Does quantitative genetics work?

Ron Lewis, Department of Animal Science,
University of Nebraska-Lincoln

Genetics 101

12th Annual Katahdin Hair Sheep International Expo & Sale

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My talk

- Some principles
  - Breeding values
  - Selection index
- Genetic gains achieved
- An example
  - Weaning weight
- Summing up

What is genetic evaluation about?

- Genetic evaluation is about parsing

$$P = G + E$$

Genotype
- WWT: 1.10 lb
- MWWT: 2.53 lb
- NLW: 26.9 %
- NLB: 11.6 %

Breeding values

- Breeding value (BV)
  - The value of the genes that a parent transfers to its offspring for a given trait
- Seldom known and therefore must be estimated (EBV)
- Estimate becomes more accurate when a trait is
  - More heritable
  - More persistently measured
    - Particularly if on closer relatives

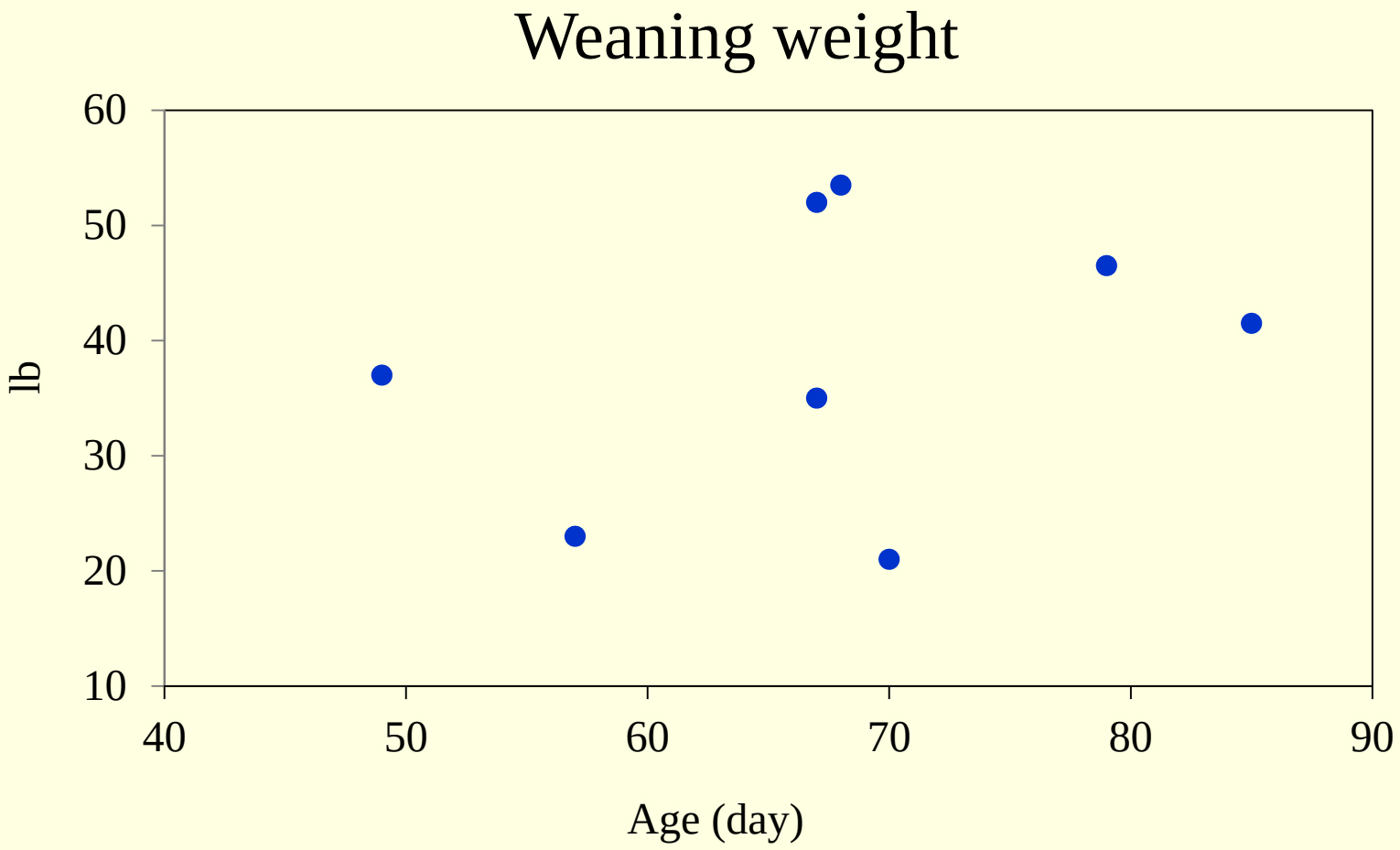
Selection index

- Breeders seldom wish to select for one trait in isolation
  - Profit usually depends on several traits
  - Optimising profit therefore depends on placing the right emphasis on each trait to be improved
- A selection index predicts genetic merit for a combination of several traits
  - Key to their design is deciding on which traits to improve

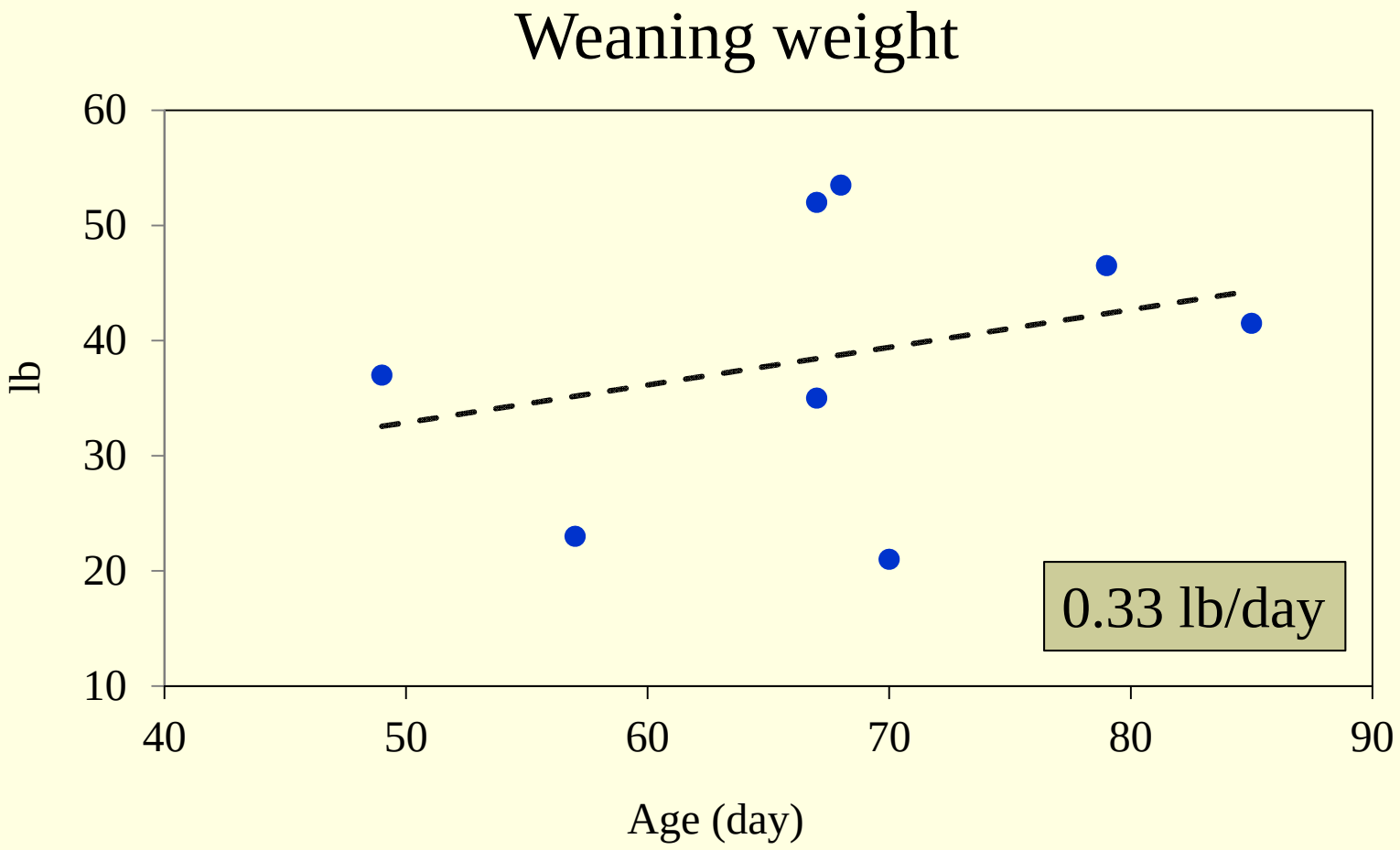
An example

- Eight Katahdin ram lambs
  - From 3 sires
  - Born mid-Oct. to mid-Nov.
  - Reared at Dale Bumpers Small Farms Research Center, USDA-ARS, Booneville, AR
- Comprehensively performance recorded
  - Weights and body condition scores
  - Ultrasound muscle and fat depths
  - Fecal egg counts, FAMACHA scores, PCVs
  - Scrotal circumference

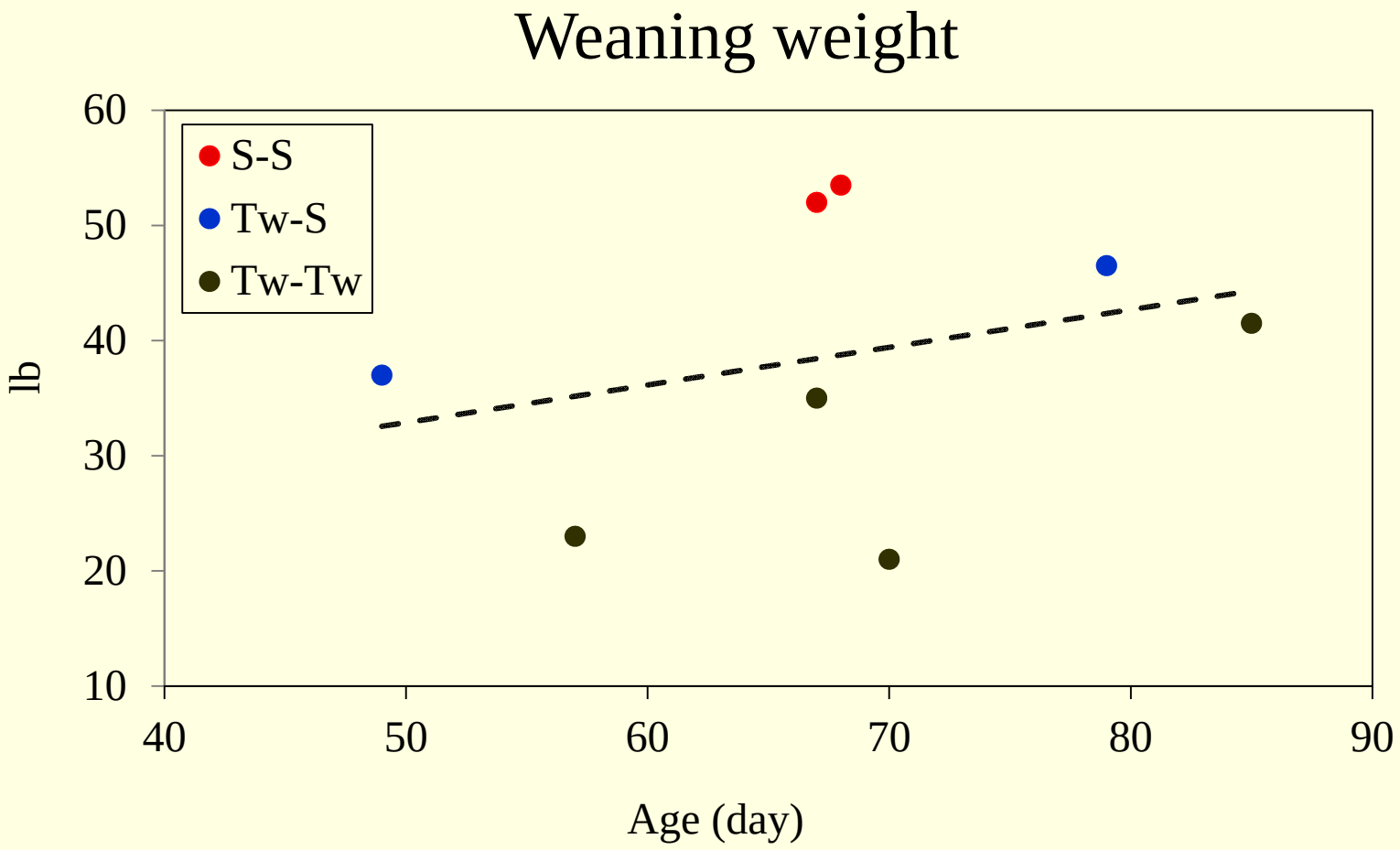
Weaning weight



Weaning weight



Weaning weight



Adjusting weaning wt. (lb)

Animal	As recorded	Age	Age adjusted†	Birth-rear type	Age, B-R adjusted
15180	37.0	49	40.6		
15155	23.0	57	24.0		
15130	52.0	67	49.7		
15133	35.0	67	32.7		
15123	53.5	68	50.9		
15121	21.0	70	17.7		
15114	46.5	79	40.3		
15108	41.5	85	33.3		

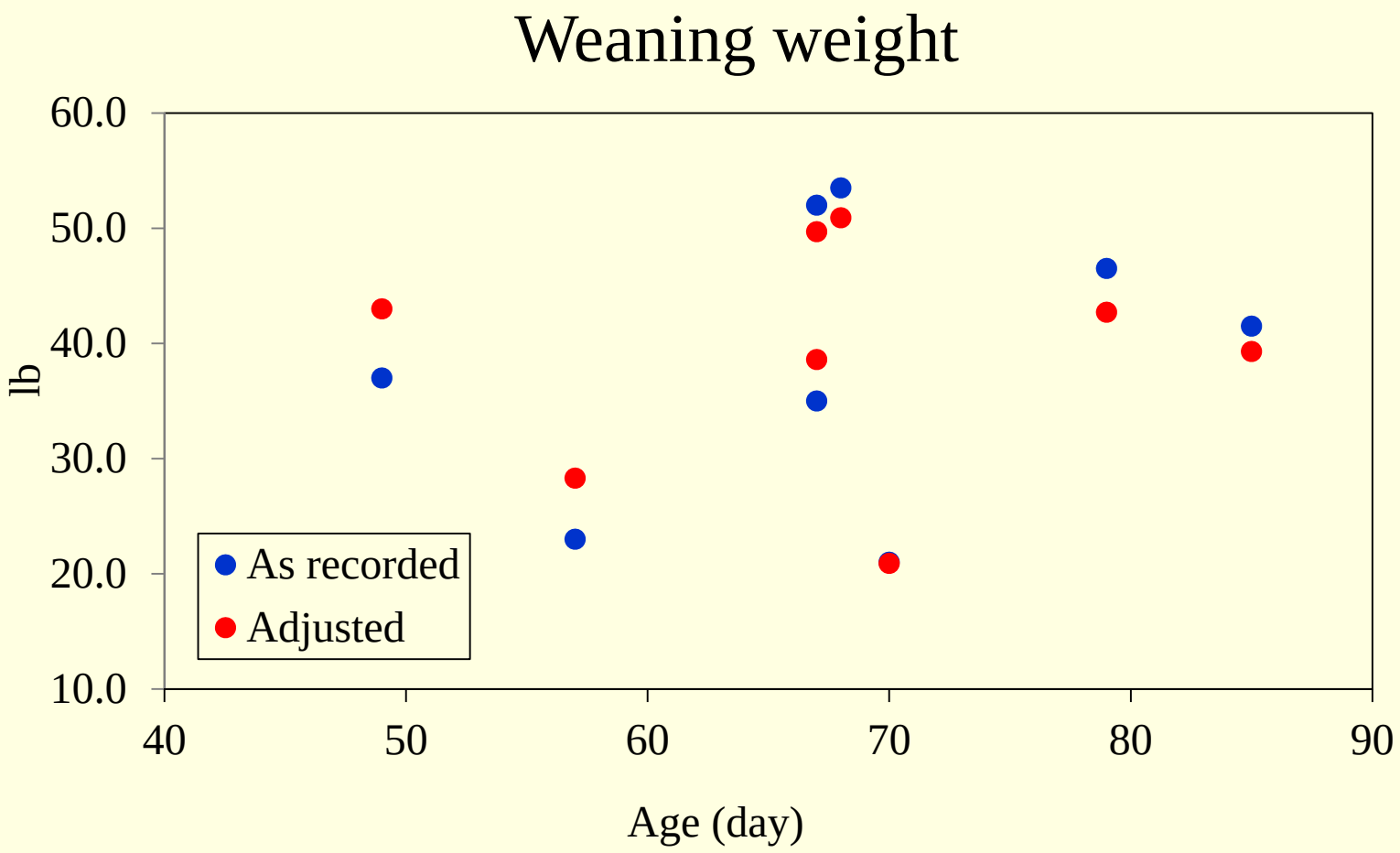
†Adjusted to 60 days

Adjusting weaning wt. (lb)

Animal	As recorded	Age	Age adjusted†	Birth-rear type	Age, B-R adjusted
15130	52.0	67	49.7	S-S	49.7
15123	53.5	68	50.9	S-S	50.9
15180	37.0	49	40.6	Tw-S	43.0
15133	35.0	67	32.7	Tw-S	38.6
15114	46.5	79	40.3	Tw-S	42.7
15155	23.0	57	24.0	Tw-Tw	28.3
15121	21.0	70	17.7	Tw-Tw	20.9
15108	41.5	85	33.3	Tw-Tw	39.3

†Adjusted to 60 days

Weaning weight



EBV for weaning wt. (lb)

Animal	As recorded	Age, B-R Adjusted	EBV Own	Sire	EBV Own & HS
15155	23.0	28.3			
15180	37.0	43.0			
15121	21.0	20.9			
15108	41.5	39.3			
15114	46.5	42.7			
15130	52.0	49.7			
15133	35.0	38.6			
15123	53.5	50.9			

$$\text{EBV} = h^2 \times (P_i - \bar{P})$$
$$= 0.12 \times (P_i - 39.2)$$

†Adjusted to 60 days

EBV for weaning wt. (lb)

Animal	As recorded	Age, B-R Adjusted	EBV Own	Sire	EBV Own & HS
15155	23.0	28.3	-1.30	14102	-1.19
15180	37.0	43.0	0.46	14102	0.17
15121	21.0	20.9	-2.18	14116	-1.79
15108	41.5	39.3	0.02	14116	-0.09
15114	46.5	42.7	0.42	14116	0.23
15130	52.0	49.7	1.26	14116	0.87
15133	35.0	38.6	-0.07	14182	0.24
15123	53.5	50.9	1.40	14182	1.37

†Adjusted to 60 days

Rankings

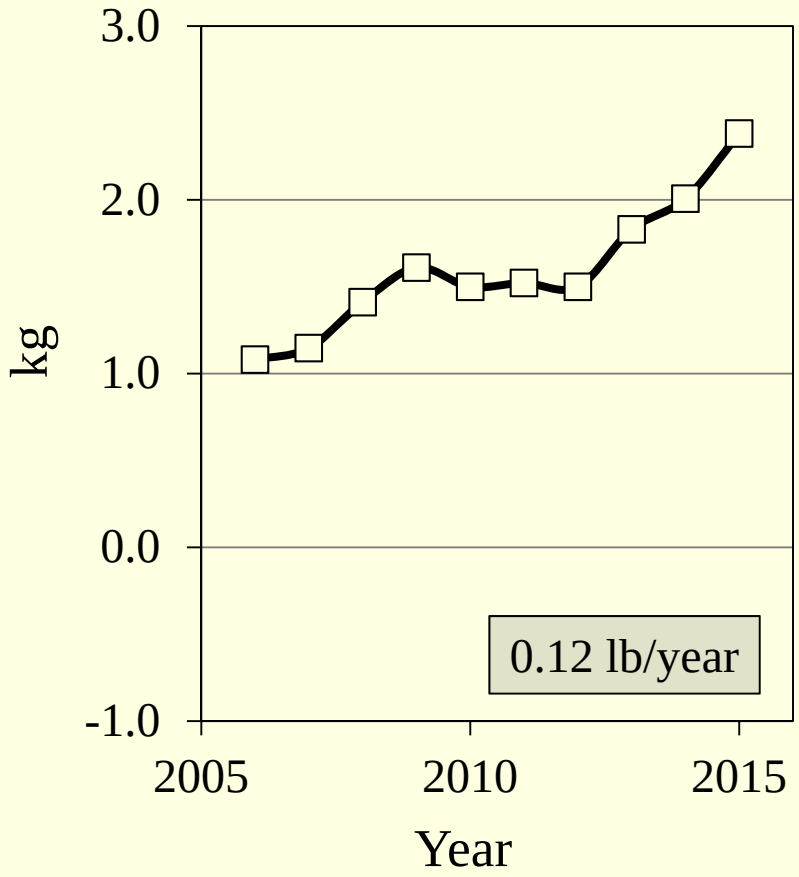
Animal	As recorded	Age, B-R Adjusted	EBV Own	EBV Own & HS
15123	1	1	1	1
15130	2	2	2	2
15114	3	4	4	4
15108	4	5	5	6
15180	5	3	3	5
15133	6	6	6	3
15155	7	7	7	7
15121	8	8	8	8

Genetic gains achieved

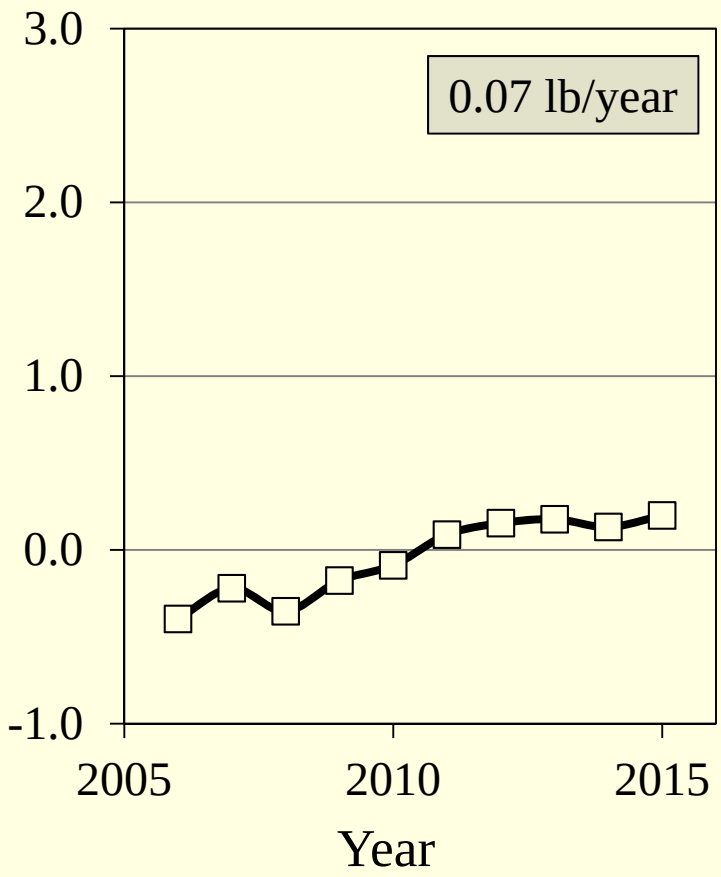
NSIP
National Sheep Improvement PROGRAM

Trends in weight EBV

Wean. wt. EBV

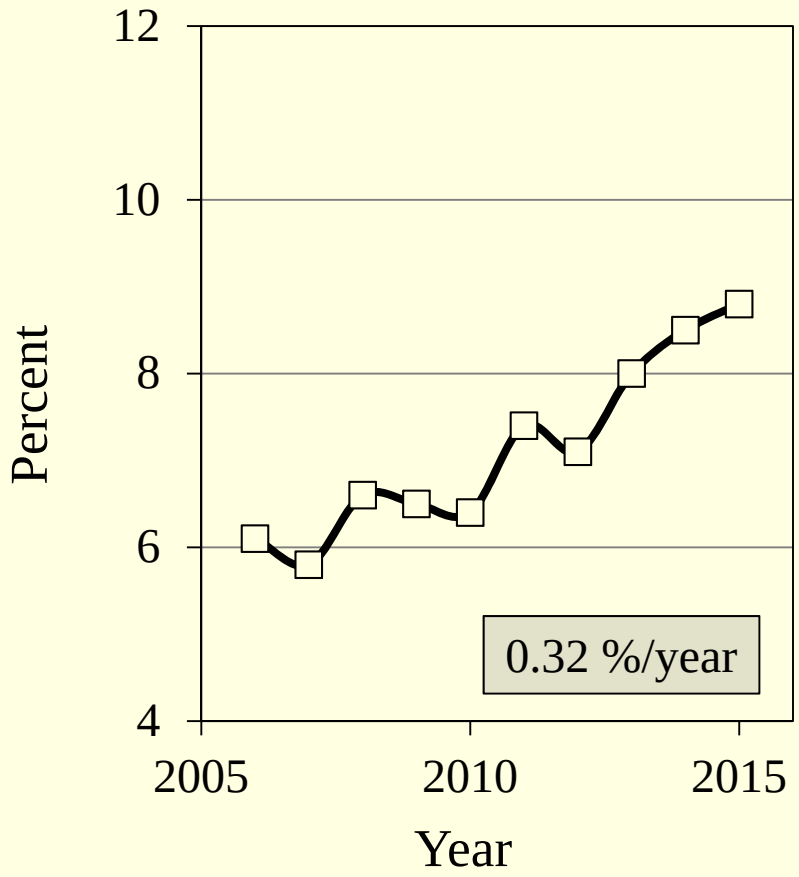


Maternal Wean. wt. EBV

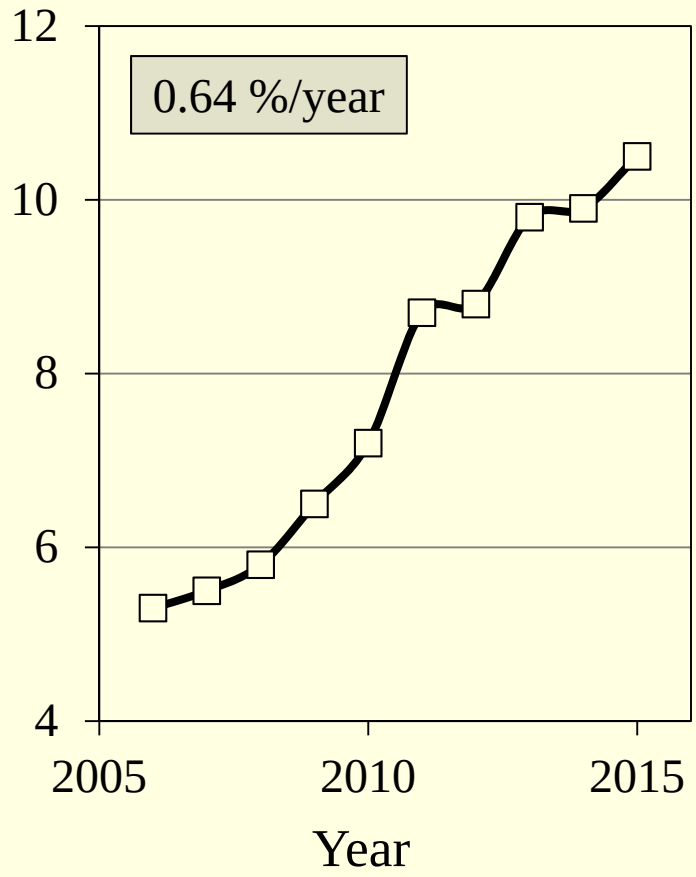


Trends in reproductive EBV

No. lamb born EBV



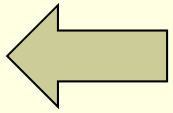
No. lamb weaned EBV



USA Hair Sheep index

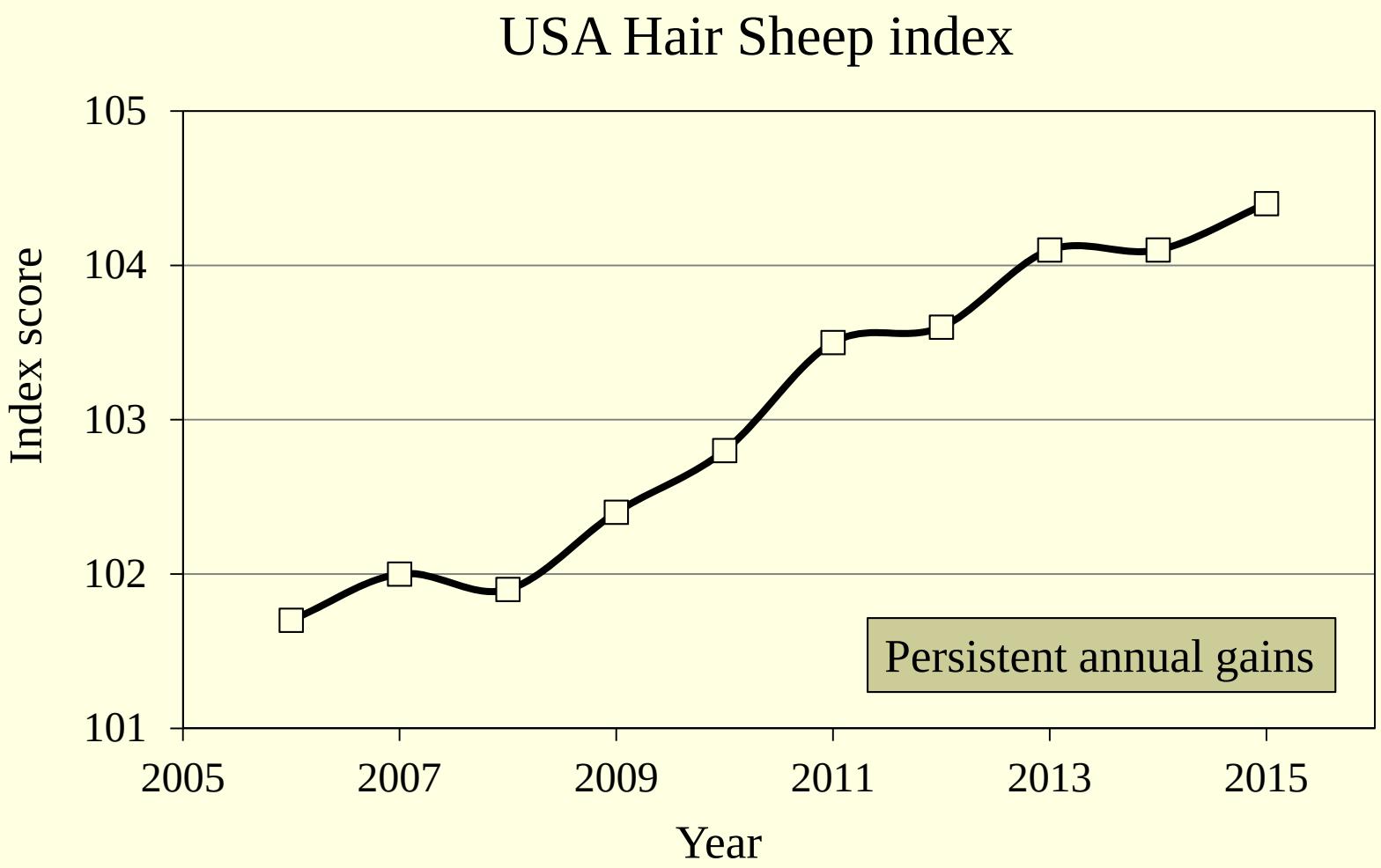
- Developed to improve overall ewe productivity
  - Designed to maximize weight of lambs weaned per ewe lambing

Criteria (EBV)	Index Weight
Weaning wt. (kg)	0.246
Maternal weaning wt. (kg)	2.226
No. lambs born (%)	-0.035
No. lambs weaned (%)	0.406



Most key

Trends in USA Hair Sheep index



Summing up

- Genetic evaluation
  - We have reliable tools that allow us to parse out genetic value
- Genetic gains achieved
  - Within recorded flocks, persistent genetic gains in production traits and index scores have been achieved
- Does quantitative genetics work?
  - Without any doubt
  - With growing adoption of such technology, our industry has a bright future

Thank you

Questions?