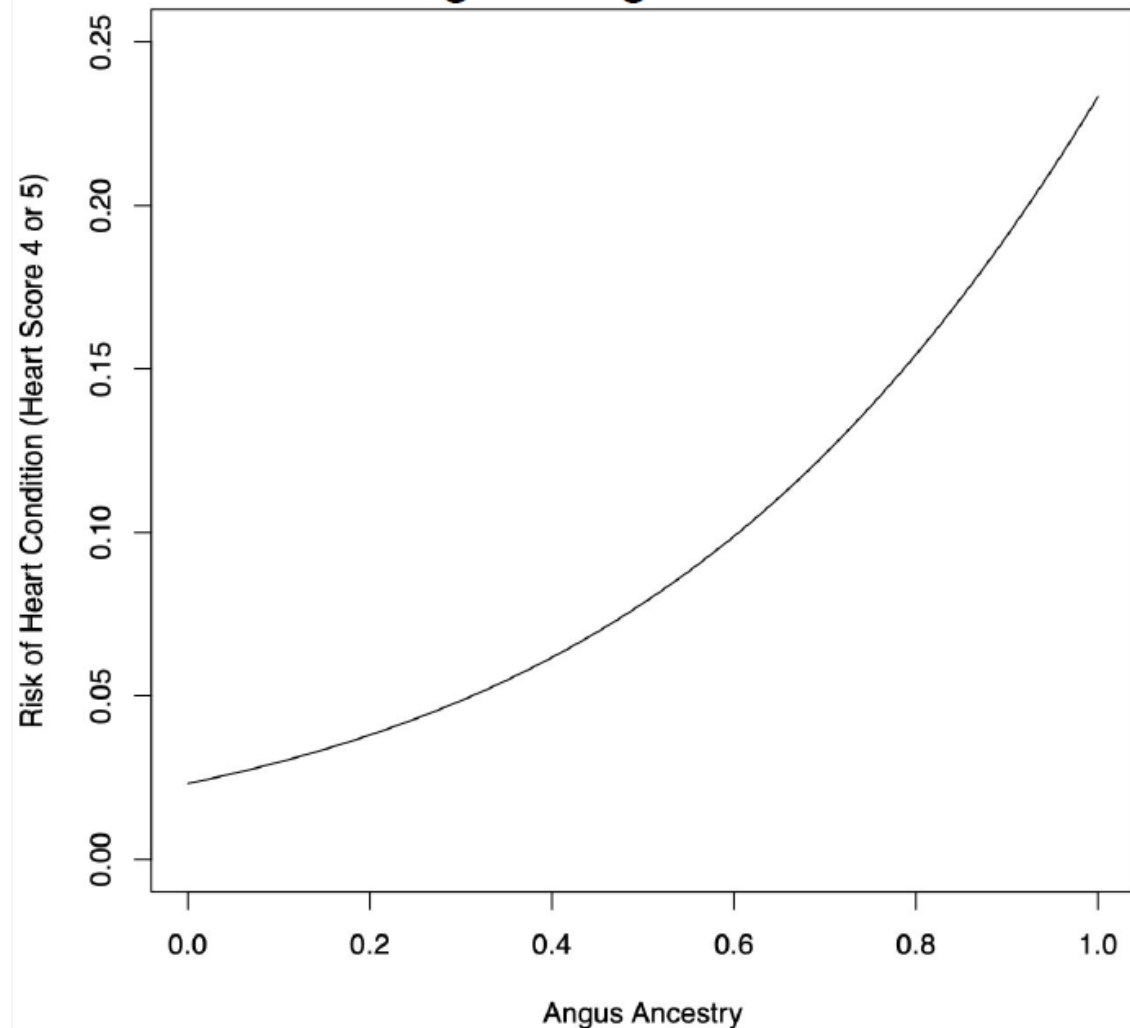
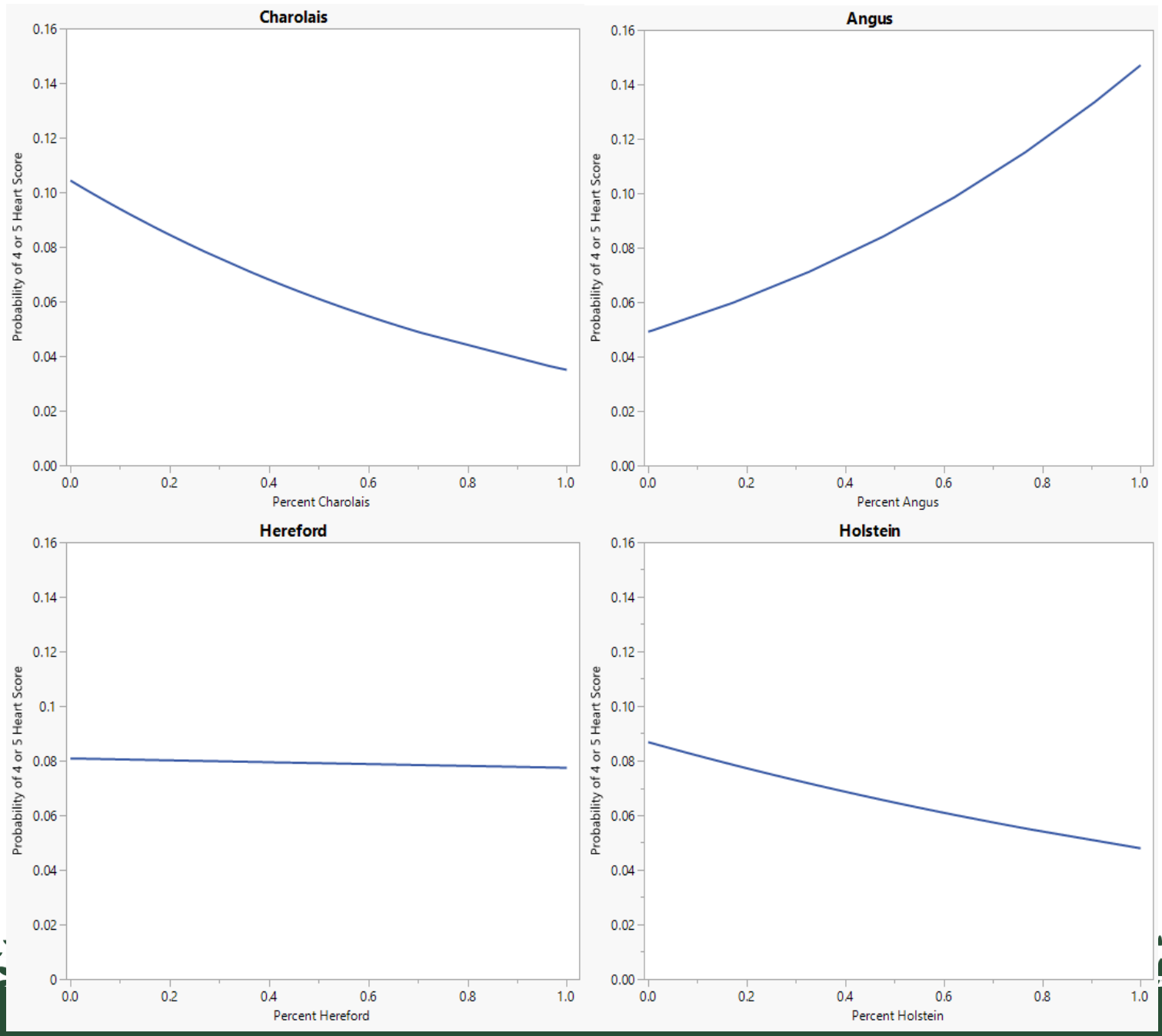


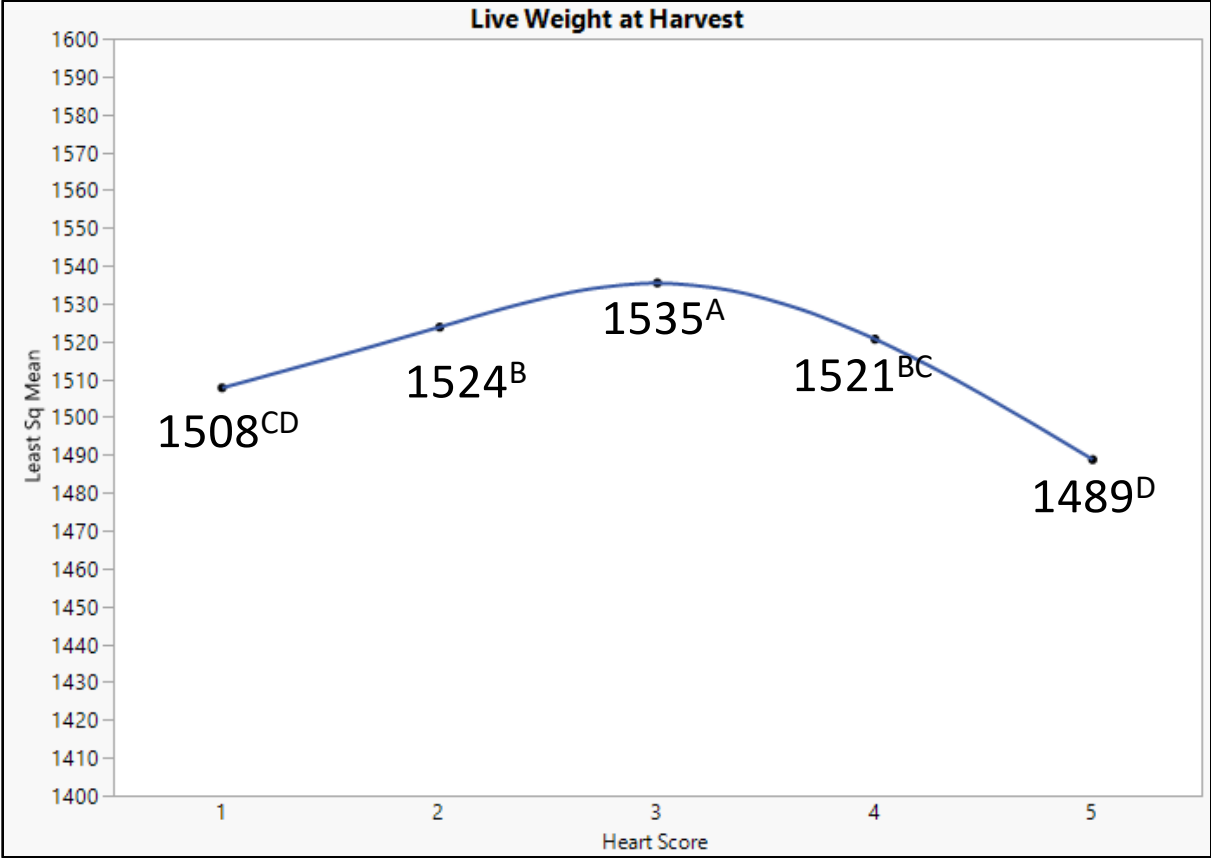
Figure 4



# Feedlot Performance – Normal Harvest Lots

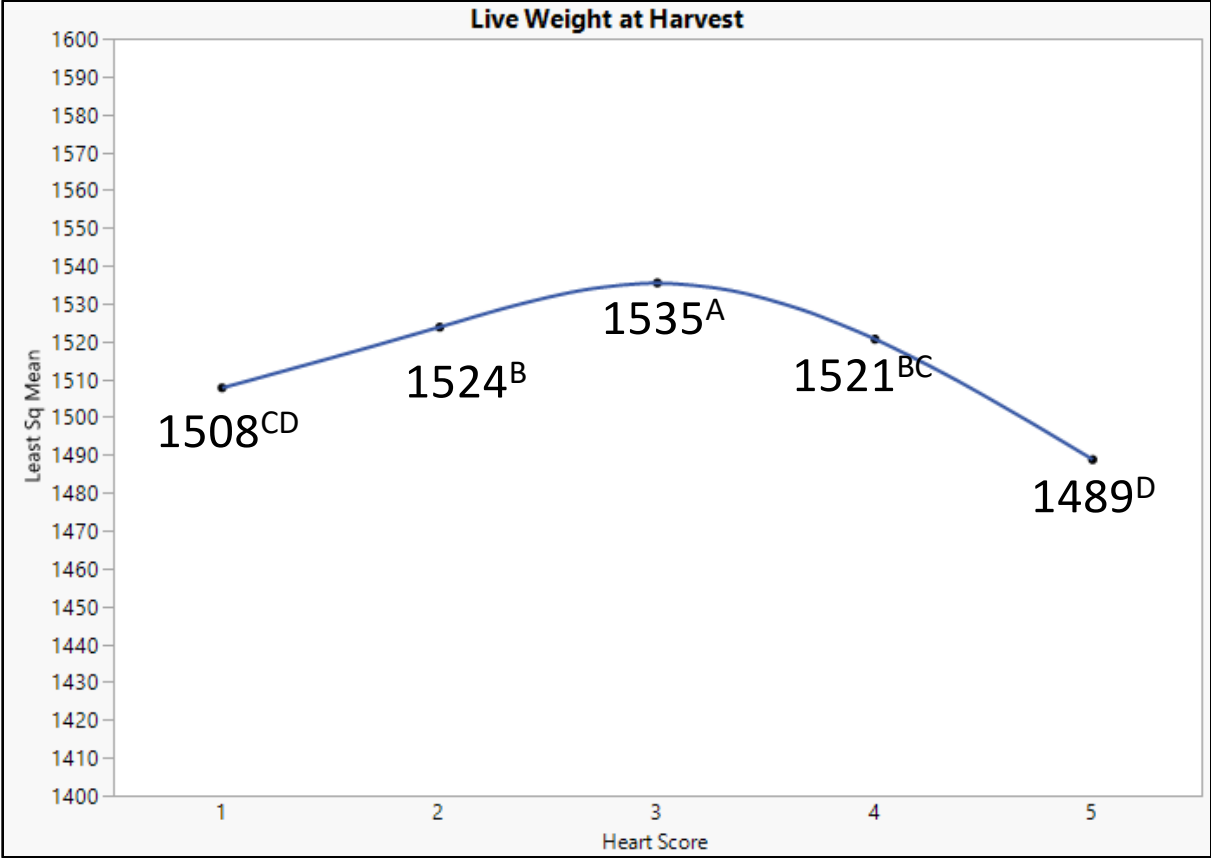
Trait <sup>1</sup>	Heart Score				
	1	2	3	4	5
	LS Mean	LS Mean	LS Mean	LS Mean	LS Mean
Harvest Weight <sup>2</sup>	1508 <sup>CD</sup>	1524 <sup>B</sup>	1535 <sup>A</sup>	1521 <sup>BC</sup>	1489 <sup>D</sup>
HCW	946 <sup>C</sup>	960 <sup>B</sup>	967 <sup>A</sup>	957 <sup>B</sup>	929 <sup>D</sup>
FAT	0.620	0.618	0.629	0.618	0.619
MARB	523	520	519	519	524
Early ADG	3.45	3.45	3.45	3.49	3.41
Late ADG	3.18 <sup>AB</sup>	3.20 <sup>A</sup>	3.22 <sup>A</sup>	3.18 <sup>AB</sup>	2.90 <sup>B</sup>
ADG	3.17 <sup>B</sup>	3.21 <sup>A</sup>	3.24 <sup>A</sup>	3.18 <sup>AB</sup>	3.14 <sup>B</sup>
DMI	21.92a	22.37b	22.52b	21.97ab	22.56b
RFI	-0.033a	0.008b	0.003b	0.059b	0.216c
N	30,592	13,675	3,331	686	307
% of Total	62.96%	28.14%	6.86%	1.41%	0.63%

# Live Weight at Harvest

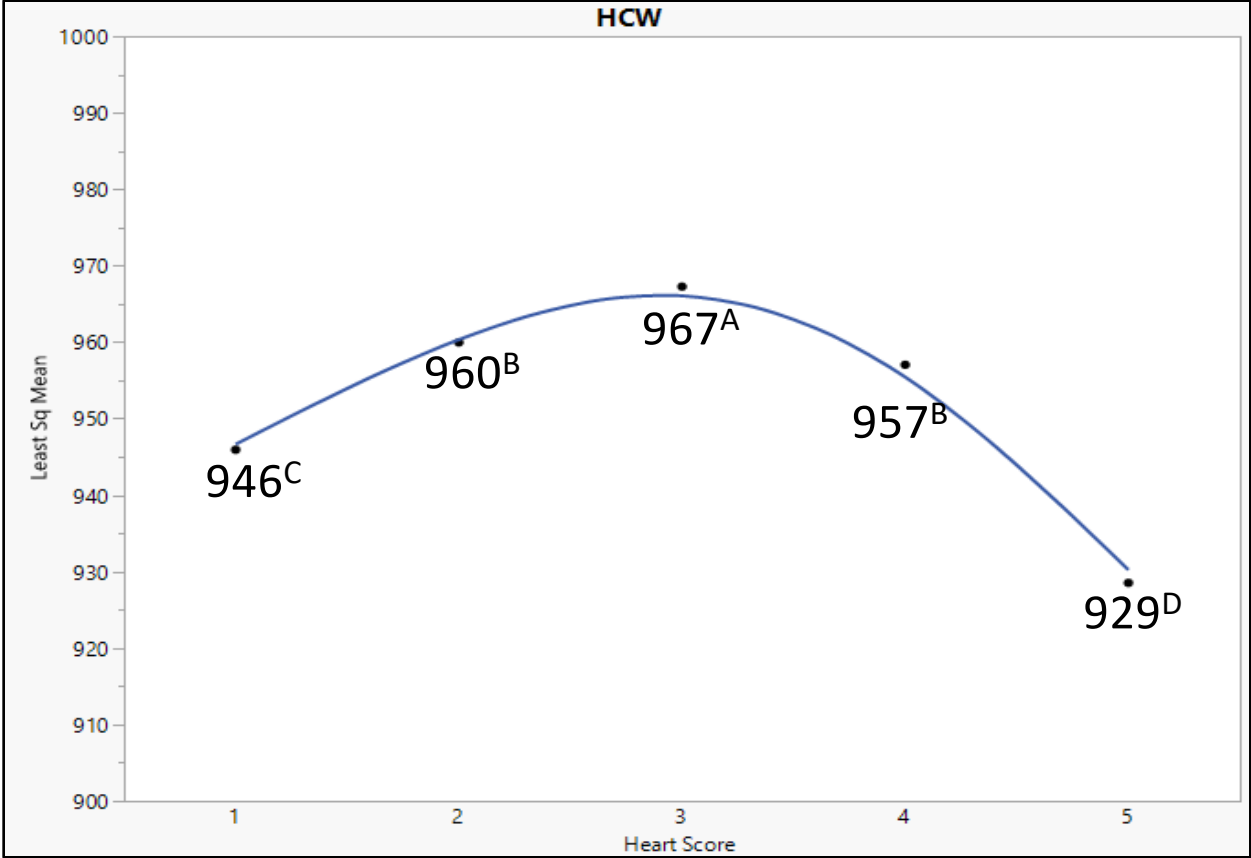




# Live Weight at Harvest

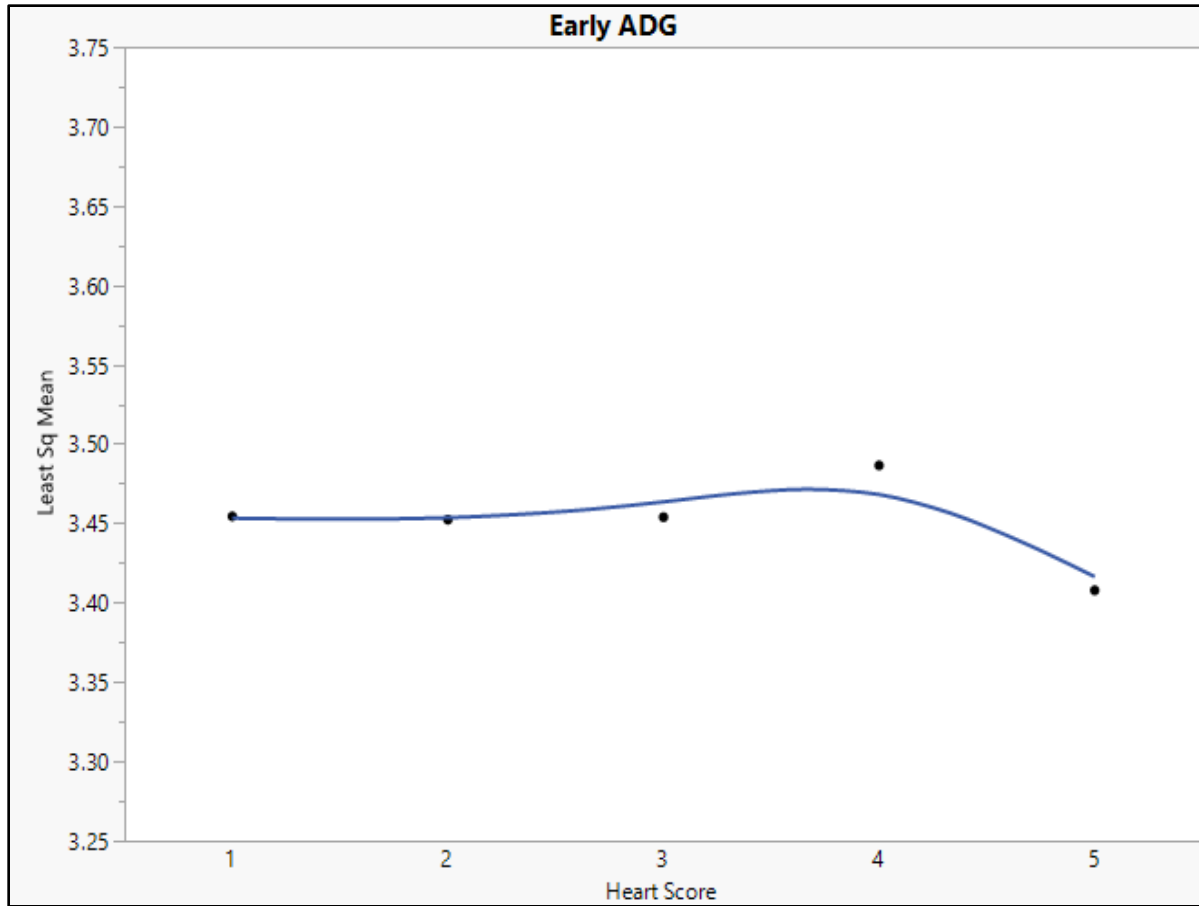


# Carcass Weight



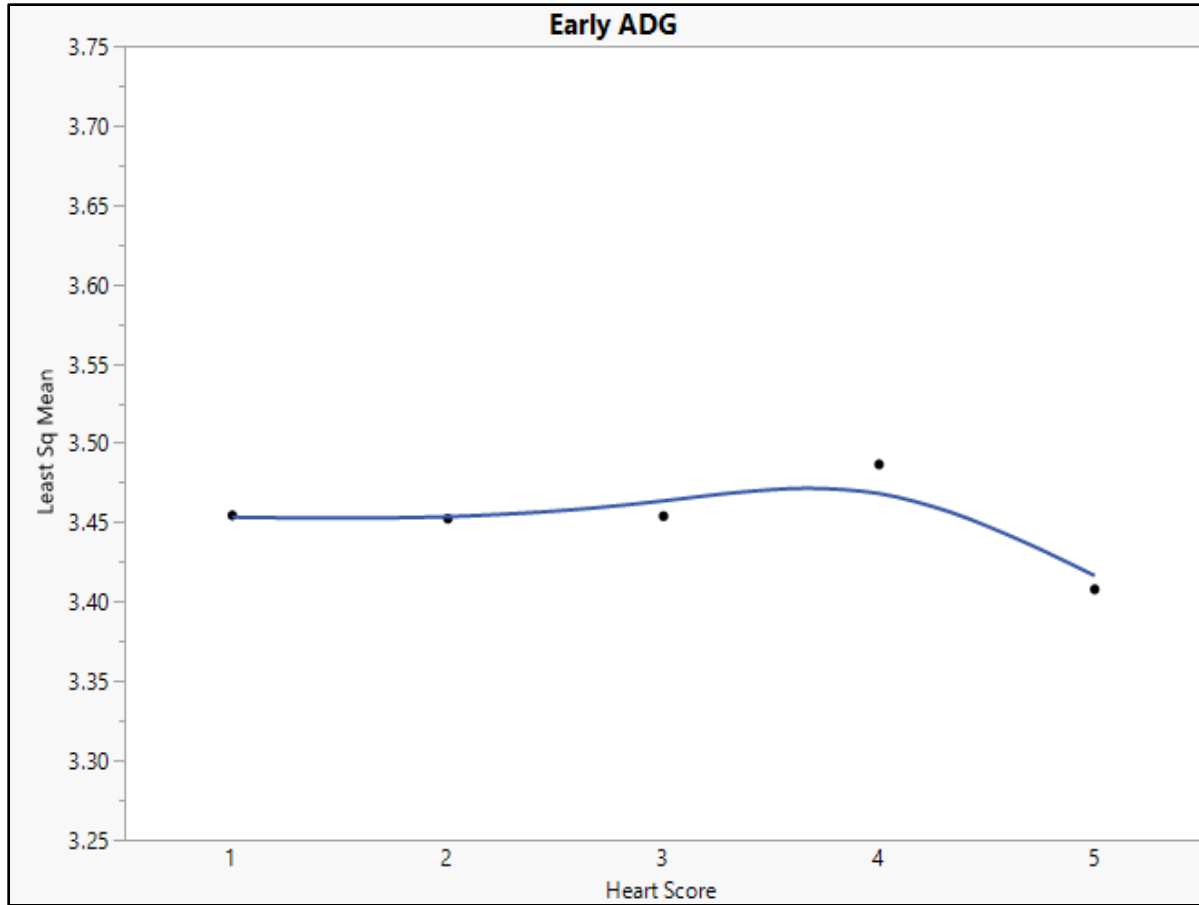
# Early ADG

## First 80 to 120 DOF



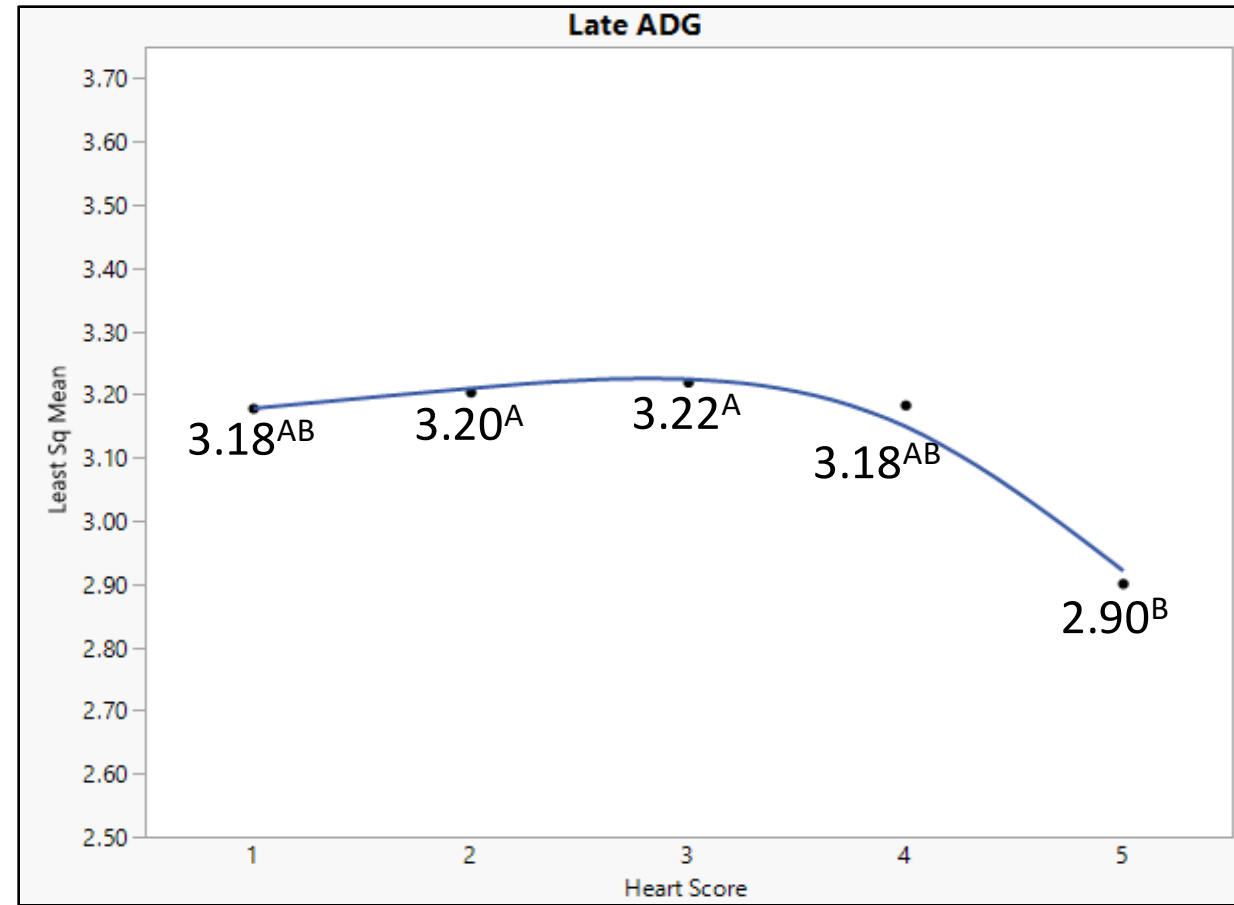
# Early ADG

## First 80 to 120 DOF

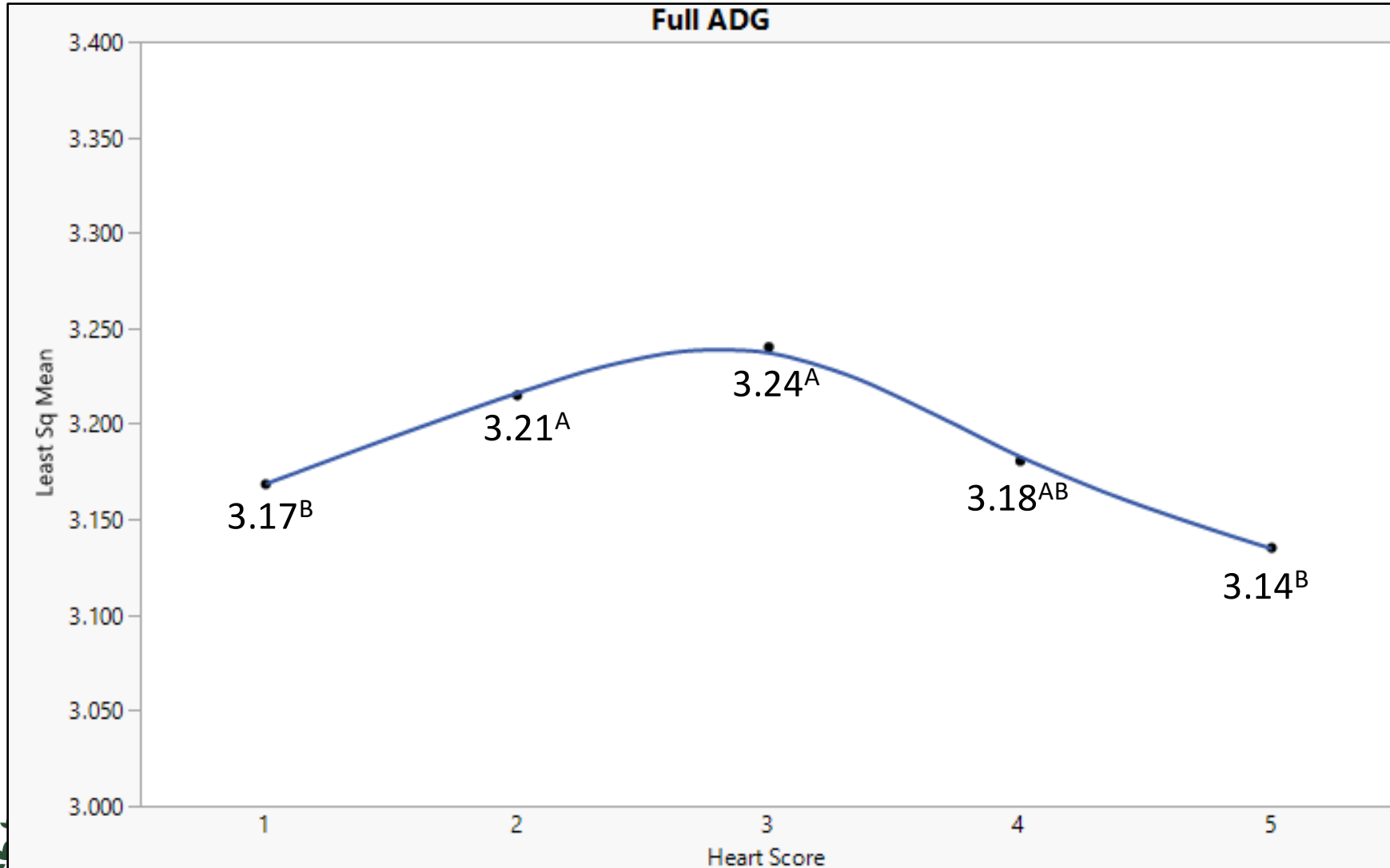


# Late ADG

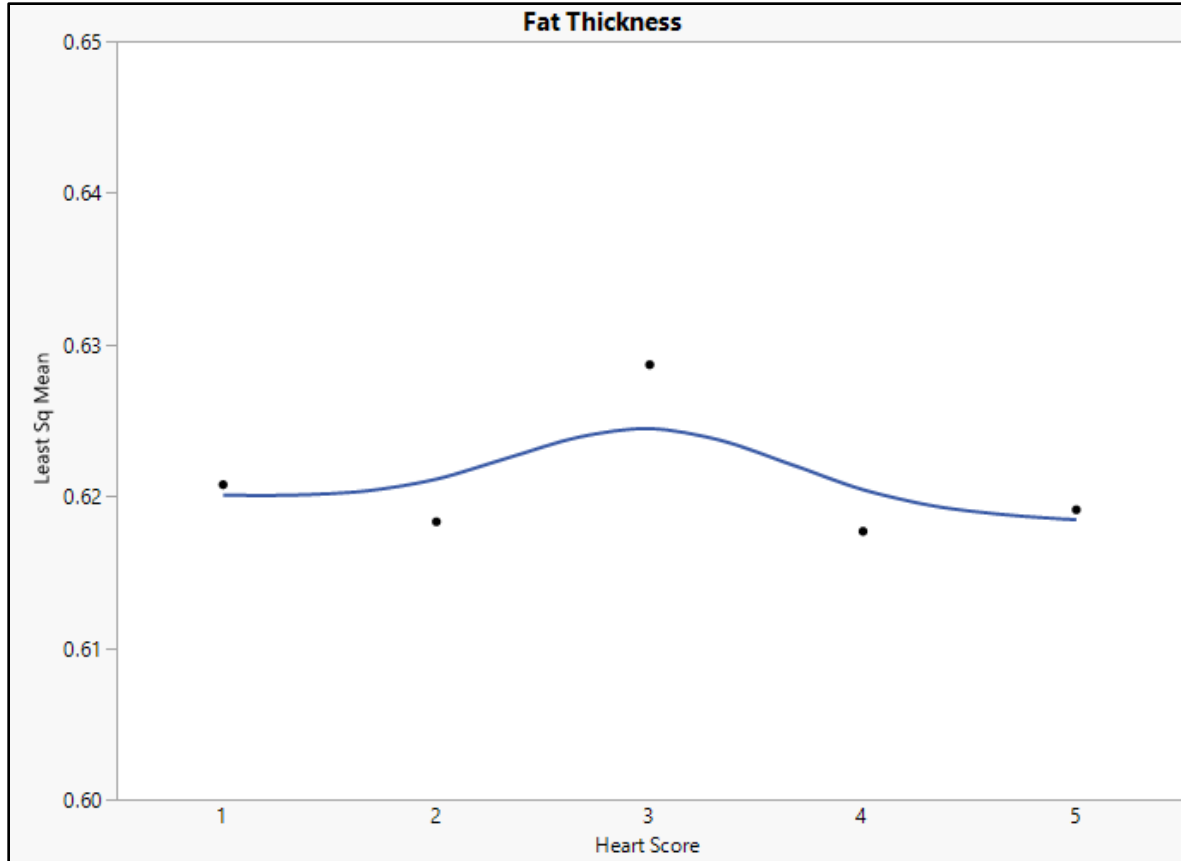
## Last 80 to 120 DOF



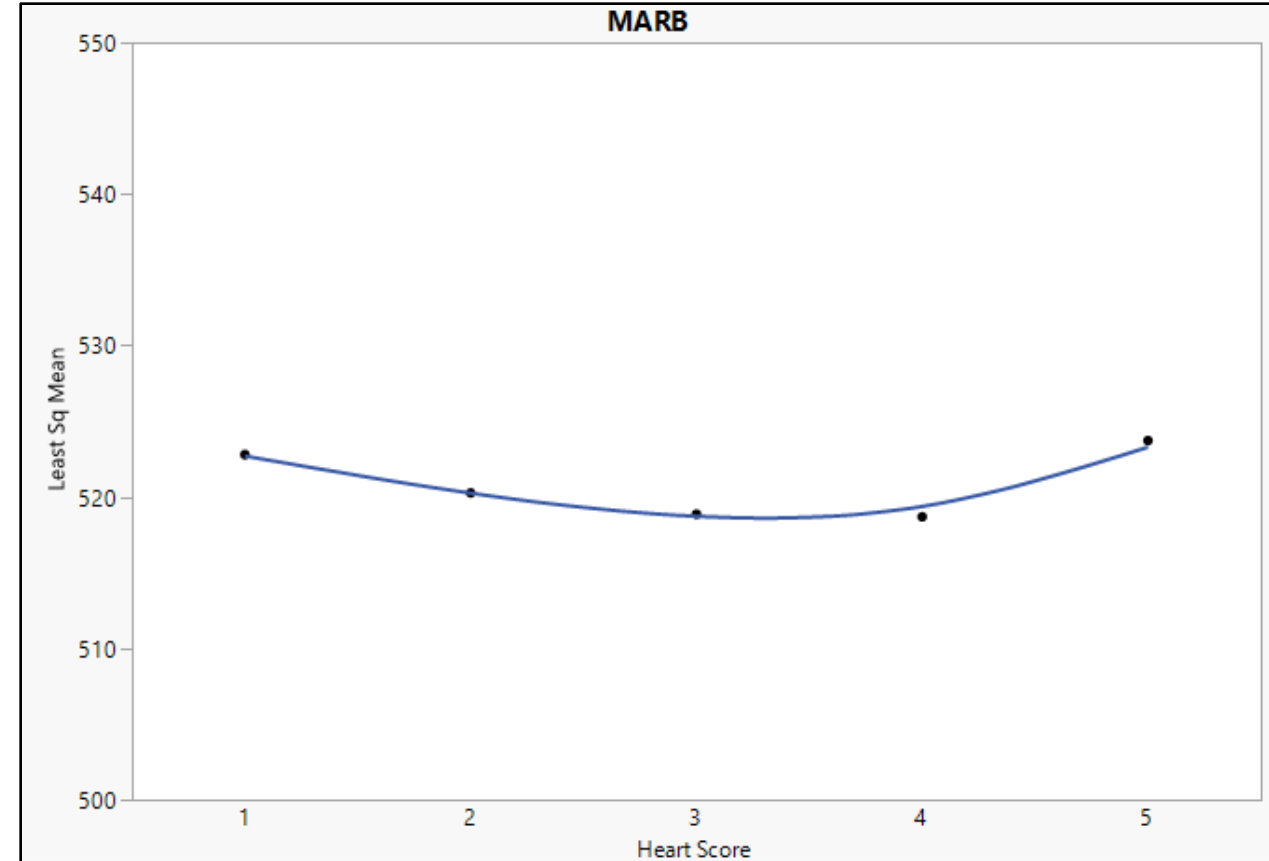
# ADG Processing to Harvest



# FAT Thickness



# Marbling Score



# Genetic Correlations to Carcass and Growth

Carcass and growth phenotypes captured on individuals with heart score phenotypes

Trait	Heritability
BCHF	0.343
HCW	0.391
BACKFAT	0.297
REA	0.295
MARB	0.373
ADG	0.216
DMI	0.304

THRGIBBSF90 threshold-linear model, 100K genotype density, %Angus covariate

# Genetic Correlations to Carcass and Growth

Carcass and growth phenotypes captured on individuals with heart score phenotypes

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MARB	0.373
ADG	0.216
DMI	0.304

BCHF Genetic Correlation	
HCW	0.399
BACKFAT	-0.120
REA	0.065
MARB	-0.112
ADG	0.266
DMI	0.238

THRGIBBSF90 threshold-linear model, 100K genotype density, %Angus covariate

# Validation of BCHF EPD

**Current Dataset:**

**11,003 genotypes + phenotypes**

**1,505 BCHF cases**

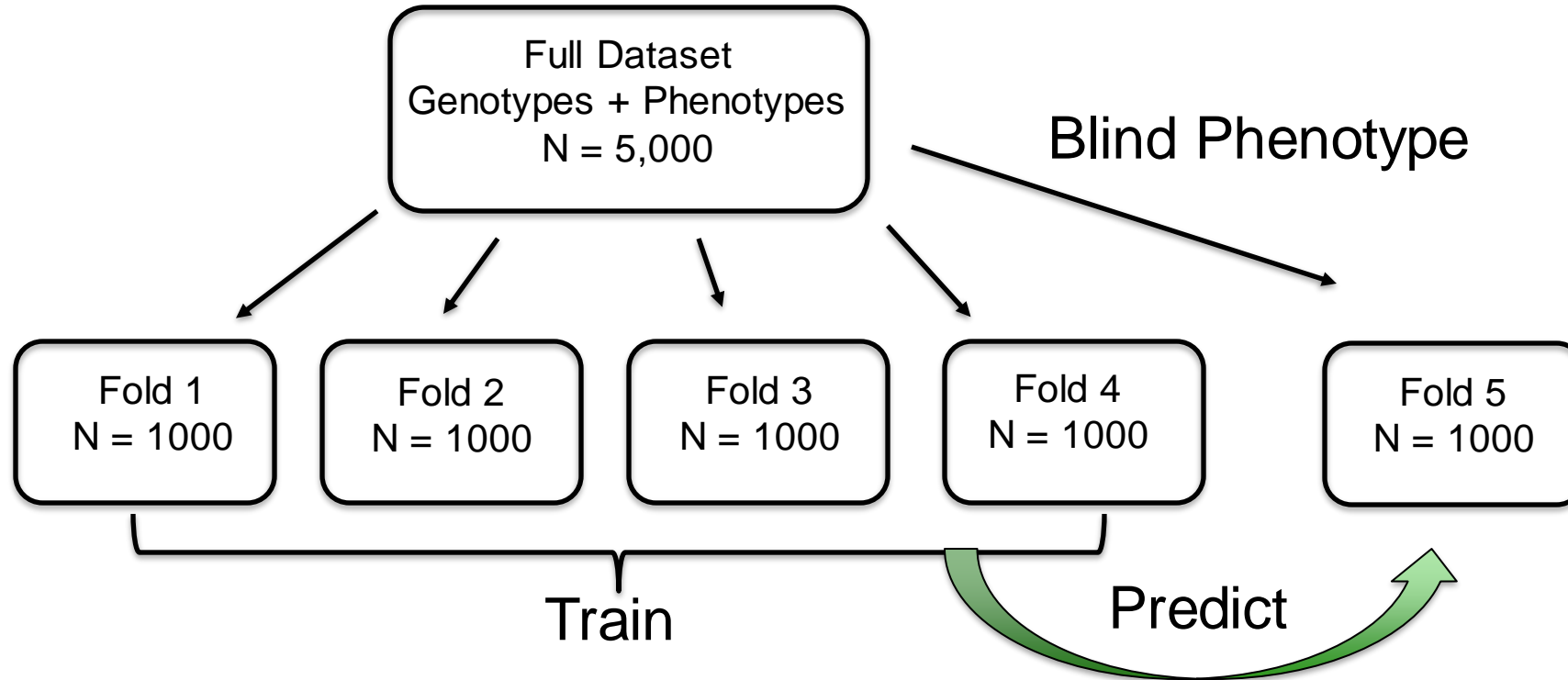


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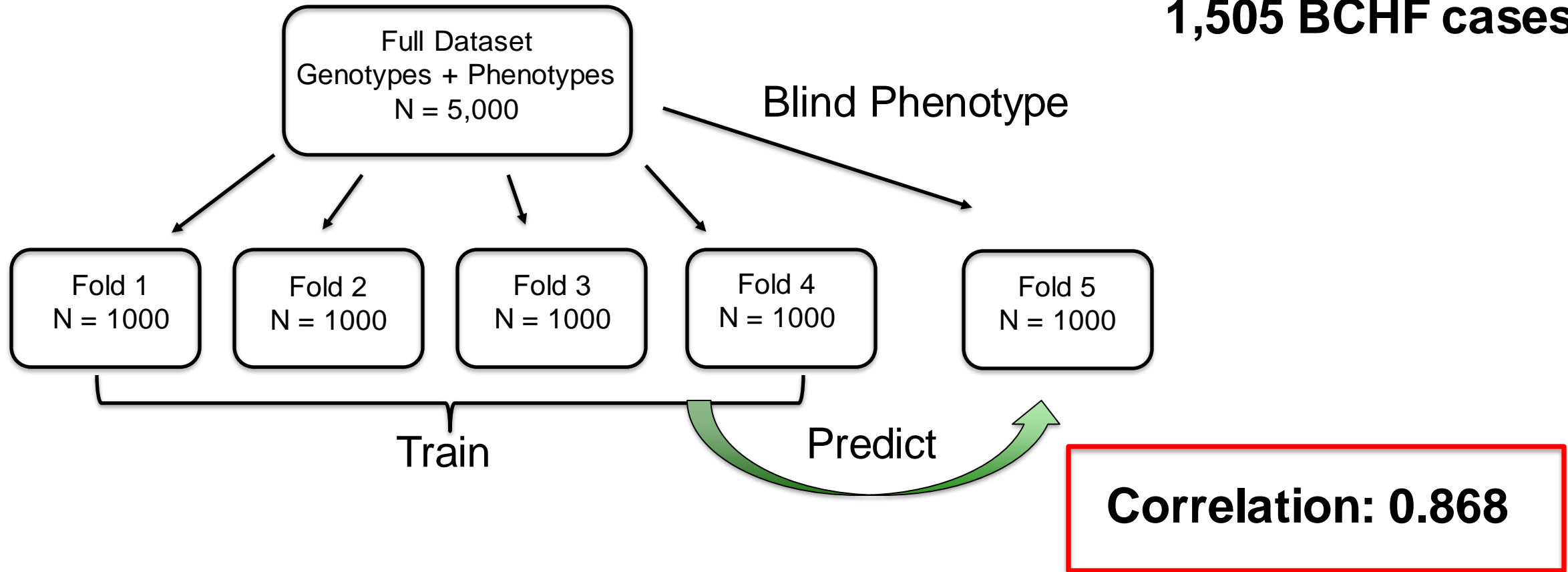


# Validation of BCHF EPD

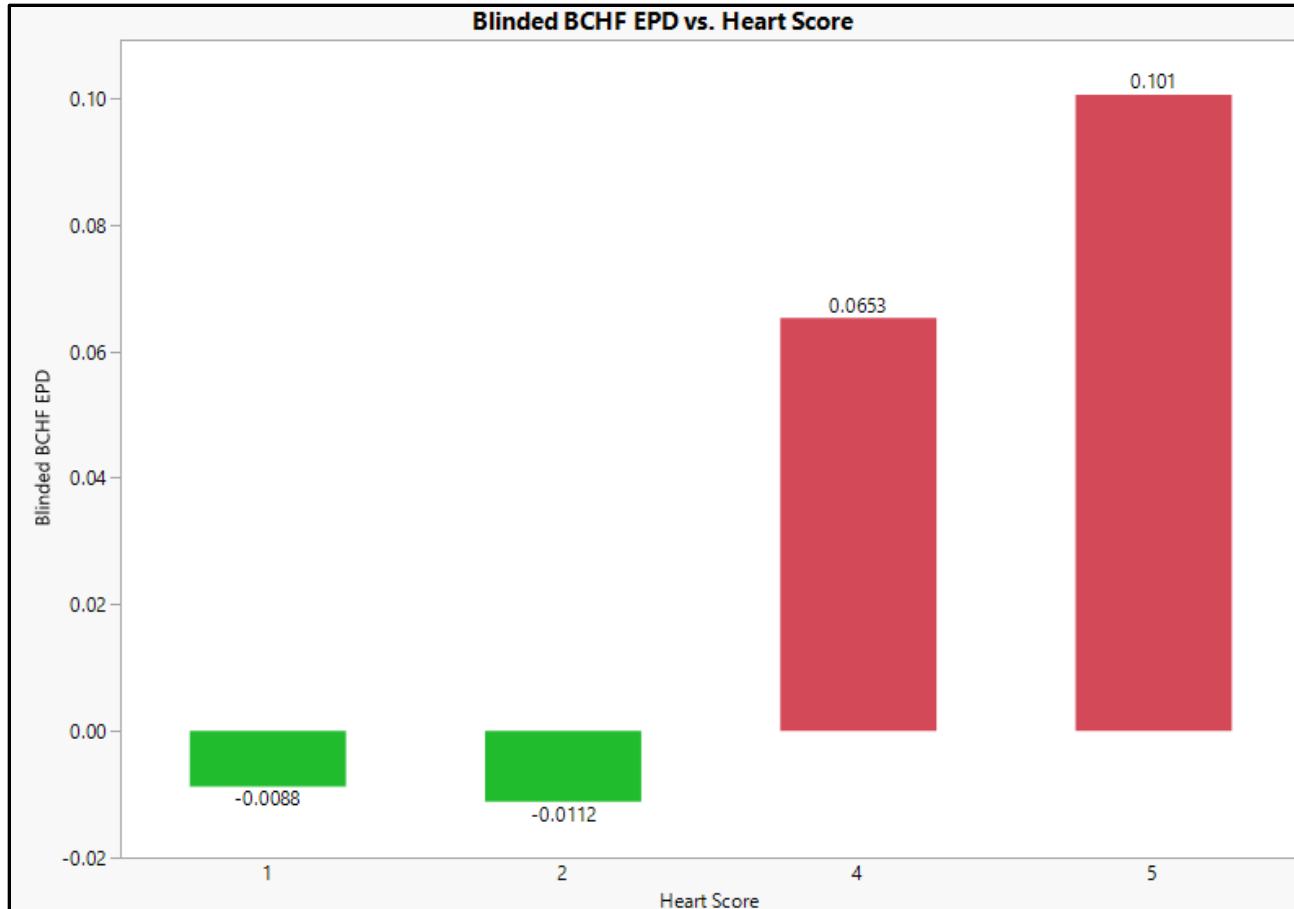
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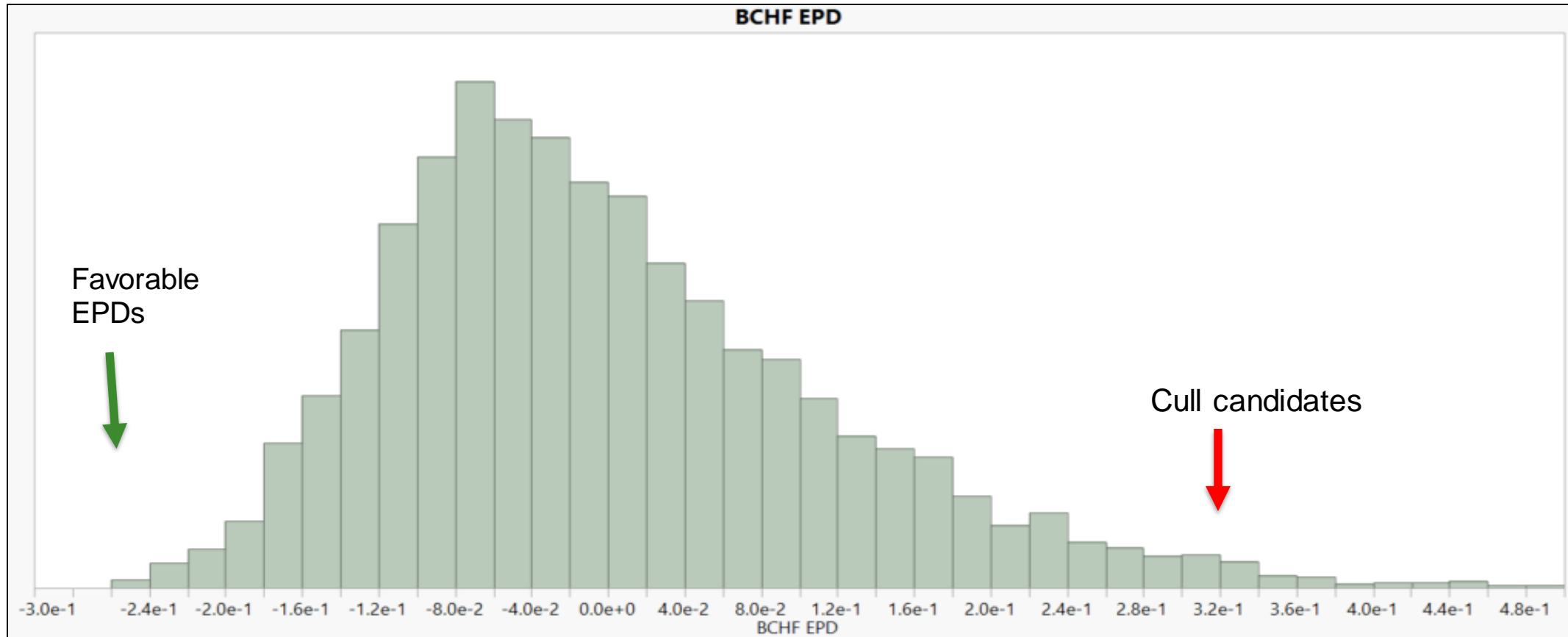
# Validation of BCHF EPD



Blinded, N=5,001

# Implementation

Path to improvement is an EPD that predicts risk of BCHF in progeny of tested Sire or Dam



Blinded, N=5,001



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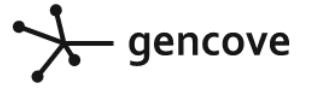
Beef

# Thanks!

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- Lex Flagel
- Joe Pickrell



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- Vickie Vargas
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- Tommie Crockett
- Alberto Ontiveros

