GWAS for hair length in Brangus heifers

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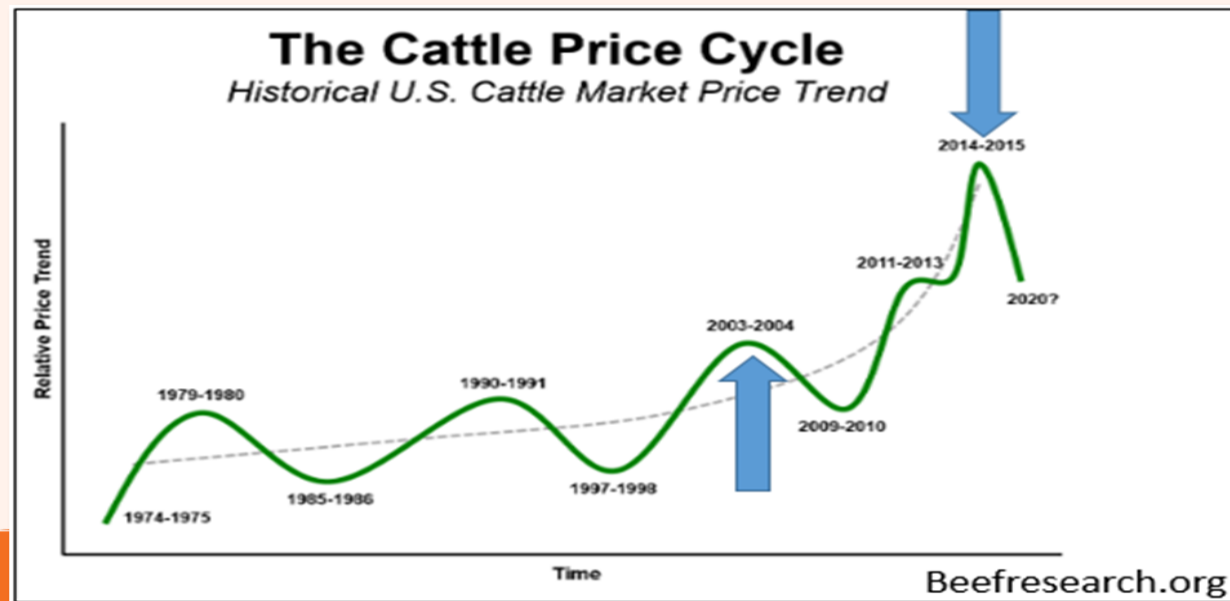**Department of Animal Sciences**
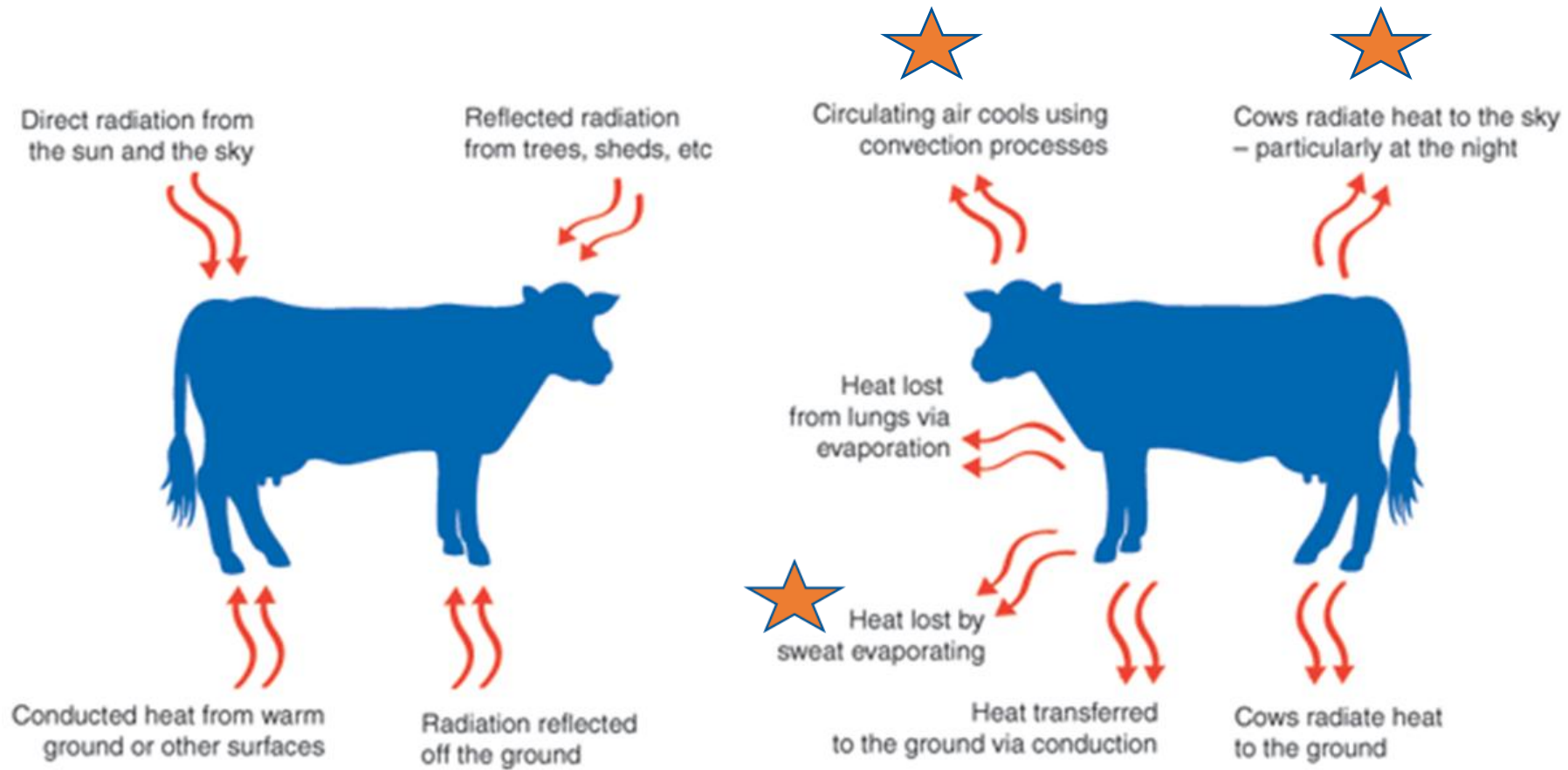
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Heat Stress

- Heat stress limits beef production

- The U.S. beef industry loses $369 million USD per year due to heat stress (St. Pierre et al., 2003)

The Cattle Price Cycle
Historical U.S. Cattle Market Price Trend

Relative Price Trend

2014-2015

2011-2013

2003-2004

2020?

1990-1991

2009-2010

1979-1980

1985-1986

1997-1998

1974-1975

Time

Beefresearch.org

Hair characteristics

Direct radiation from the sun and the sky

Reflected radiation from trees, sheds, etc

Circulating air cools using convection processes

Cows radiate heat to the sky – particularly at the night

Heat lost from lungs via evaporation

Heat lost by sweat evaporating

Conducted heat from warm ground or other surfaces

Radiation reflected off the ground

Heat transferred to the ground via conduction

Cows radiate heat to the ground

(Dairy Australia)

Objectives

- Identify genetic variants associated with:
  - Undercoat length
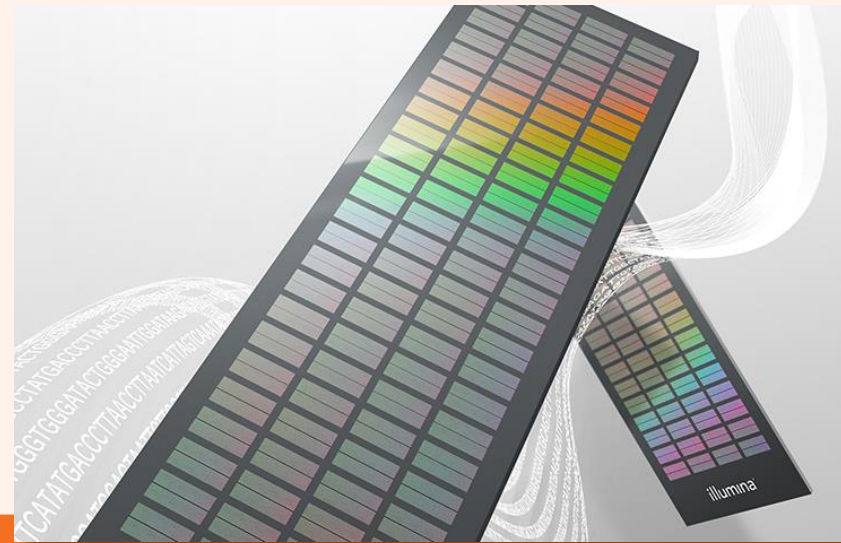 - Topcoat length

Hair Collection and Measurement

- Collected from 1,456 heifers in 2016 and 2017

- Measured with ImageJ
  - 5 short hairs = undercoat
  - 5 long hairs = topcoat

Short hair   Long hair
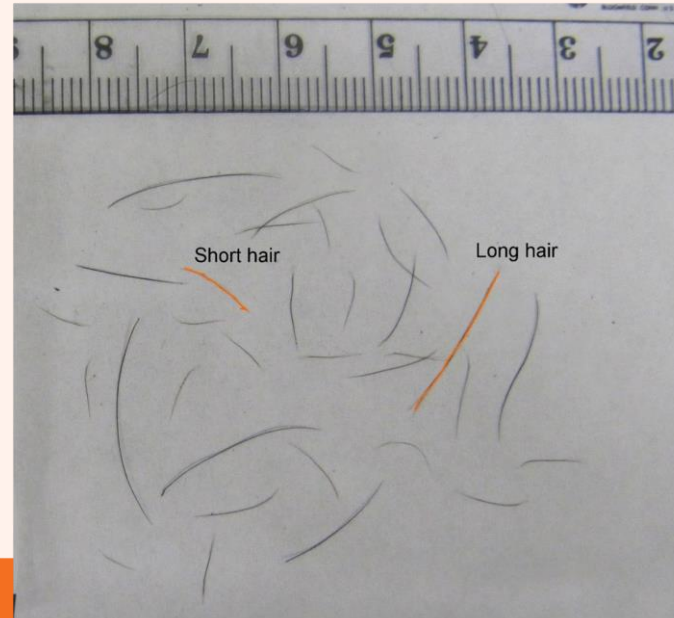
Genotyping

- DNA extracted from blood samples

- Genotyped with Bovine GGP F250 array

- After quality control 109,538 SNP for analysis
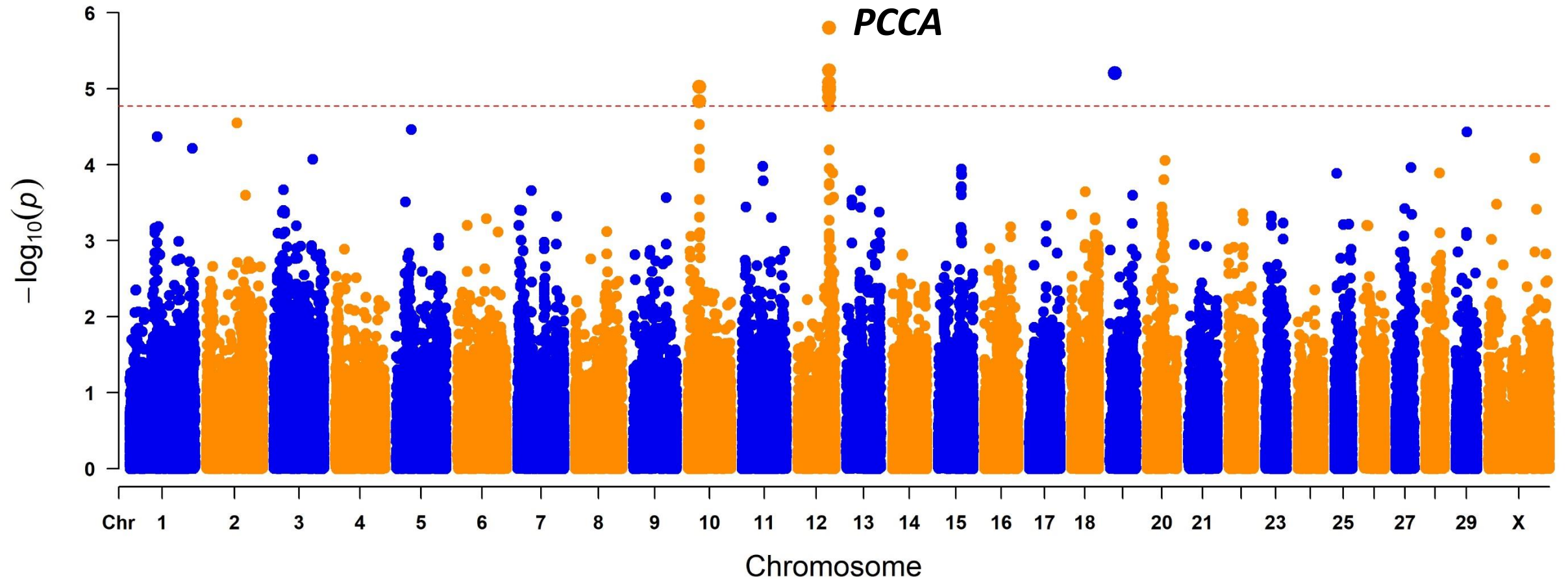 - MAF = 0.05
  - Call rate = 0.10

Association Analysis

- Phenotypes were pre-adjusted for collection group
  - Using linear model procedures in R

- Univariate procedures of GEMMA
  - GRM fitted to account for genetic covariance among animals
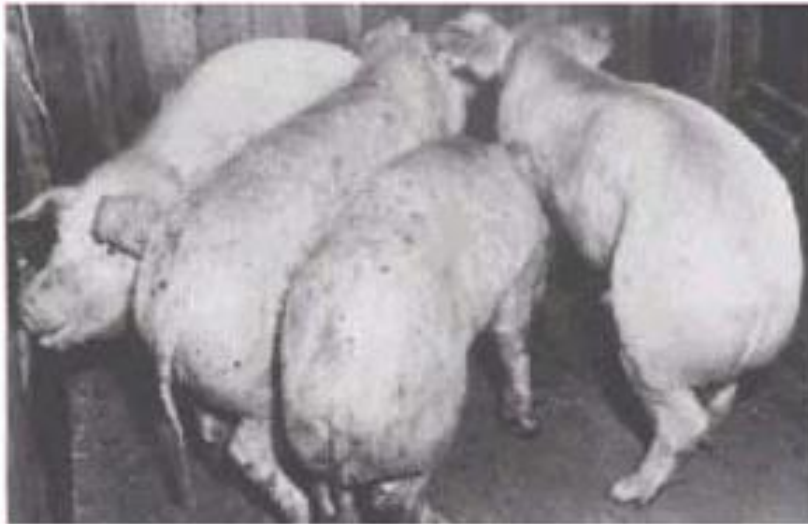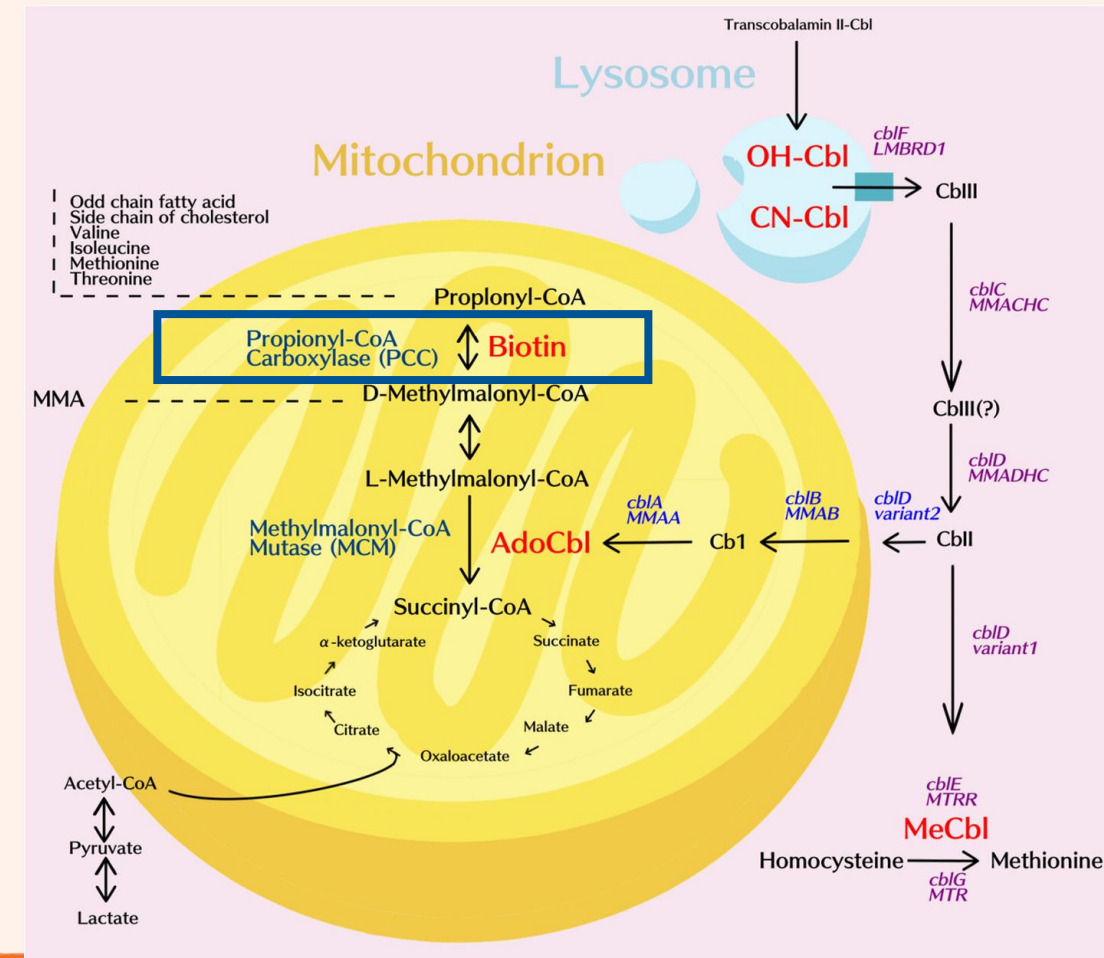
- Benjamini-Hochberg FDR = 0.20

Results: Undercoat

- *Propionyl-CoA Carboxylase Subunit Alpha*
  - Biotin transport and metabolism

The two pigs in the middle are biotin deficient. Note the hair loss and dermatitis.
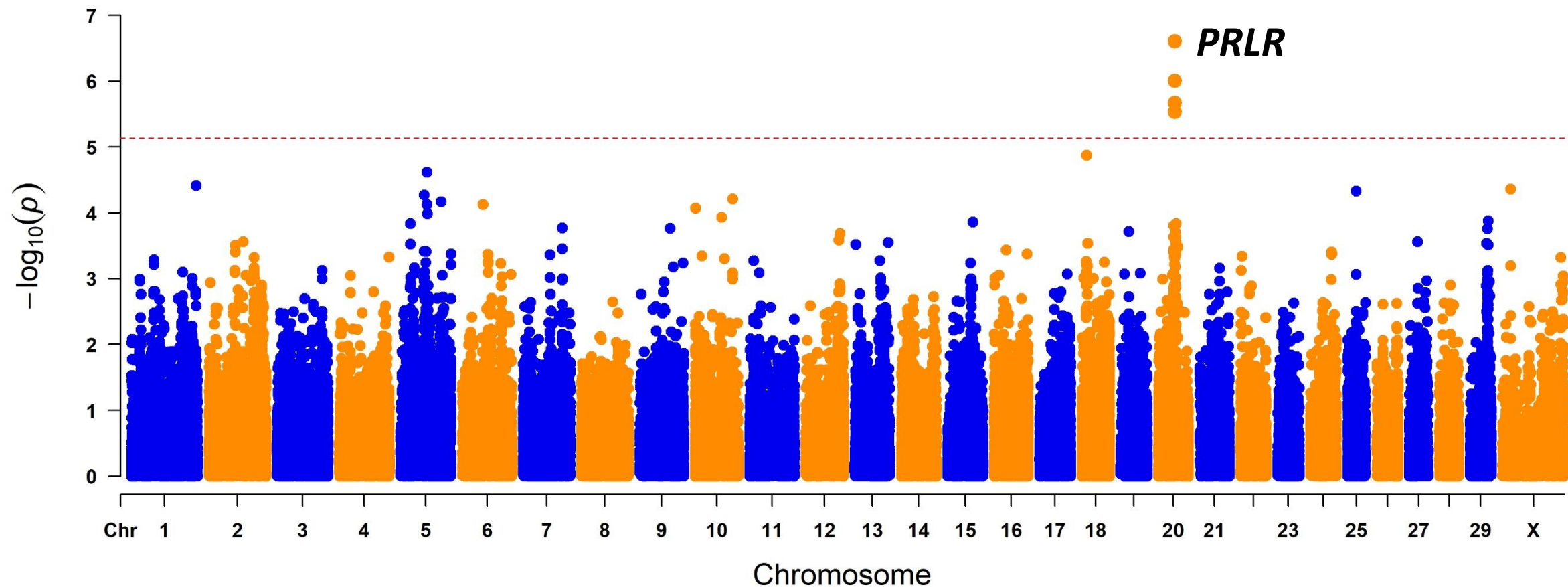
Courtesy of T.J. Cunha and Washington State University
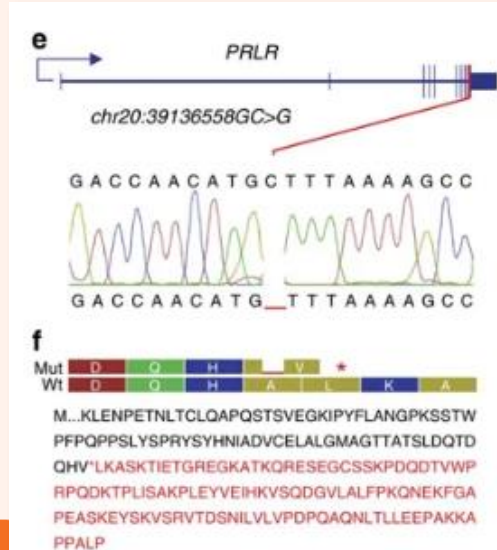

(Chu et al., 2019)

Results: Topcoat

PRLR

- *Prolactin Receptor*

- *SLICK* mutations *PRLR* impacts hair length in cattle

Littlejohn et al., 2014

Conclusions

- These genetic variants may contribute to a shorter hair coat and more thermotolerant animals

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