NSIP EBV Notebook

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New Traits for NSIP Polypay Genetic Evaluations

Introduction

NSIP recently completed reassessment of traits that can be evaluated in the Polypay (and other Maternal Wool breed) genetic evaluation. The immediate goal was to recognize that several Polypay breeders are reporting fleece data, largely to document wool quality attributes for Western range customers, and would like to have EBVs for these traits. This step required addition of adjustment factors and genetic parameters for fleece traits to the Maternal Wool breed evaluations. In addition, NSIP added the capacity to generate EBVs for three additional sets of traits that may be important for maternal sheep breeds. The first includes body weights at yearling (10 to 15 months) and hogget (14 to 19 months) ages. EBVs for these weights can be used to monitor adult ewe size and control increases in ewe maintenance requirements. The second trait is ram postweaning scrotal circumference, measured at 3 to 7 months of age. Positive selection on postweaing scrotal circumference EBVs is anticipated to increase breeding capacity of rams and have a small positive effect on reproductive performance in female relatives. The correlated response in females is expected to be most evident for ewe lamb fertility, but small improvements in adult fertility, prolificacy, and maternal ability are also expected. The third set of traits includes ultrasonic measurements of fat thickness and loin eye muscle depth. Improvement in these traits is most important in terminal-sire breeds, but generally less important relative to other traits in maternal breeds.

Current NSIP/LAMBPLAN EBVs for Maternal Wool Breeds

The current genetic evaluation system for Maternal Wool breeds, including the Polypay, Border Leicester, Blue-Faced Leicester, Romney, Coopworth, and Lincoln breeds, produces EBVs for seven traits and one index:

- The **Birth Weight EBV** estimates direct genetic effects 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.
- The **Maternal Weaning Weight EBV** estimates genetic merit for mothering ability.
- The **Postweaning Weight EBV** combines information on preweaning and postweaning growth to predict genetic merit for postweaning weight at 120 days.
- 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 **Polypay Ewe Productivity Index** combines EBVs for various traits into an index designed to maximize pounds of lambs weaned per ewe lambing.

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 Polypay Fleece Traits

Maternal Wool breeds can now report fleece data and receive EBVs for the following traits:

- The **Fleece Weight EBV** is based on greasy fleece weights and provides an estimate of the animal's genetic potential for wool production. Sales of wool generally account for a much smaller percentage of total annual receipts than sales of lamb, and Fleece Weight EBVs will likely receive only modest positive selection emphasis in most maternal breeds. However, fleece weight EBV can be used to monitor wool production potential and maintain baseline wool production levels appropriate to the breed in question.

- The **Fiber Diameter EBV** provides an estimate of genetic merit for fleece quality. Animals with finer, more desirable fleeces have negative fiber diameter EBVs, so negative EBVs would be favored for this trait. Fiber diameter EBVs will likely receive only modest selection emphasis in most maternal breeds, but can be used to identify and remove animals with particularly coarse, undesirable fleeces and maintain baseline levels of wool quality appropriate to the breed in question.

- The **Staple Length EBV** estimates genetic potential for length of the wool fiber. Staple length EBVs will likely receive only modest positive selection emphasis in most maternal breeds. However, some emphasis on increasing staple length may be indicated if fleeces are being discounted because they do not have adequate staple length to allow production of high-value worsted yarns.

- The **Fiber Diameter Coefficient of Variation (FDCV) EBV** provides an estimate of genetic merit for fleece uniformity. The fiber diameter coefficient of variation (CV) measures the uniformity of fiber diameter among the individual wool fibers within a fleece sample. Animals with more uniform fleeces (lower CV) are desired, so negative EBVs are favored for fiber diameter coefficient of variation. EBVs for fiber diameter coefficient of variation will likely receive little selection emphasis in most maternal breeds, but can be used to identify and remove animals that lack fleece uniformity and maintain baseline levels of wool uniformity appropriate to the breed in question.

LAMBLAN allows reporting of fleece data at up to seven different time points including postweaning lambs, yearlings, hoggets, and adult ewes at 2, 3, 4, and 5 years of age. However, only three records are currently being used in the 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.

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. In most cases, yearling EBVs for fleece traits are adequate for evaluation and merchandising purposes, and include information on correlated measurements taken at other ages.

Body weight records can accompany fleece records, but are not required.

Records on postweaning fleeces taken at 91 through 304 days of age are not currently used to derive EBVs. Only the first adult fleece record is currently used to derive EBVs, but 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.

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 the previous shearing must be reported. If exact dates are not available, a reasonable estimate is adequate and should be supplied.

Heritabilities for Polypay fleece traits are all reasonably high, at 0.36 for fleece weight, 0.57 for fiber diameter, 0.50 for staple length, and 0.53 for fiber diameter coefficient of variation. With these heritabilities, fleece records on 15 progeny will yield sire EBVs with accuracies of 77 to 84%. Fleece weight and staple length have positive genetic correlations with body weights and with one another, so heavier lambs are expected to have heavier fleeces and longer staples. However, heavier fleeces tend to also be coarser and more variable, with undesirable genetic correlations of 0.50 between fleece weight and fiber diameter and 0.20 to 0.25 between fleece weight and fiber diameter CV. Fiber diameter also has modest positive (undesirable) genetic correlations with body weights and staple length. Emphasis on improving fiber diameter will thus limit selection response in body weight, fleece weight, and staple length. 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.

There is evidence for a small undesirable genetic relationship between fleece traits and ewe reproduction. This relationship is reflected in the current EBV system by 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 all small, but emphasis on fleece characteristics in maternal breeds is likely justified only if breeders or their customers are receiving premiums for production of high-quality fleeces.

Reporting Yearling and Hogget Body Weights

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. Body weights of replacement ewe lambs can now be reported as either late postweaning (5 to 10 month), yearling (10 to 15 month), or "hogget" (15 to 19 month) weights. EBVs for these weights will allow identification of ewes with different 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.

Yearling and hogget body weights are moderately heritable (0.25 and 0.27, respectively) and will respond to selection. However, body weights at different ages are highly intercorrelated (Table 1), so attention to limiting adult body weights will also reduce rates of progress in weaning and postweaning weights. The proper response to this situation is to extend the Polypay Ewe Productivity Index to incorporate and properly account for changes in both lamb postweaning growth rates and ewe maintenance costs associate with selection for body weights. However, until we can do this, the current modification to the EBV system will allow interested breeders to begin collecting body weights in ewe lambs and young ewes. Breeders who are recording fleece data often also record body weights and now have a place to store those records in NSIP.

Recording of breeding weights in replacement ewe lambs is relatively straightforward, with similar requirements for contemporary grouping to those experienced for weaning and postweaning body weights. For older ewes, however, care should be taken to place open ewes in separate contemporary groups from those that lambed. Among ewes that lambed, additional contemporary groups may be required if the range in lambing dates is large (i.e., more than 45 days or so) or if lactating ewes were managed in different ways. For these reasons, NSIP does not currently recommend reporting body weights in ewes beyond hogget age. If breeders are interested in recording adult ewe weights, they should contact the NSIP Office so that we may develop appropriate guidelines for recording body weights of adult ewes.

Recording of yearling and hogget weights on rams is recommended only if a reasonable number of ram lambs (at least 5 to 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 Maternal Wool breeds [a]

Weight	Weight				
	Birth	**Weaning**	**Postweaning**	**Yearling**	**Hogget**
Birth	0.12, 0.14	0.69	0.34	0.20	0.15
Weaning	0.60	0.09, 0.08	0.92	0.50	0.40
Postweaning	0.60	1.00	0.21, 0.03	0.70	0.55
Yearling	0.60	1.00	1.00	0.25, 0.02	0.80
Hogget	0.60	1.00	1.00	1.00	0.27, 0.02

[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.

EBVs for Ram Postweaning Scrotal Circumference

Genetic differences among males in scrotal circumference have been reported to be positively associated with reproductive performance in their female relatives. Selection for larger scrotal circumference thus may be advantageous in terms of both breeding capacity of rams and reproductive performance of their daughters. Research involving relatively early maturing breeds such as the Polypay confirms a positive relationship between male scrotal circumference and female reproduction, but the magnitude of the relationship is relatively small, so active selection for large testis size in Polypays is expected to have only a modest impact on female reproduction. The most useful measurement appears to be the postweaning scrotal circumference, which is 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 useful supplemental information to aid in improving reproduction in older ewes.

Scrotal circumference may be recorded postweaning (early or late) and in yearlings, hoggets, and 2-yr-olds, but at the moment, only postweaning measures are used for Maternal Wool breeds in order to focus selection on early scrotal development prior to the likely first breeding of ram lambs at 7 to 8 months of age. Scrotal circumference measurements can be reported without an accompanying body weight. However, if both body weight and scrotal circumference are reported, the scrotal circumference measurement must be taken at the same time as (or at least within ± 7 days of) the postweaning weight. Scrotal circumference measurements are adjusted for age prior to calculation of EBVs.

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. Early postweaning measures of scrotal circumference at 90 to 150 days will be most strongly influenced by age at puberty, whereas late postweaning measures are more likely to reflect joint effects of early puberty and adult testis size. Recording of scrotal circumferences on only a few highly selected breeding rams is not likely to be useful, and postweaning scrotal circumference measurements would ideally be taken on a reasonable numbers of ram lambs (preferably 10 or more) from the same contemporary group.

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. In maternal breeds, improving reproductive and maternal traits is likely more important than changing carcass merit and deserves greater selection

emphasis. However, EBVs for these traits may be useful to some breeders and are now available for Maternal Wool breeds.

Ultrasound measurements for Maternal Wool breeds must be taken at the same time as (or at least within ± 7 days of) the early and/or late postweaning body weight (i.e., between 90 and 150 or between 150 and 304 days of age, respectively) and must be accompanied by a body weight record. If lambs are scanned at both early and late postweaning ages, only the first reported postweaning ultrasound measurements are used to derive EBVs. Therefore, breeders should be sure that the most informative postweaning ultrasound data is also the first reported postweaning measurement. 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/wordpress/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 postweaning fat thickness and loin eye muscle depth are 0.24 and 0.39, respectively, and were derived from U.S. Suffolk 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 larger than those observed in Australian breeds, perhaps reflecting more intense selection for frame size in U.S. Suffolks. We reduced the size of these genetic correlations somewhat for U.S. Maternal Wool breeds. Final values for correlations with birth, weaning and postweaning weights were -0.40, -0.35, and -0.37, respectively, for fat thickness and -0.30, -0.25, and -0.28, 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 equal to zero for Maternal Wool breeds. We will update these genetic parameters when adequate numbers of records from Maternal Wool breeds become available.