Using EBVs to Achieve Your Breeding Goals

NSIP
National Sheep Improvement PROGRAM

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Using EBVs to Achieve your Breeding Goals

- We tend to often focus on how to collect the data that are necessary to get EBVs
- But tonight we want to flip that to focus on what you do with the EBVs once you have them.
- Too often, breeders expect customers to beat a path to their door because they have EBVs.
  - But that won't happen, at least at first.
- Customers beat a path to your door because your sheep work for them.
  - EBV help you do a better job of making sheep that will work for your customers

NSIP Traits

Trait
Birth weight (direct and maternal)
Weaning weight (direct and maternal)
Postweaning weight
Yearling weight
Hoggest (breeding) weight
Ultrasound fat and muscle depth

Trait
No. lambs born/weaned (litter size/lamb survival)
Fecal egg counts
Scrotal circumference
Greasy fleece weight
Fiber diameter (OFDA fiber profile)
Staple length

LAMBPLAN expands this list to 85 different traits

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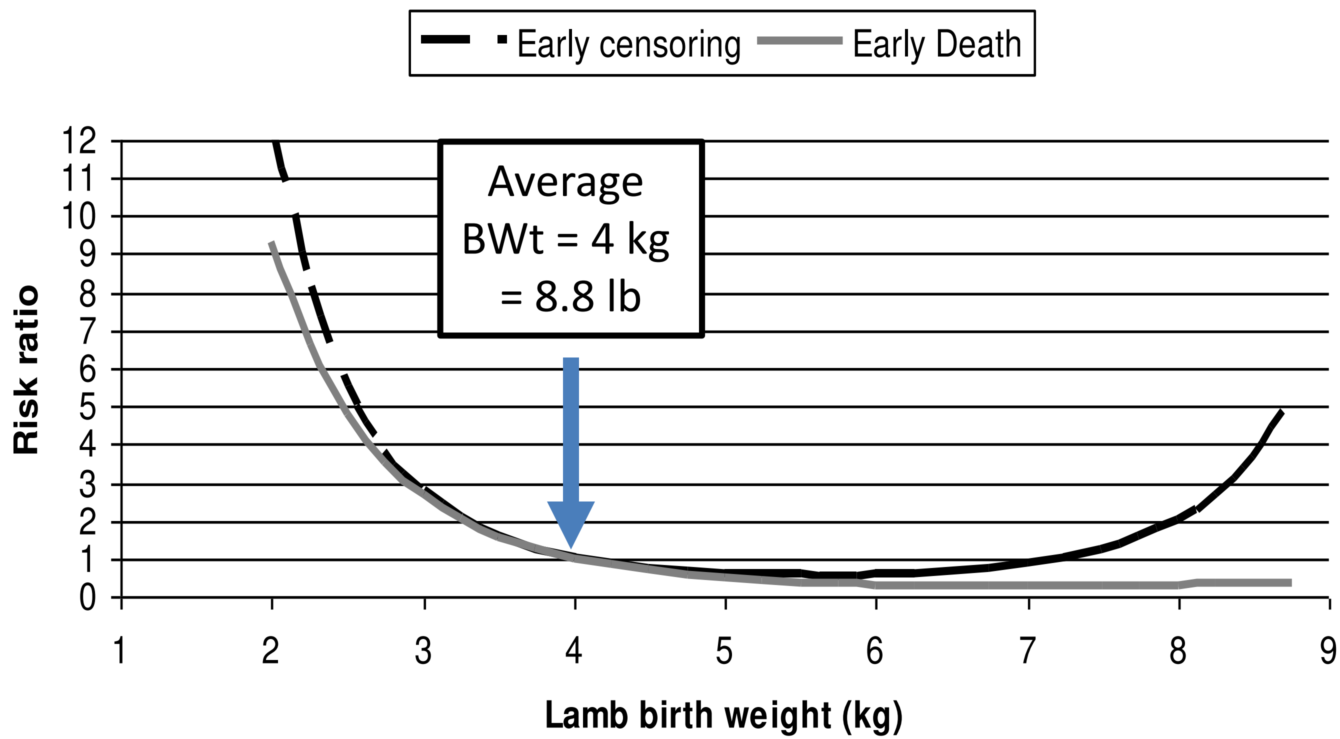
Using Body Weight EBVs to Manage the Growth Curve

- The ideal lamb is born with a modest birth weight: big enough to get up, nurse, and thrive but not too big for the mother to deliver.
- The lamb then needs to grow like a house on fire to sale time, either as a feeder or a finished lamb.
- If it is a ewe lamb, it should get plenty big enough to breed at 7-8 months of age and raise its first lambs.
- Growth then needs to flatten off so adult maintenance costs stay low, condition is maintained, and the animal can thrive on pasture or range.

Effect of lamb birth weight on the risk of death within 3 days of birth.



Changes in risk of death associated with differences in birth weight. Baseline risk ratio was set relative to the mean birth weight of 4 kg (8.8 lb). Early censoring = censoring of lambs removed within 3 d of age, Early death = assumed all lambs removed within 3 d of age were dead.

Using Body Weight EBVs to Manage the Growth Curve

- “Growth then needs to flatten off so adult maintenance costs stay low, condition is maintained and the animal can thrive on pasture or range.”
- This is the hard one: big sheep tend to stay big and little sheep tend to stay little.
- If we don’t pay attention, our ewes are going to get bigger (and maybe too big).

Using Body Weight EBVs to Manage the Growth Curve

- If we want to change growth patterns, we really only have two strategies:
  - Crossbreeding, to mate big, lean rams to smaller, easy-keeping ewes.
  - Changing Maternal Weaning Weight EBVs to get more milk in the ewe flock.
- These are about the only ways to achieve heavy weaners with modest adult ewe weights.
- And, increasing milk production may create some of the same problems as increasing adult size—both increase nutrient requirements.

Genetic Correlations among NSIP Body Weights
Range Breeds

	WWT	PWWT	YWT	HWT
BWT	0.50	0.45	0.30	0.20
WWT		0.88	0.35	0.25
PWWT			0.65	0.40
YWT				0.70
HWT				

Genetic Correlations among NSIP Body Weights
Range Breeds

	WWT	PWWT	YWT	HWT	AWT*
BWT	0.50	0.45	0.30	0.20	0.36
WWT		0.88	0.35	0.25	0.72
PWWT			0.65	0.40	0.74
YWT				0.70	0.85
HWT					0.96

* Montana State University Targhee data (Borg et al., 2009)

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Using EBVs for NLB & NLW

- Desire to Optimize, not Maximize, NLB
- Many breeders would like to have “all twins” but that is not realistic
- If you keep frequency of triplets below ~5%, then frequency of twins births rarely exceeds 65%, on a whole-flock basis.
- To WEAN a 200% lamb crop requires an average lamb drop of ~2.25 lambs per ewe lambings.
- Everybody has their own optimum NLB.
- EBVs are not great at moving NLB towards an optimum.
- NLW at least keeps ewes honest regarding lamb death losses, but can be affected by management and predation.

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Using Fecal Egg Count (FEC) EBVs

- Currently used almost exclusively by Katahdin
- But increasing interest in other breeds (PP, SU, DO)
- Genetic improvement in parasite resistance is possible in any sheep breed and probably in any goat breed.
- Katahdin, as a hair sheep cross, had a head start and was in the best position to capitalize on FEC EBVs.
- Meaningful progress in other breeds will be slower.

Using Fecal Egg Count (FEC) EBVs

- A regional and seasonal problem.
- More investment in collecting the data
  - Must collect a fecal sample from the rectum
  - Must ship sample to a lab for evaluation
  - Must pay for that service
- More effort involved in scheduling; worms have to be present to get meaningful information
- But cannot push lambs too far, or you start to get death losses.
- Our most promising trait for using genomics.

Measuring parasite resistance (fecal egg counts)

Spring-born lambs

Monitor parasite levels (FAMACHA)

Collect fecal samples at first deworming (Innate resistance)

Maintain normal parasite mgmt. (FAMACHA, etc)

(Optional for Katahdin)

If >10-20% dewormed, then deworm ALL lambs. Otherwise (we will) exclude recently dewormed lambs from the data

Collect a fecal sample 4 to 5 wk after deworming (Acquired resistance)

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Targhee Western Range Index

PWWT + 0.26 MWWT - 0.26 YWT + 1.92 YFW – 0.47 YFD + 0.36 NLB

	YWT	YFW	YFD	MWWT	NLB
PWWT	0.65	0.49	0.10	0.00	0.00
YWT		0.60	0.21	0.00	0.00
FWT			0.57	0.00	-0.10
YFD				0.00	0.10
MWWT					0.00

Targhee Western Range Index

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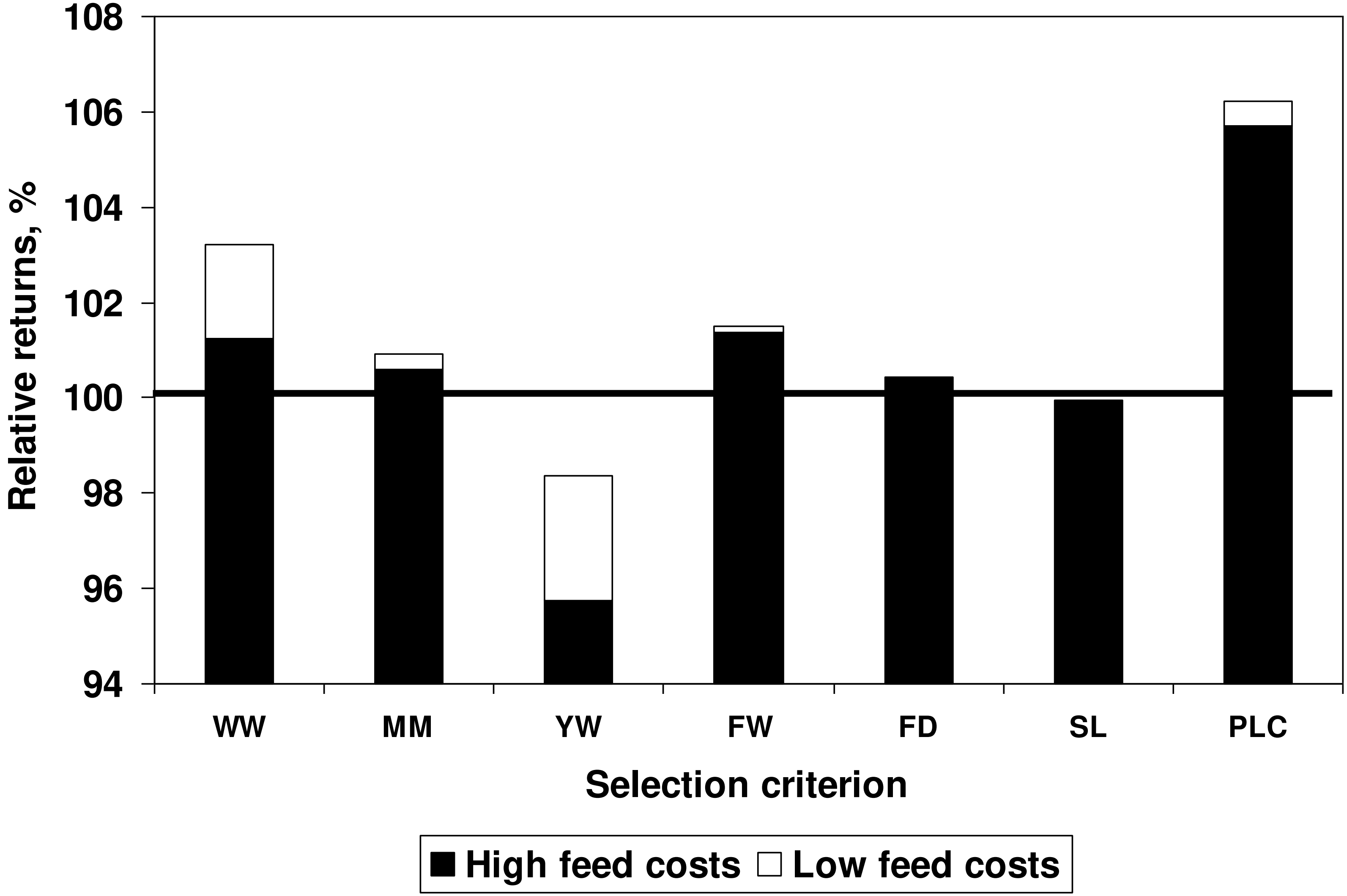
FWT			0.57	0.00	-0.10
YFD				0.00	0.10
MWWT					0.00 (-0.25)

Returns over feed costs as a % of the base flock for 1 additive SD change in each trait in Targhee sheep

WW = weaning wt
MM = maternal WW
YW = yearling wt
FW = fleece wt
FD = ↓fiber diameter
SL = staple length
PLC = % lamb crop born

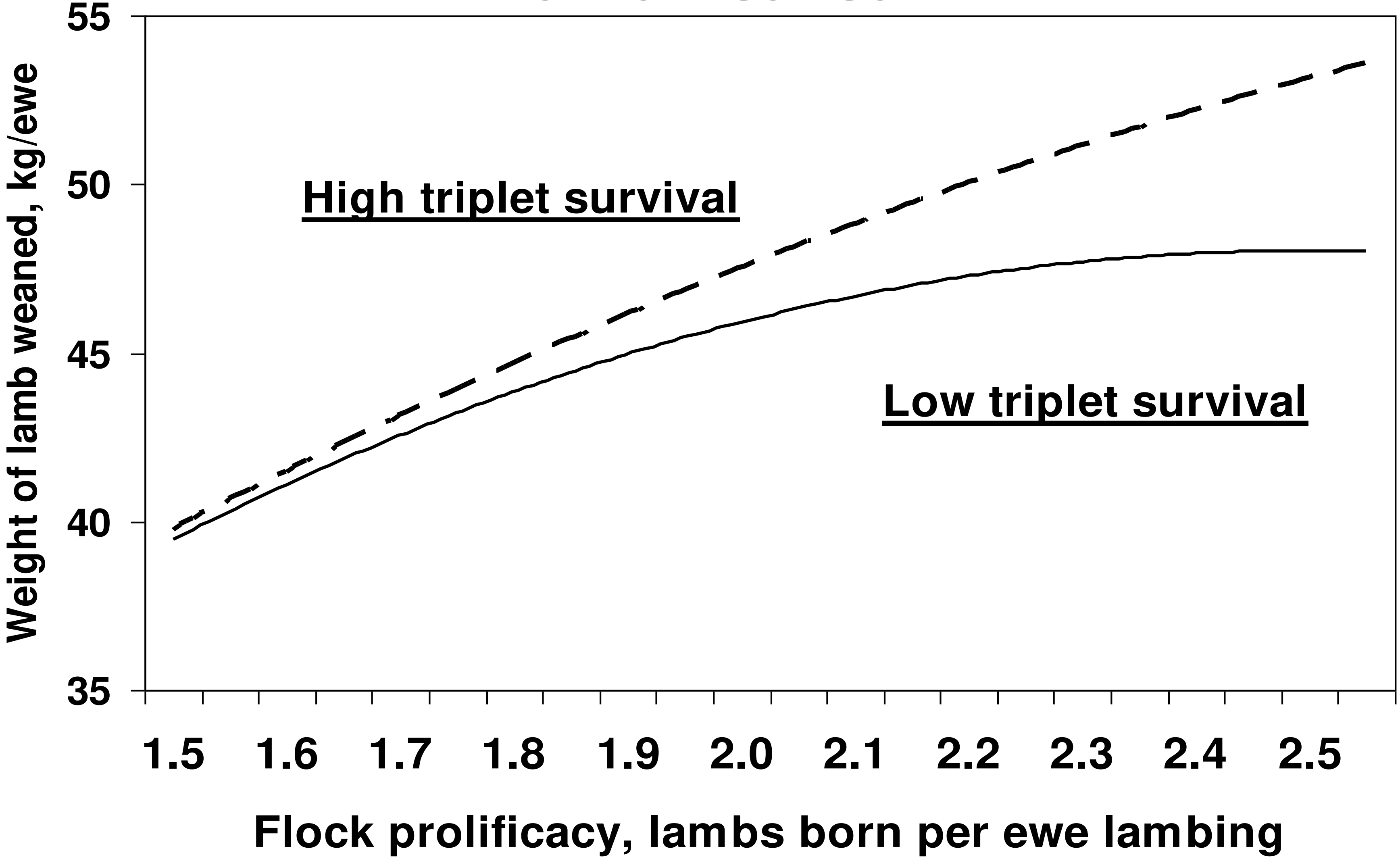


Genetic Correlations among Body Weights and Fitness Traits in Targhee Sheep

	BWT	WWT	PWWT	YWT	HWT	AWT
AWT	0.36***	0.72***	0.74***	0.85***	0.96***	
NLB	-0.10	0.25	0.31*	0.53***	-0.08	0.12†
Stayability = Prob (6|2)	0.19	-0.32	-0.17	-0.50	-0.17	-0.32*
Productive life	0.05	-0.64†	-0.29	-0.99**	-0.29	-0.46*

* Montana State University Targhee data (Borg et al., 2009a,b)

Effects of flock prolificacy on weight of lamb weaned



Genetic Correlations among NSIP Body Weights and Ultrasound Scans
Terminal and Hair Breeds *

	BWT	WWT	PWWT	PCF	PEMD
BWT		0.61	0.36	-0.55	-0.35
WWT	0.54		0.90	-0.45	-0.30
PWWT	0.36	0.91		-0.51	-0.38
PCF	-0.40	-0.35	-0.37		-0.16
PEMD	-0.30	-0.25	-0.28	0.00	

* Above and below the diagonal, respectively.

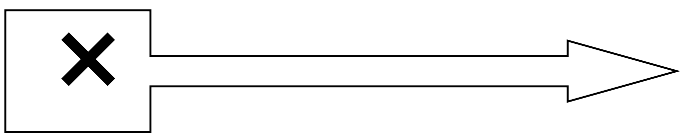
Terminal Sire Breed Evaluation


Columbia


Composite

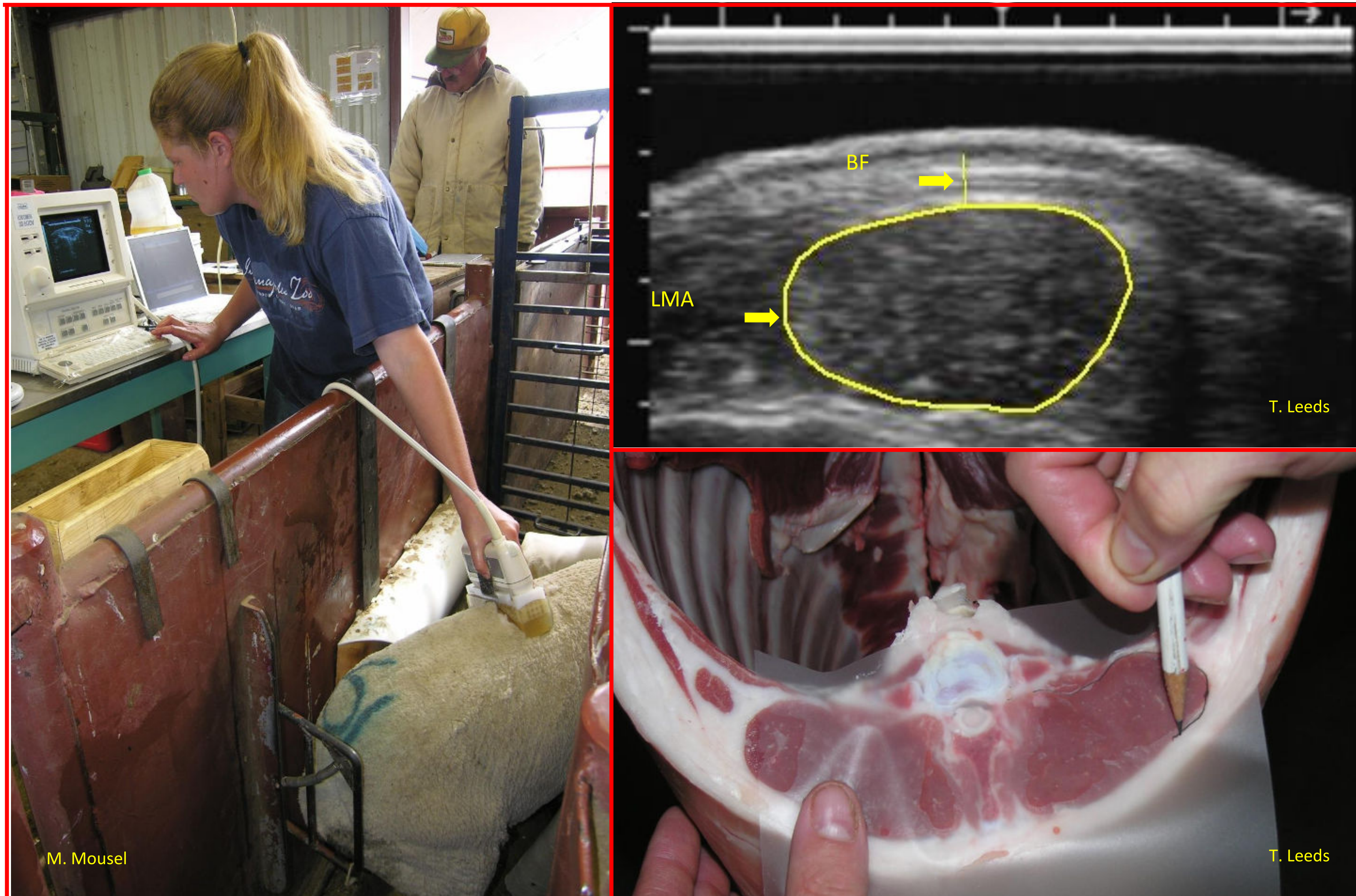

Suffolk


Texel




Rambouillet


F_1 Progeny


M. Mousel
BF
LMA
T. Leeds
T. Leeds

Predict lamb carcass value from off-test body weight, ultrasonic backfat thickness, and predicted ultrasonic loin muscle depth

Prediction	Regression coefficients ± SE			R^2
	Weight, kg	USBF, mm	USLMD, mm	
CVal, $ × OTBW	2.46 ± 0.06***	1.05 ± 0.17***	1.07 ± 0.11***	.95
TrCVal, $ × OTBW	2.51 ± 0.06***	-0.31 ± 0.19†	1.36 ± 0.12***	.94

Compare the value of 100 lambs produced by average vs. top 10% of NSIP sires

EBV	Mean EBV by Percentile			Value difference for 100 lambs
	10^{th}	50^{th}	Difference	Sires in 10^{th} versus 50^{th} percentile
120-day Post-weaning Wt	7.62	2.94	4.68 kg (10.3 lb)	$587
Backfat thickness	-0.67	-0.34	0.33 mm (0.013 inches)	$ 15
Loin eye depth	2.48	1.05	1.43 mm (~ 0.20 sq. in)	$ 97

One additive SD= 4.17 kg for 120-d postweaning weight
0.57 mm for ultrasound backfat thickness
1.30 mm for ultrasound loin muscle depth

Selection Indexes

Now add effects on feed requirements and time to harvest and consider alternative market endpoints and price differentials.

Constant time: $I_1 = 1.2\ EBV_{PWWT} - EBV_{USBF} + 1.0\ EBV_{USLMD}$

Constant wt: $I_2 = 1.5\ EBV_{PWWT} - EBV_{USBF} + 1.0\ EBV_{USLMD}$

Constant fat: $I_3 = 3.0\ EBV_{PWWT} - EBV_{USBF} + 2.0\ EBV_{USLMD}$

But genetic correlations among indexes are **> 0.98**!

And their genetic correlation with PWWT is **> 0.96**!

So indexes are robust to changes in management and marketing.

Selection Indexes for the Future

Now assume that reducing fat and increasing muscularity will be more important in future markets (?)

Start with I_2, the weight-constant index:

Constant wt: $I_2 = 1.5\ EBV_{PWWT} - EBV_{USBF} + 1.0\ EBV_{USLMD}$

Then produce a high-quality index by increasing the impact of reducing fat depth by 4X and the impact of increasing loin muscle depth by 2X.

Hi Quality index: $I_4 = 0.4\ EBV_{PWWT} - EBV_{USBF} + 0.5\ EBV_{USLMD}$

Genetic correlation between I_2 and I_4 is still **> 0.95**!

Genetic correlation between I_4 and PWWT is **> 0.88**!

Compare the NSIP Hi-Quality Index

Hi Quality Index: $\mathbf{I_4 = 0.4\ EBV_{PWWt} - EBV_{USBF} + 0.5\ EBV_{USLMD}}$

with the LAMBPLAN "Carcass Plus" Index

$$\mathbf{I_{CP} = 0.2\ EBV_{WWT} + 0.3\ EBV_{PWWt} - EBV_{USBF} + 0.9\ EBV_{USLMD}}$$

Genetic correlation between I_4 and I_{CP} is **0.96**!

Genetic correlation between I_{CP} and PWWT is **0.73**!

I_{CP} is thus appropriate for use under U.S. conditions if we assume a future market with greater premiums for leanness and, particularly, muscularity **but** undervalues growth under current market conditions.

NSIP Maternal Indexes

Polypay Ewe Productivity Index:

0.6 WWT + 2.6 MWWT + 0.4 NLW – 0.035 NLB

Katahdin Ewe Productivity Index:

0.25 WWT + 2.25 MWWT + 0.4 NLW – 0.035 NLB

1) Designed to predict genetic merit for weight of lamb weaned per ewe lambing;
2) Appropriate for maternal breeds used mainly for crossing with terminal sires;
3) Does not consider the value of postweaning growth and carcass merit in the ewe flock

Combining Selection for Ewe Productivity and Lamb Postweaning Performance in Maternal Breeds

- Development of a "proper" selection index is a relatively big job.
- For Polypay and Katahdin, the Ewe Productivity Indexes meet the needs of many breeders.
- But others would like to include postweaning growth and scanning data in these indexes.
- And some Katahdin flocks need to incorporate Fecal Egg Count EBVs into their index.

Combining Selection for Ewe Productivity and Lamb Postweaning Performance in Maternal Breeds

- Start with the Ewe Productivity Index (EP) as the main indicator of value in the ewe.
- Add the Postweaning Weight EBV (PWWT), or, if you prefer, the Carcass Plus Index (CP), as the indicator of value in the lamb.
- Resulting index is:

$$I = \beta_1 \, EP + \beta_2 \, PWWT$$

- Must decide on the optimal emphasis on EP and PWWT. It is unlikely that PWWT should receive >50% of selection emphasis, and maybe considerably less!

Selection Indexes and Breed Roles (“Dual Purpose” versus “Maternal”)

- A “Maternal” breed is one that is mainly used in crossbreeding with Terminal Sire breeds.
- A “Dual Purpose” breed has significant numbers of purebred commercial flocks (Targhee, Katahdin, Rambouillet, Dorset).
- For a true Maternal breed, EP is likely a pretty good index.
- For a Dual-Purpose breed, EP and PWWT both influence value; lots of purebred market lambs.
- Also: do you market feeder lambs (EP focus) or finished lambs (PWWT influence)?

Selection Indexes and Breed Roles (“Dual Purpose” versus “Maternal”)

- For a Dual-Purpose flock, ~ 85% of the lambs get sold, with 15% retained as replacements.
- For a Maternal flock, only about 20% of purebred ewe lambs (60% of the total lambs) get sold, and each replacement ewe lamb goes on to produce crossbred market lambs.
- Assume that increasing ewe size has no direct positive impact on net returns—increased lamb value is wiped out by increased ewe feed requirements and reduced stayability.

Selection Indexes and Breed Roles (“Dual Purpose” versus “Maternal”)

- A Dual-Purpose flock has ~ 85% of the lambs sold and 15% retained as replacements. Over his lifetime, one ram produces ~ 160 lambs and ~ 136 of these go to market. ALL the market lambs, and ALL the replacement ewes, come from the same Dual-Purpose rams.
- For a Maternal flock, one ram producing 160 lambs will have ~ 100 lambs sold and ~ 60 ewe lambs retained as replacements.
  - Those replacements can maintain a total flock of ~ 200 ewes, with ~ 135 bred to terminal sires. In the overall flock, maternal sires produces ALL the replacement ewe lambs but only ~ 20% of the market lambs.

Selection Indexes and Breed Roles (“Dual Purpose” versus “Maternal”)

- In a Dual-Propose flock, a reasonable index would be:

EP + 3.0 PWWT

(Equal emphasis on EP and PWWT)

- In a Maternal flock that sells only breeding rams, optimum index is more like:

EP + PWWT

(PWWT only 40% as important as EP)

- In a Maternal flock that sells breeding rams and replacement ewes, index looks more like:

EP + 0.5 PWWT

Updating the Targhee Western Range Index (?)

Now: PWWT + 0.26 MWWT - 0.26 YWT +
1.92 YFW – 0.47 YFD + 0.36 NLB

Reduce importance of NLB:
PWWT + 0.26 MWWT - 0.26 YWT +
1.92 YFW – 0.47 YFD + **0.18 NLB**

Add emphasis on postweaning growth:
1.75 PWWT + 0.26 MWWT + **0.50 YWT – 0.15 HWT** + 1.92 YFW – 0.47 YFD + 0.18 NLB
(Dual-Purpose flock)

1.25 PWWT + 0.26 MWWT **- 0.20 HWT** +
1.92 YFW – 0.47 YFD + 0.18 NLB
(with Terminal crossing)

Updating the Western Range Index for Fine-Wool Flocks

Current: PWWT + 0.26 MWWT - 0.26 YWT + 1.92 YFW – 0.47 YFD + 0.36 NLB

1) Probably should NOT reduce importance of NLB much unless you are already seeing triplets
2) Record and place negative weight on HWT.

1.25 PWWT + 0.26 MWWT + 0.10 YWT - 0.20 HWT + 1.92 YFW – 0.47 YFD + 0.24 NLB

Re-evaluate:

1) Relative importance of YFW and YFD (> emphasis on YFD?; other OFDA traits?)
2) Re-consider relative importance of PWWT and YWT relative to YFW and YFD as related to lamb management and marketing procedures.

Summary

- Data-based EBVs do work; genetic change will occur!
- Some traits (e.g., birth weight, ultrasonic fat and muscle depths) deserve emphasis only when there is an opportunity or a problem. Otherwise emphasize traits that have greater economic importance.
- Being proactive is good, but requires some guesswork!
- Optimizing NLB/NLW is important!
- Controlling increases in ewe size is important!
- Good indexes are increasingly necessary to properly use EBVs. They are not always intuitive, so they need to be done right, with a sound economic basis.