NSIP EBV Notebook

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New Traits for NSIP Western Range Breed Genetic Evaluations

Introduction

NSIP recently completed reassessment of traits that can be evaluated for Western Range breeds (Targhee, Rambouillet, and Columbia). The immediate goal was incorporation of OFDA wool measurements and ultrasonic scanning information on fat thickness and loin eye muscle depth into the evaluation. However, NSIP also added capability to generate EBVs for hogget body weight at 14 to 19 months of age and scrotal circumference at late postweaning and yearling ages. Hogget body weight EBVs can be used to monitor adult ewe size and control increases in ewe maintenance requirements and should be superior to yearling weight EBVs for this purpose. Positive selection on scrotal circumference EBVs is anticipated to increase breeding capacity of rams and have positive effects on ewe reproduction in female relatives. Correlated responses in females are expected to be most evident in ewe lambs and yearlings, but small improvements in adult fertility, prolificacy, and maternal ability are also expected.

Current NSIP/LAMBPLAN EBVs for Western Range Breeds

The current genetic evaluation system for Western Range breeds, including the Targhee, Rambouillet, and Columbia, produces EBVs for 10 traits and one index:

- The **Birth Weight EBV** estimates direct genetic effects of the lamb on weight at birth.
- The **Maternal Birth Weight EBV** estimates genetic effects of the ewe on the birth weight of her lambs.
- The **Weaning Weight EBV** provides an estimate of preweaning growth potential. In Western Range breeds, the Weaning Weight EBV is normally based on preweaning weights taken at 45 to 90 days of age.
- The **Maternal Weaning Weight EBV** estimates genetic merit for mothering ability.
- The **Postweaning Weight EBV** predicts genetic merit for body weight at 120 days. In extensively managed flocks with weaning at 90 to 150 days, the weaning weight is commonly recorded as an early postweaning weight, and the Postweaning Weight EBV predicts genetic differences in body weight at typical weaning ages.
- The **Yearling Weight EBV** estimates growth potential to 12 months of age.
- The **Yearling Fleece Weight EBV** provides an estimate of the animal's genetic potential for wool production.
- The **Yearling Fiber Diameter EBV** provides an estimate of genetic merit for fleece quality.
- The **Yearling Staple Length EBV** estimates genetic potential for length of the wool fiber.
- The **Number of Lambs Born (NLB) EBV** evaluates genetic potential for prolificacy.
- The **Number of Lambs Weaned (NLW) EBV** evaluates combined ewe effects on prolificacy and lamb survival to weaning.
- The **Western Range Index** combines EBVs for various traits into an index designed to improve profitability in Western Range flocks with positive emphasis on both lamb and wool production.

More information regarding these EBVs and the Polypay Ewe Productivity Index can be found in NSIP EBV Notebook #1, "The NSIP EBVs" at the NSIP web site.

New OFDA Fleece Trait EBVs for Western Range Breeds

Western Range breeds can now report data and receive EBVs for the following OFDA wool traits:

- The **Fiber Diameter Coefficient of Variation (FDCV) EBV** estimates genetic merit for fleece uniformity, expressed as the coefficient of variation (CV) among wool fibers in a fleece sample. Animals with more uniform fleeces (lower CV) are desired, so negative EBVs are favored for fiber diameter coefficient of variation.

- The **Fiber Curvature EBV** is an indicator of genetic differences in crimp frequency. This EBV is based on an OFDA optical measurement of fiber curvature, which is measured in degrees and is a very accurate predictor of crimp. Higher values for curvature indicate broader or bolder crimp. Positive EBVs therefore indicate more crimp and, depending on the end-product (knitwear or worsted fabric), may or may not be desirable. Use of Fiber Curvature EBVs in breeding programs therefore depends on the requirements, premiums, and discounts applied to your wool.

LAMBLAN allows reporting of fleece data at seven different ages including postweaning lambs, yearlings, hoggets, and adult ewes at 2, 3, 4, and 5 years of age. At this time, only three records are used for genetic analysis. These are:

- Yearling records reported at ages of 305 to 426 days (10 to 14 months).
- Hogget records reported at ages of 427 to 580 days (14 to 19 months).
- The first adult fleece record, reported at 2 to 5 years of age.

However, records on postweaning fleeces taken at 91 through 304 days of age and multiple adult records collected at 2, 3, 4, and 5 years of age can be stored and may be used to derive EBVs at some point in the future.

Separate EBVs are calculated for each fleece trait at each of the three ages, but EBVs at different ages are very highly correlated and may be viewed as alternative expressions of a common underlying EBV for each trait. For example, even though fiber diameter measurements taken on yearling fleeces at first shearing are often significantly finer than comparable measurements taken at maturity, and 2-year-old fleeces are therefore more indicative of the type of wool that sheep will produce as adults, our data indicate that EBVs for yearling fiber diameter are acceptable predictors of genetic differences in adult fleeces. Yearling EBVs for fleece traits are therefore adequate for selection and merchandising purposes, and include information on correlated measurements taken at other ages.

When reporting fleece data, it is important to distinguish between animals that have never been sheared and those that have been sheared before. If records are being submitted for all shearings, the problem is automatically taken care of, as the software looks for shearing records at younger ages and adjusts current records for time since last shearing. However, in some cases, yearlings or hoggets may have been sheared as lambs, but without obtaining data on those fleeces. In such cases, you should report a shearing date at the previous shearing age (usually postweaning), even if no fleece data were reported at that time. This procedure allows the system to recognize a previous shearing and properly calculate the shearing interval (time since last shearing) for the current fleece. If entering fleece data on adult ewes for the first time, the date of previous shearing must be reported. If exact dates are not available, a reasonable estimate is adequate and should be supplied.

Fiber diameter measurements taken on yearling fleeces (first shearing) are often significantly finer than comparable measurements taken at maturity. Although 2-year-old fleeces are therefore more indicative of the type of wool that sheep will produce as adults, our data indicate that yearling fleece measurements are adequate for use in genetic evaluation.

Heritabilities for new OFDA fleece traits are all reasonably high, at 0.52 to 0.54 for fiber diameter coefficient of variation and 0.47 to 0.52 for fiber curvature. With these heritabilities, fleece records on 15

progeny will yield sire EBVs with accuracies of 82 to 84%. Fleece uniformity, as measured by the fiber diameter coefficient of variation, has desirable genetic correlations with fiber diameter and staple length and is not genetically associated with body weights, but heavier fleeces tend to be more variable, with an undesirable genetic correlation of 0.20 to 0.25 between fleece weight and fiber diameter CV. Fiber curvature has an undesirable genetic relationship with fleece weight and staple length, with genetic correlations between -0.35 and -0.50, but is favorably correlated with fiber diameter and fiber diameter coefficient of variation. Fiber curvature is assumed to be independent of body weight.

There is evidence for a small genetic antagonism between fleece traits and ewe reproduction, and genetic parameters used for genetic evaluation of Western Range breeds have been updated to include undesirable genetic correlations of -0.10, 0.10 to 0.15, and -0.05 between number of lambs born or weaned and fleece weight, fiber diameter, and staple length, respectively. These correlations are small, but recognize that intensive selection on fleece characteristics may limit genetic progress in ewe reproductive traits.

Hogget Body Weight EBVs

Selection to increase weaning and postweaning weights generally increases revenue from lamb sales, but is also associated with correlated increases in ewe body weights and maintenance costs. EBVs for "hogget" weights at 427 to 580 days (15 to 19 months) of age will allow monitoring of ewe growth patterns into adulthood and discrimination between ewes with rapid early growth but modest adult weights versus ewes with extended growth curves and heavy adult weights.

Hogget body weight is moderately heritable (0.28) and will respond to selection. However, body weights at different ages are positively correlated (Table 1), so attention to limiting adult body weight will also reduce rates of progress in weaning and postweaning weights. The current Western Range Index attempts to address this situation by placing positive emphasis on postweaning weight but negative emphasis on yearling weight. Future incorporation of Hogget Weight EBVs into the Western Range Index would improve our ability to manage the antagonism between rapid early growth and heavy adult ewe weight. However, until we can do this, the Hogget Weight EBV will allow interested breeders to begin collecting body weights of young ewes.

Recording of hogget weights on ram lambs is recommended only if a reasonable number of ram lambs (at least 10) remain from a common weaning contemporary group. Submitting weights for a small number of highly selected rams that have been retained for breeding is generally not informative.

Table 1. Assumed direct and maternal heritabilities and genetic correlations among body weights for Western Range breeds [a]

Weight	**Weight**				
	Birth	**Weaning**	**Postweaning**	**Yearling**	**Hogget**
Birth	0.14, 0.15	0.50	0.45	0.30	0.20
Weaning	0.60	0.06, 0.13	0.88	0.35	0.25
Postweaning	0.60	1.00	0.10, 0.06	0.65	0.40
Yearling	0.60	1.00	1.00	0.26, 0.03	0.70
Hogget	0.60	1.00	1.00	1.00	0.28, 0.03

[a] Values on the diagonal are heritabilities for direct and maternal effects on body weights. Genetic correlations among direct effects are shown above the diagonal. Genetic correlations among maternal effects are shown below the diagonal; values of 1.00 for correlations among postnatal maternal effects indicate that the maternal effect at weaning is maintained at later weights but becomes progressively less important in older lambs. Direct and maternal effects on body weights are assumed to be uncorrelated.

Postweaning Scrotal Circumference EBVs

Genetic differences among males in scrotal circumference have been reported to be positively associated with reproductive performance in their female relatives. Positive selection for scrotal circumference thus

may be advantageous in terms of both breeding capacity of rams and reproductive performance of their daughters. The most useful measurements for Western Range breeds appear to be postweaning and yearling scrotal circumferences, which are diagnostic of early age at puberty in both sexes and therefore may be associated with improved ewe lamb and yearling ewe fertility. Expected impacts of selection for large scrotal circumference on reproduction in adult ewes are less clear, but scrotal circumference EBVs may provide some supplemental information to aid in improving reproduction in older ewes.

Scrotal circumference may be recorded postweaning (early or late) and in yearlings, hoggets, and adults (2-yr-olds), but only postweaning and yearling measures are currently used for Western Range breeds. Scrotal circumference measurements can be reported without an accompanying body weight. However, if body weight and scrotal circumference are both reported, the scrotal circumference measurement must be taken at the same time as (or at least within ± 7 days of) the corresponding body weight. In contrast to the situation for postweaning weights, only the first reported postweaning scrotal circumference measurement is used to derive EBVs. Therefore, breeders should be sure that the most informative postweaning scrotal circumference measurement is also the first reported postweaning measurement. Scrotal circumference measurements are adjusted for age prior to calculation of EBVs.

Genetic Evaluation of Ultrasonic Scanning Data

Ultrasonic measures of fat thickness and loin eye muscle depth are extremely useful in terminal-sire breeds where improving carcass merit is a primary selection goal. However, in maternal and dual-purpose breeds, improving reproductive and maternal traits is likely to be more important than changing carcass merit and deserves greater selection emphasis. EBVs for scanning traits in Western Range breeds are therefore expected to be most useful in Columbia flocks, but may assist Targhee and Rambouillet breeders to identify outliers with unacceptable levels of muscling or fatness.

Ultrasound measurements for Western Range breeds may be taken at late postweaning (150 to 304 days), yearling (305 to 426 days), or hogget (427 to 580 days) ages. Scanning records must be accompanied by a body weight and must be taken at the same time as (or at least within ± 7 days of) the corresponding weight. Scanning data will be adjusted to a constant body weight of 187 lb (85 kg) before analysis. This relatively heavy body weight was chosen because lambs from Western Range breeds are normally weaned at 120 to 150 days of age and commonly experience a period of compensatory postweaning growth in fat and muscle depths. The procedure for recording and adjusting scanning information in Western Range breeds was derived from records on relatively rapidly growing ram lambs and are not appropriate for ewe lambs developed as replacement females on a lower plane of nutrition. Scanning records at hogget ages are accepted to meet the needs of flocks that develop yearling rams more slowly, but late postweaning and yearling scans are preferred. The fact sheet "Recording and reporting scanning data for NSIP/LAMBPLAN" on the NSIP web site provides additional information on collecting ultrasound data (http://nsip.org/wor dpress/wp-content/uploads/2011/05/Recording-and-reporting-scanning-data.pdf). An equation to convert measurements of loin eye area to estimates of loin eye depth is also provided in that document.

Heritability estimates for fat thickness and loin eye muscle depth in Western range breeds are 0.20 and 0.40, respectively, and were derived from a combination of Australian and U.S. records. In U.S. Suffolks, birth, weaning and postweaning weights had large negative associations with fat thickness (genetic correlations of -0.55, -0.45, and -0.51, respectively) and loin eye muscle depth (-0.35, -0.30, and -0.38, respectively). These correlations were considerably larger than those observed in Australian breeds, perhaps reflecting more intense selection for frame size in U.S. Suffolks. We therefore reduced the size of these genetic correlations somewhat for Western Range breeds. Final correlations with birth, weaning, postweaning, yearling, and hogget weights averaged -0.18, -0.18, -0.23, -0.27, and -0.23, respectively, for fat thickness and -0.17, -0.17, -0.22, -0.25, and -0.23, respectively, for loin eye muscle depth. The genetic correlation between fat thickness and muscle depth was -0.16 in U.S. Suffolks but was assumed to average 0.25 for Western Range breeds. These genetic parameters will be updated as additional information on Western Range breeds become available.