Local Genetic Adaptation in Beef Cattle

Jared Decker
Assistant Professor
Beef Genetics Specialist
Computational Genomics

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- [ ] Select on Genetics
- [ ] Reliable EPDs for Young Animals
- [ ] Match Cattle to Environment

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E FAIR

Select on Genetics

Reliable EPDs for Young Animals

Match Cattle to Environment

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Local Adaptation is Heat Stress

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Local Adaptation is More Than Heat Stress

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Congestive Heart Failure

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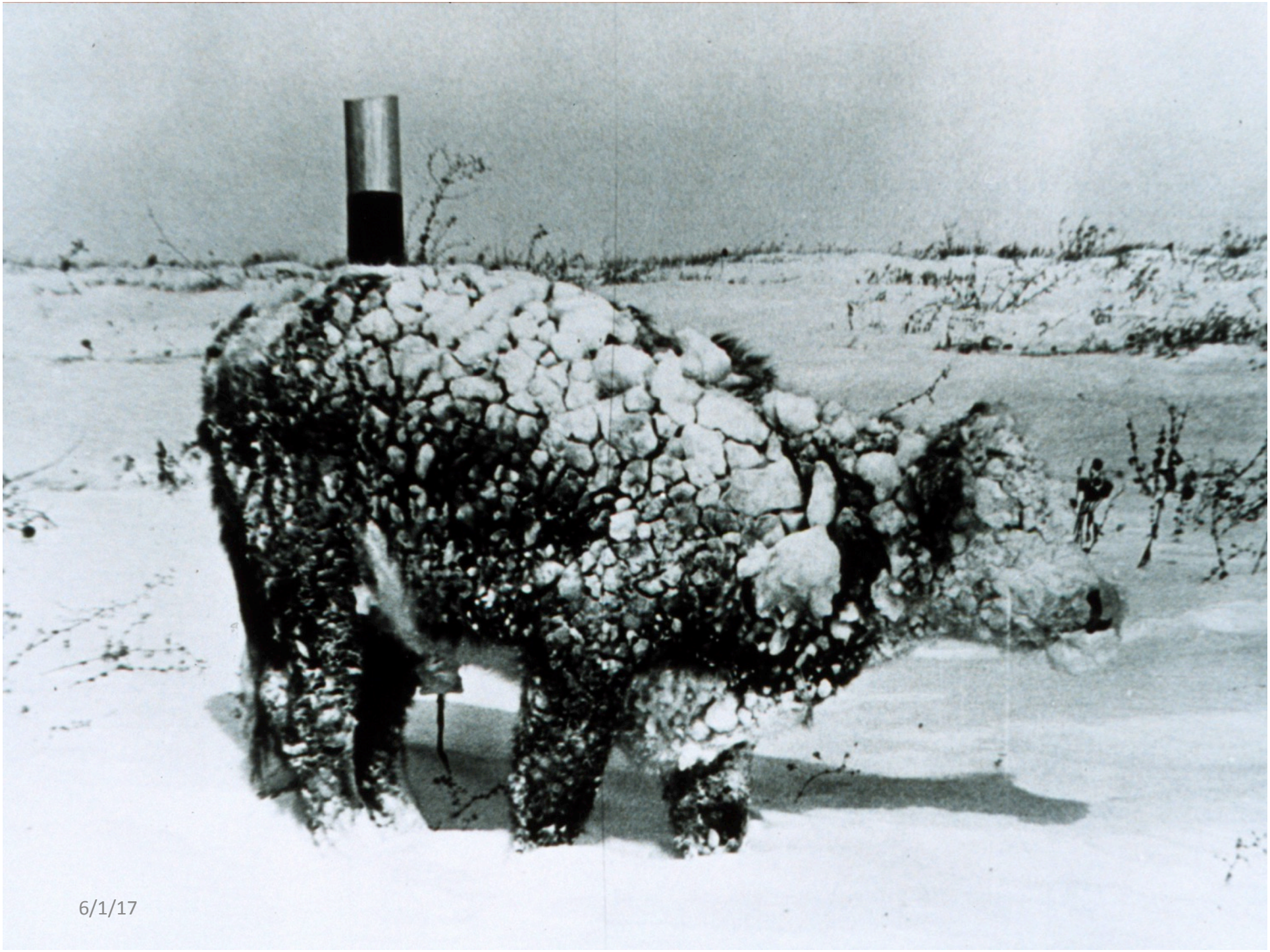


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50 LBS. NET
KENTUCKY
31
TALL
FESCUE

Fescue Toxicosis

- 1993 estimate: Fescue toxicosis cost the U.S. beef industry $609 million annually (Hoveland, 1993)
- Adjusting for inflation, over $1 Billion in 2017 dollars
- Ignores increases in feeder calf and grain prices

- How does a breeder select for fescue tolerance?


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- **Data, technology, and methods are available**
- We ***must*** provide beef producers with the necessary tools to effectively identify animals suited to their region

Our Approach

- Identifying selection between regions
- Design region-specific genomic predictions focusing on variants responding to local adaptation selection

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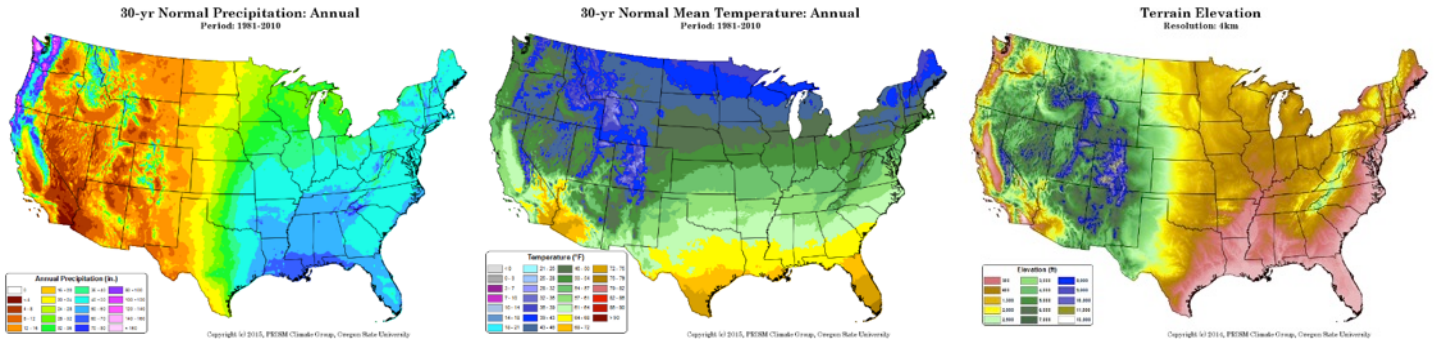
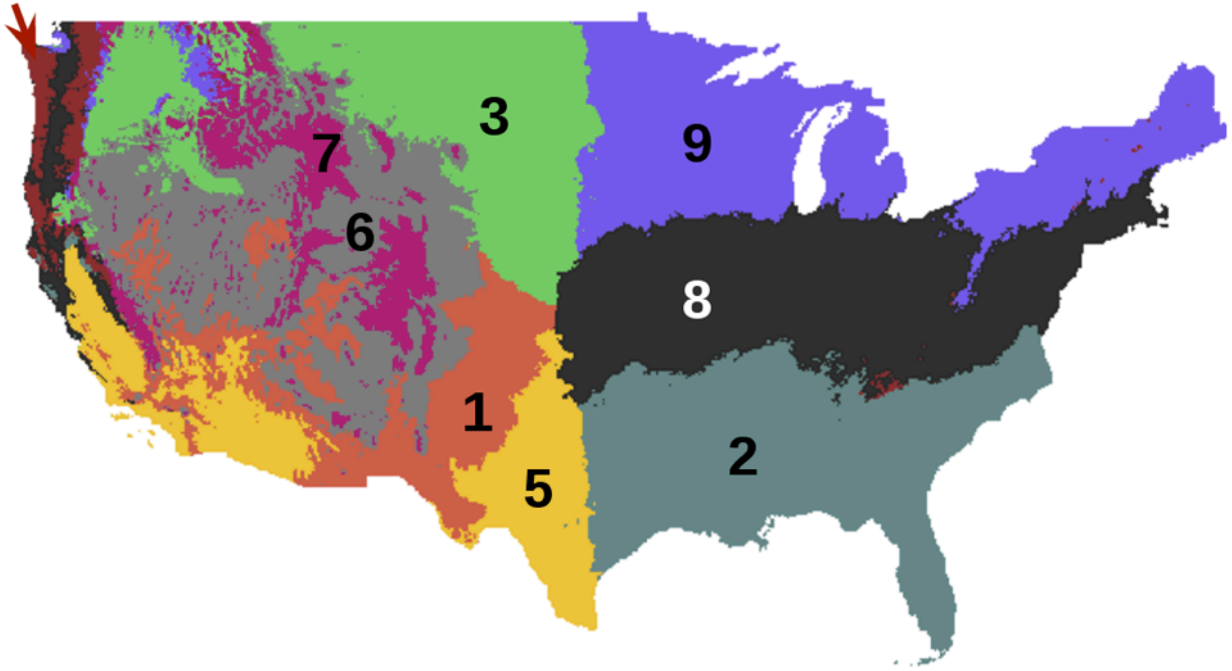
- Supplemented by analyses of body temperature, hair shedding, and water intake.



- **30 Year Normals**
  - Precipitation
  - Temperature
  - Elevation
- K-means clustering
- 9 climate regions
- Zip-code → "Climate Cohort"



PRISM GROUP

Selection between regions

If animal is adapted to a region:

- It performs well
- Produces progeny in that region

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- Culled, no progeny

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Selection between regions

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- It under performs
- Culled, no progeny

This selection changes frequency of DNA variants responsible for local adaptation

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Selection between regions

- Identify variants associated with differences in many traits
  - Heat
  - Cold
  - Altitude
  - Humid
  - Arid
  - Parasite
  - Hair Shedding
  - Immunity
  - Water Intake
  - Feed Intake
  - **Others we can't measure or wouldn't think to measure**
- Use multiple methods with significance tests
- Utilizes 140 year history of cattle in regions across the US

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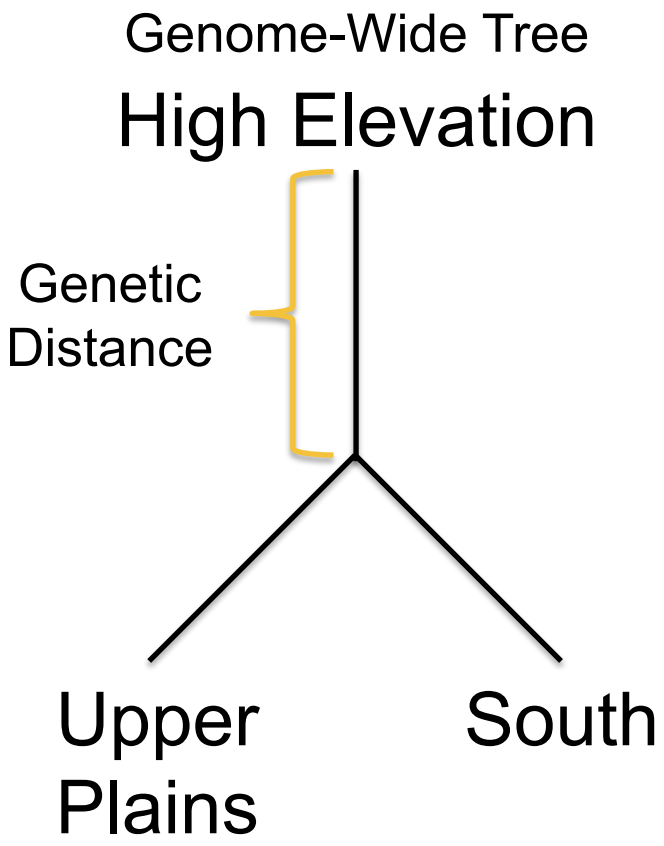
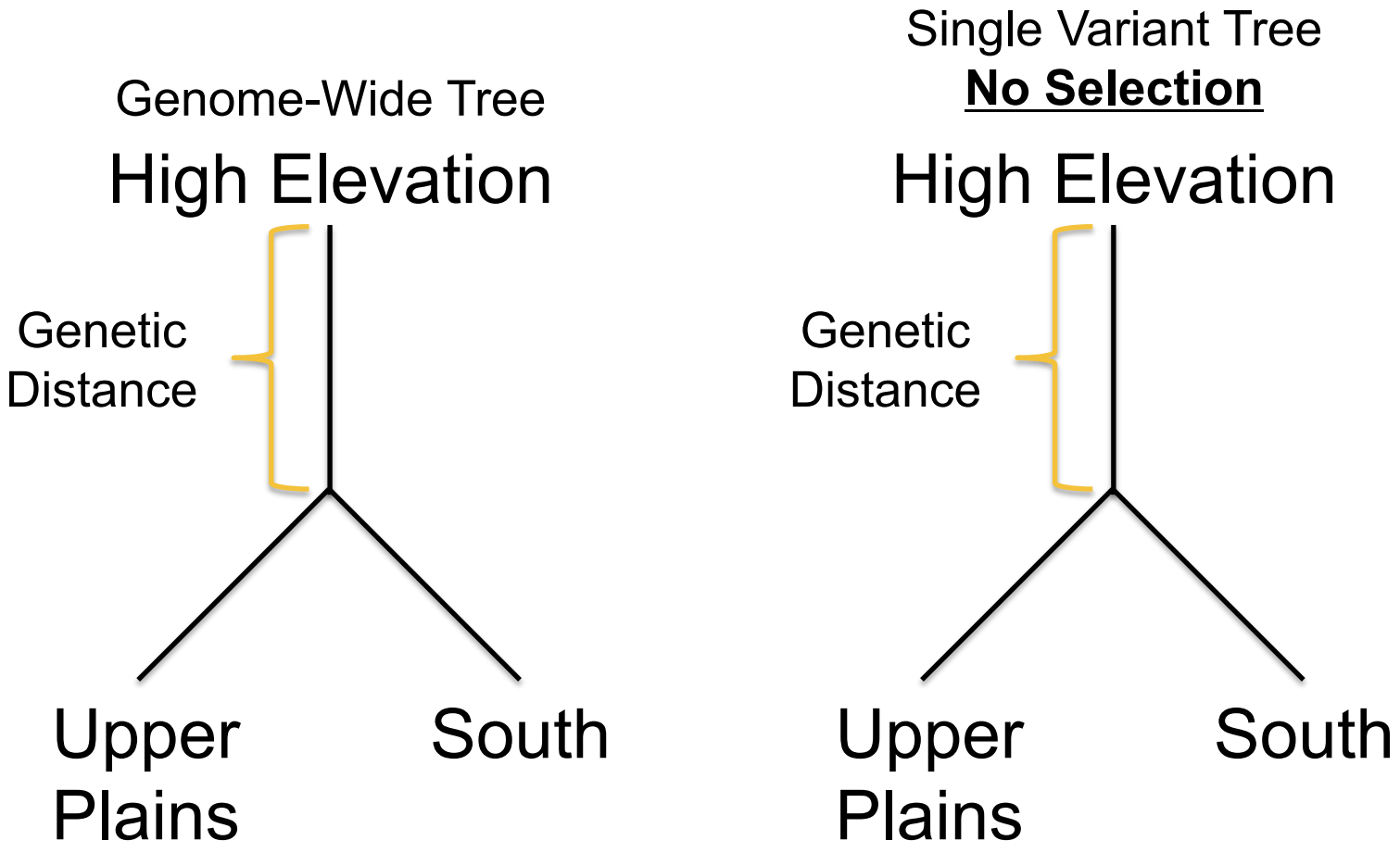
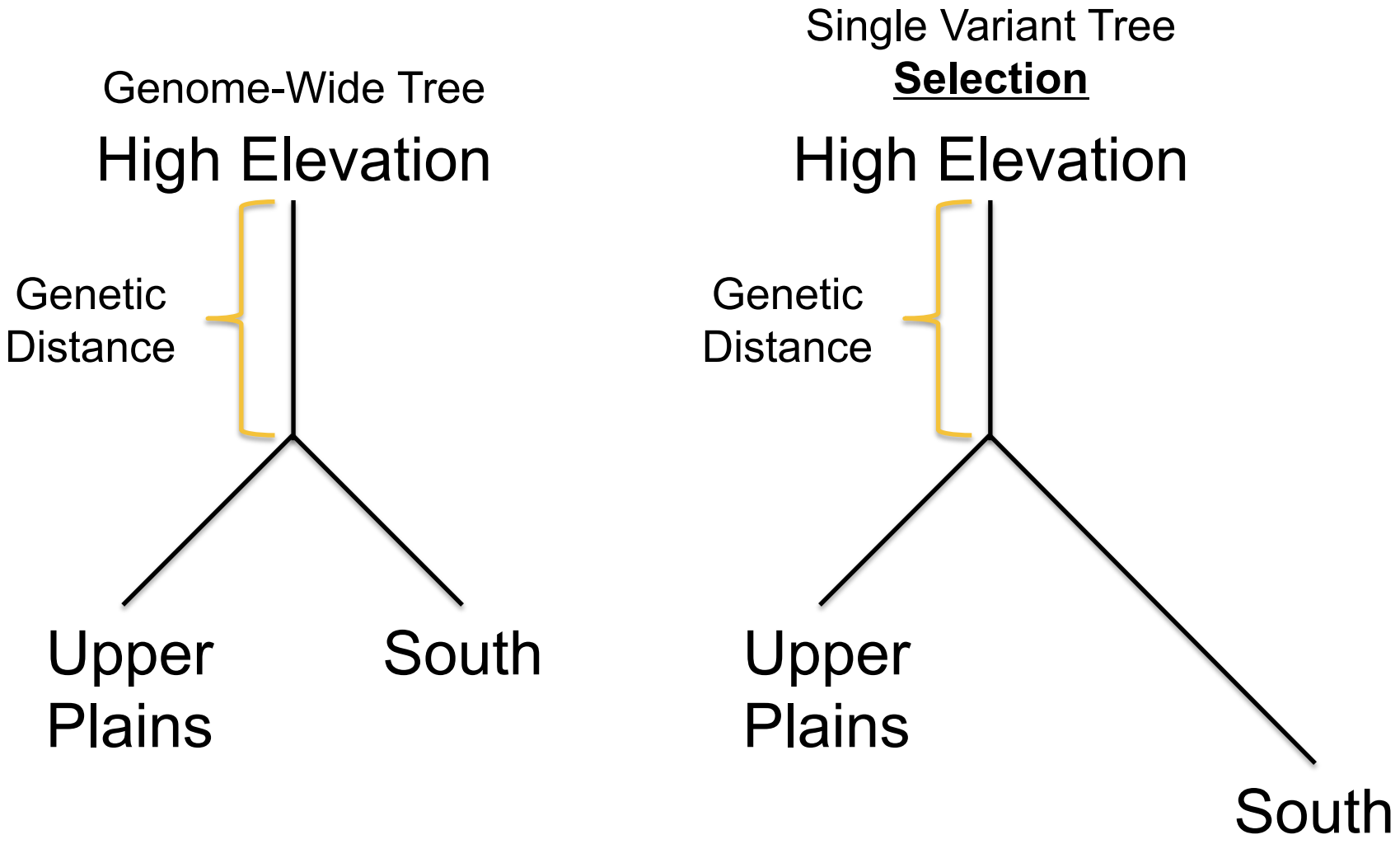
Selection between regions



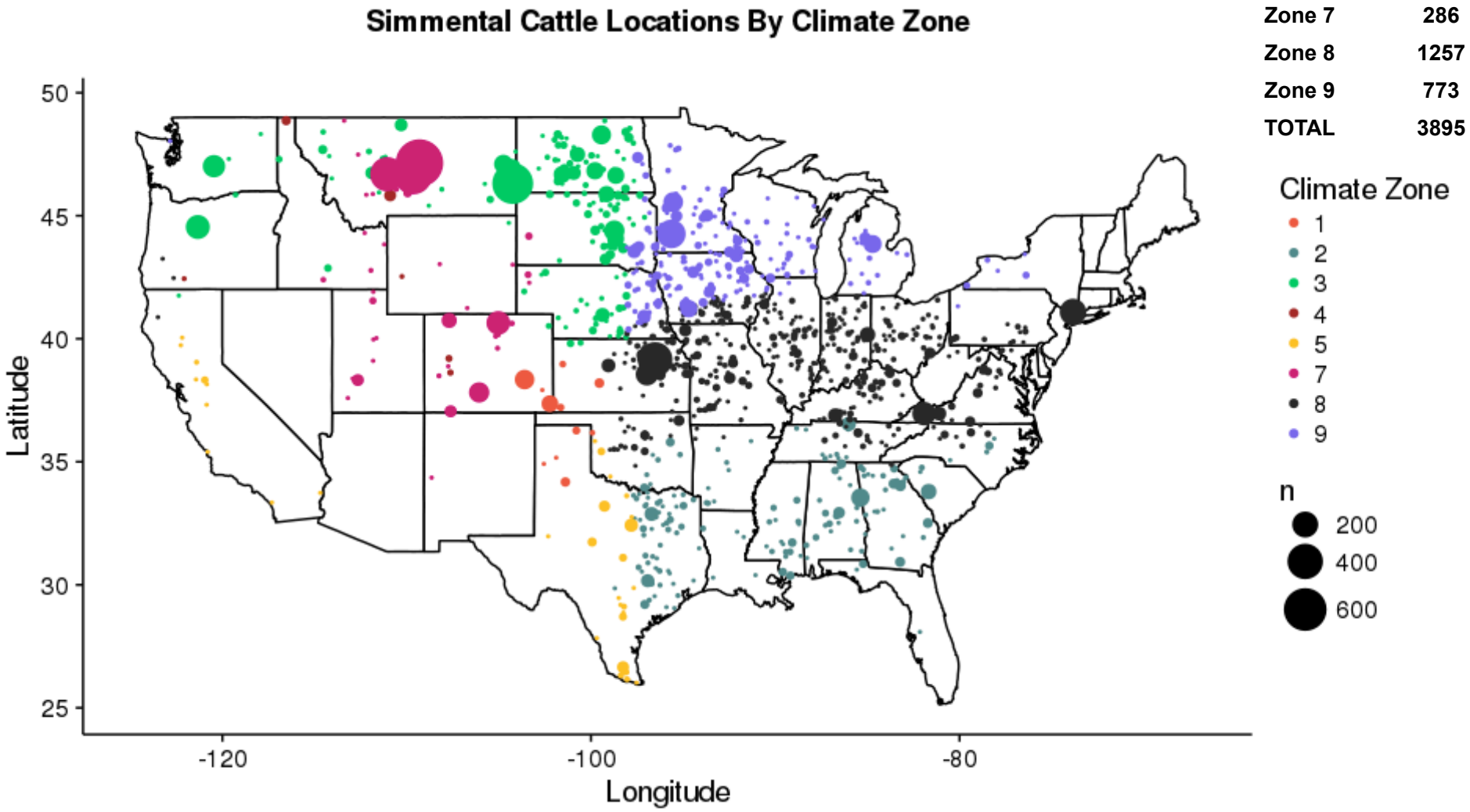
Selection between regions



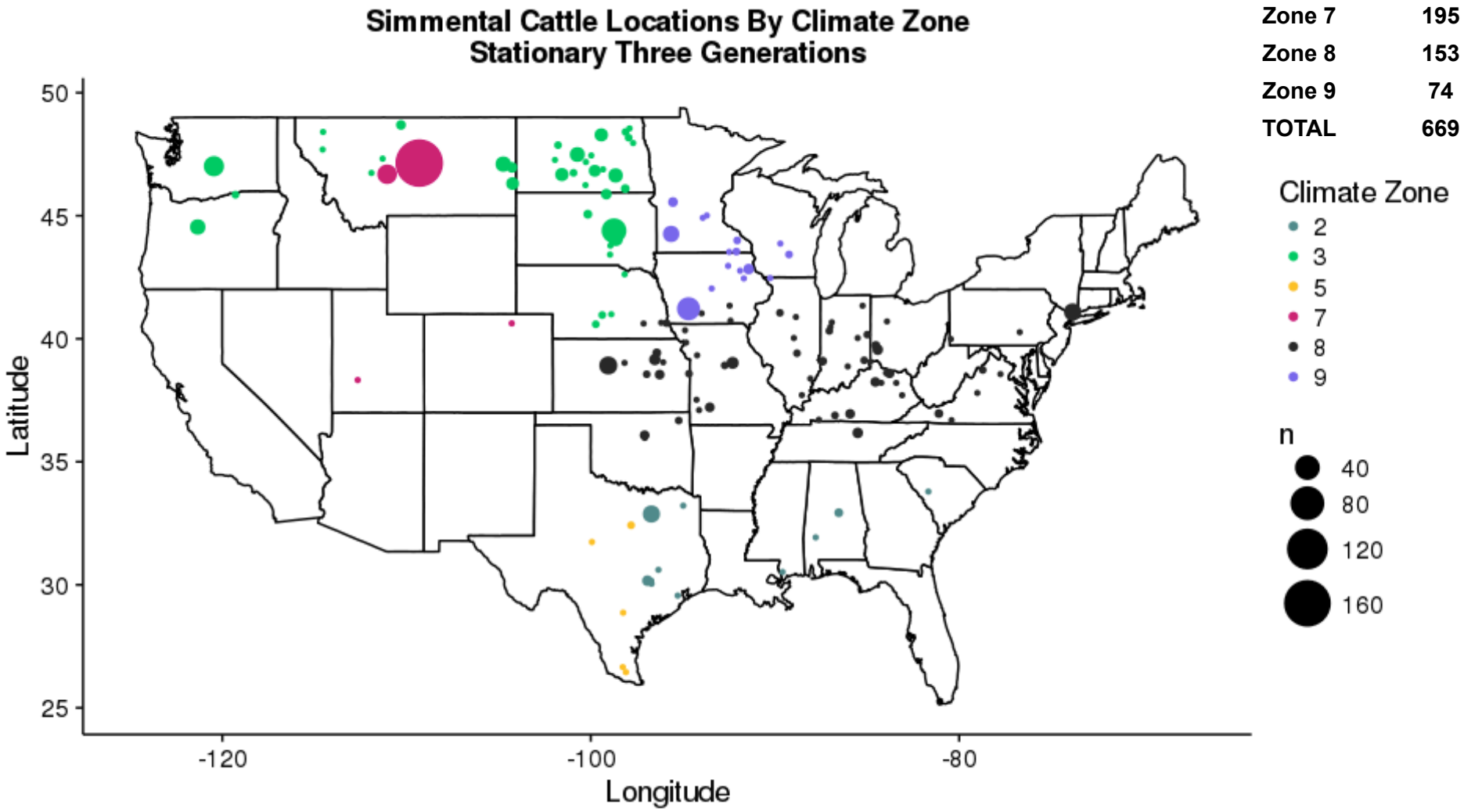
Selection between regions



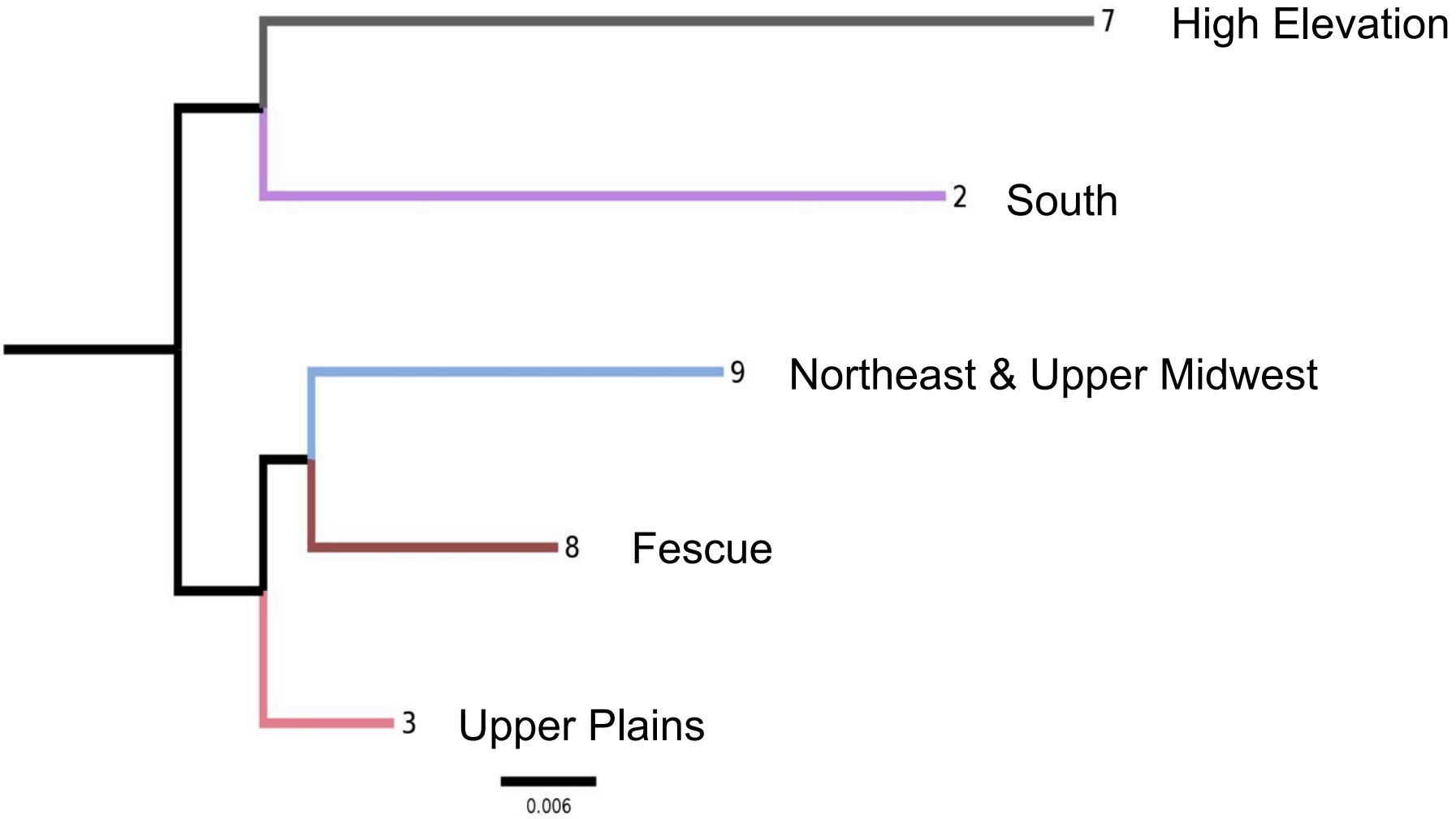
Zone 1	122
Zone 2	411
Zone 3	920
Zone 4	15
Zone 5	111
Zone 6	0
Zone 7	286
Zone 8	1257
Zone 9	773
TOTAL	3895



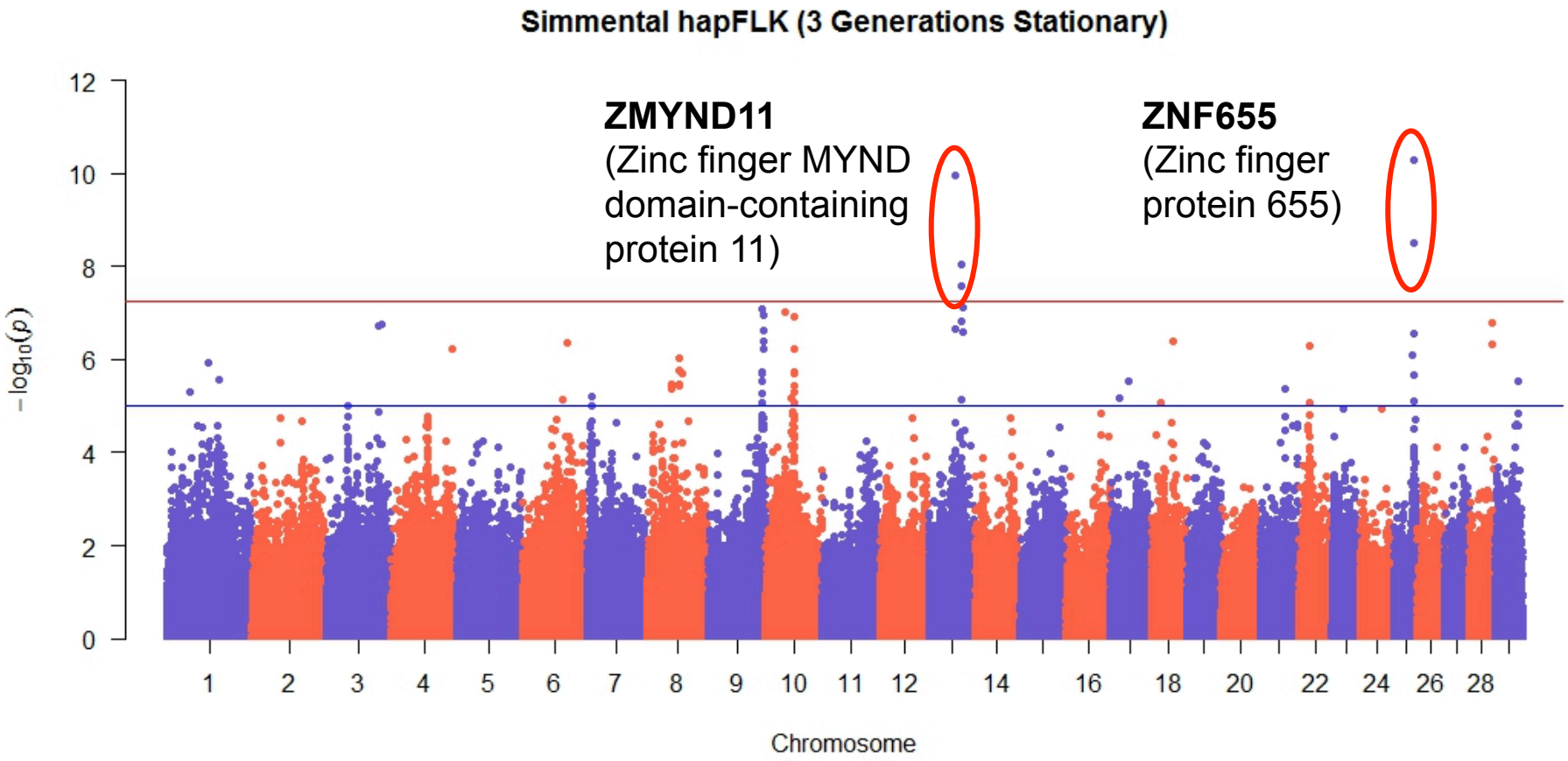
Zone 1	0
Zone 2	33
Zone 3	208
Zone 4	0
Zone 5	6
Zone 6	0
Zone 7	195
Zone 8	153
Zone 9	74
TOTAL	669



hapFLK -- 3 Gen Stationary Tree



Selection Scan



Region-Specific GE-EPDs and Indexes

- Gene-by-environment interactions and local adaptation lead to re-ranking of animals between environments

Environment 1

Animal	WW EPD	Milk EPD	MW EPD	$W
Bull A	56	27	25	52
Bull B	49	23	27	42

Region-Specific GE-EPDs and Indexes

- Gene-by-environment interactions and local adaptation lead to re-ranking of animals between environments

Environment 1

Animal	WW EPD	Milk EPD	MW EPD	$W
Bull A	56	27	25	52
Bull B	49	23	27	42

Environment 2

Animal	WW EPD	Milk EPD	MW EPD	$W
Bull A	47	22	21	40
Bull B	48	23	27	43

Region-Specific GE-EPDs and Indexes

- Train genomic predictions for 9 different regions

Region-Specific GE-EPDs and Indexes

Animal gets prediction for all 9 regions

- Animal must be genotyped
  - Accuracy
  - Predictions for all 9 regions (young animal only has data for region of birth)
  - ***Match animal to region***

Hair Score 5

Hair Score 4

Hair Score 3

Hair Score 2

Hair Score 1

A Steak in Genomics

Local Genetic Adaptation Grant
http://blog.steakgenomics.org/2016/05/local-genetic-adaptation-grant.html

Producers invited to participate in research to identify cows that match their environment
http://blog.steakgenomics.org/2016/04/producers-invited-to-participate-in.html

Hair shedding scores: A tool to select heat tolerant cattle
http://articles.extension.org/pages/74069/hair-shedding-scores:-a-tool-to-select-heat-tolerant-cattle

Photos curtesy Trent Smith, Mississippi State

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Did She Stay or Did She Go?

EPD	T-statistic	P-value
Birth Weight	4.29	<.0001
Milk	-5.37	<.0001
Fat Thickness	-3.69	0.0002
Calving Ease Direct	-3.49	0.0005
Teat Size	-3.44	0.0006
Calving Ease Maternal	-3.35	0.0008
Udder Attachment	-3.15	0.0017
Milk+Gain	-2.93	0.0035
Mature Cow Weight	2.5	0.0128
Weaning Weight	1.52	0.1277
Yearling Weight	1.3	0.1938
Carcass Weight	1.04	0.2974
Marbling	-0.87	0.3873
Scrotal Circumference	0.45	0.6522
Ribeye Area	0.16	0.876

Preliminary Data

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Respond to Survey, Be Entered To Win $100!

- We are conducting a survey looking at the attitudes and beliefs regarding genetics and technology in the beef industry.
- Five survey participants will be randomly selected to receive a $100 Visa gift card.
- Open until June 16th.

http://blog.steakgenomics.org/2017/05/BeefSurvey.html

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Acknolwedgements

MU Animal Genomics Group

- Dr. Bob Schnabel
- Dr. Jerry Taylor
- Troy Rowan
- Jesse Hoff
- Lynsey Whitacre
- Sara Nilson
- Harly Durbin
- Mike MacNeil

Project Funding:

- USDA NIFA Funding Grant No. 2016-68004-24827 “Identifying local adaptation and creating region-specific genomic predictions in beef cattle.”
- Angus Foundation
- Gelbvieh Foundation
- American Simmental-Simbrah Foundation

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Thanks!

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