NSIP EBV Notebook

Number 1 Revised September 1, 2011

David Notter
Department of Animal and Poultry Sciences
Virginia Tech

The NSIP EBVs

EBVs for Weight Traits

- The **Birth Weight (BWT) EBV (kg)** estimates direct genetic effects on weight at birth. Positive selection on Birth Weight EBV is anticipated to increase birth weight and have correlated positive effects on early lamb survival, especially in twins and triplets. Negative selection on Birth Weight EBV is anticipated to reduce birth weight and lambing difficulty associated with oversized lambs, especially in singles. Changing birth weights is generally not a primary selection goal. Positive selection may be advantageous in prolific breeds and in flocks where lambing difficulty is not a problem, whereas negative selection may be desirable in less-prolific breeds or flocks with a history of heavy birth weights and associated lambing difficulties. The birth weight EBV is positively correlated with weaning and postweaning body weight EBVs. Selection to increase weaning and postweaning weights is anticipated to result in increased birth weights, and negative selection on birth weight EBV will reduce selection responses in weaning and postweaning weights.
[All Breeds]

- The **Maternal Birth Weight (MBWT) EBV (kg) e**stimates genetic effects of the ewe on the birth weight of her lambs. This EBV mainly reflects the quality of the uterine environment provided by the ewe and may also be influenced by ewe effects on gestation length. Ewes with positive Maternal Birth Weight EBVs provide a favorable uterine environment for lamb development, whereas ewes with negative Maternal Birth Weight EBVs provide a more limiting uterine environment. The Maternal Birth Weight EBV will not receive major selection emphasis in most flocks, but positive emphasis on Maternal Birth Weight EBV can be useful in flocks that have had problems with, small, weak lambs.
[All Breeds]

- The **Weaning Weight (WWT) EBV (kg)** provides an estimate of preweaning growth potential and will likely receive positive selection emphasis in most flocks. In extensively managed flocks with weaning at 90 to 150 days, the Weaning Weight EBV is commonly estimated from preweaning weights taken at 45 to 90 days of age. In such flocks, the true weaning weight is recorded as an early postweaning weight, with genetic differences reflected in the Postweaning Weight EBV.
[All Breeds]

- The **Maternal Weaning Weight (MWWT) EBV (kg)** estimates genetic merit for mothering ability. This EBV mainly reflects genetic differences in ewe milk production, but other aspects of maternal behavior may also be involved. The Maternal Weaning Weight EBV is derived by evaluating if individual ewes produce lambs that are heavier or lighter than expected based on the weaning weight EBVs of the parents. Ewes whose lambs grow faster than predicted are assumed to be better milk producers, whereas ewes whose lambs grow more slowly than predicted are assumed to produce less milk. Selection for high maternal milk EBVs is expected to improve milk production and mothering ability and considered to be important for maternal breeds. [**Note: the Maternal Weaning Weight EBV is the same as the NSIP Maternal Milk EBV.]**
[All Breeds]

- The **Total Maternal Weaning Weight EBV** was provided by NSIP as the **Milk plus Growth EBV.** This EBV combines information on weaning weight and maternal milk in order to estimate the total anticipated contribution of an animal's daughters to lamb weaning weight. The Total Maternal Weaning Weight EBV is

not explicitly provided in LAMBPLAN, but can be calculated from maternal weaning weight and weaning weight EBVs as:

Total Maternal Weaning Weight EBV (kg) = MWWT EBV + 0.5 x WWT EBV.

The Total Maternal Weaning Weight EBV recognizes that the genetic contribution of a ewe to the weaning weight of her lambs combines effects of her milk production (measured by the Maternal Weaning Weight EBV) and a sample one half of her genes for preweaning growth potential (measured by the Weaning Weight EBV).

[All Breeds]

- The **Postweaning Weight (PWWT) EBV (kg)** combines information on preweaning and postweaning growth to predict genetic merit for postweaning weight at 120 days. Up to two postweaning weights can be recorded: an "early" postweaning weight at 90 to 150 days and a "late" postweaning weight at 150 to 305 days. Either or both can be recorded. These two postweaning weights are assumed to have a genetic correlation of 1.0 and contribute equally to the final Postweaning Weight EBV. 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. Positive selection on Postweaning Weight EBV is expected to favor rapid growth to typical market ages.

  [All Breeds]

- The **Yearling Weight (YWT) EBV (kg)** estimates growth potential to 12 months of age. Animals with high Yearling Weight EBVs exhibit sustained postweaning growth, but ewe lambs with high Yearling Weight EBVs are anticipated to have heavier adult body weights and greater maintenance requirements.

  [Western Range Breeds, Wool Maternal Breeds]

- The **Hogget Weight (HWT) EBV (kg)** estimates genetic effects on body weight at 18 months of age. Negative selection pressure on Hogget Weight EBV can be used to control adult body weights of breeding ewes, but will limit progress in weaning and postweaning weights. Selection emphasis on Hogget Weight EBV must consider the optimum balance between these competing goals.

  [Western Range Breeds, Maternal Wool Breeds]

- LAMBPLAN also allows recording of body weights of adult ewes at 2, 3, 4, and 5 years of age and uses the first reported adult ewe weight to produce Adult Body Weight EBV. However, this option is not currently active for NSIP.

EBVs for Wool Traits

Fleece data can be reported at postweaning, yearling, and hogget ages and for adult ewes at 2, 3, 4, and 5 years of age. NSIP/LAMBPLAN currently uses data from yearlings, hoggets, and the first adult fleece (regardless of ewe age) to produce yearling, hogget, and adult EBVs for wool traits. However, breeders who wish to collect fleece data for adult ewes at more than one age may do so. Those data will be stored for possible future use.

Records on the same fleece trait at different ages are strongly and positively correlated, so most NSIP breeders can likely base selection decisions and marketing programs on yearling EBVs.

- The **Fleece Weight (GFW) EBV (%)** is based on greasy fleece weights and estimate the animal's genetic potential for wool production. Fleece weights are stored and analyzed in kilograms, but, because of the limited range in resulting EBVs, are reported as percentages of the mean FW.

  [Western Range Breeds; Maternal Wool Breeds]

- The **Fiber Diameter (FD) EBV (microns)** estimates genetic merit for fleece quality. Animals with finer, more desirable fleeces have negative fiber diameter EBV, so negative EBVs are favored for this trait.

  [Western Range Breeds; Maternal Wool Breeds]

- The **Staple Length (SL) EBV (mm)** estimates genetic potential for length of the wool fiber. Positive selection emphasis on Staple length EBV is recommended in flocks that receive premiums for long-staple fleeces or have experienced discounts for fleeces with excessively short staples.
[Western Range Breeds; Maternal Wool Breeds]

- The **Fiber Diameter Coefficient of Variation (FDCV) EBV (%)** estimates genetic merit for fleece uniformity, expressed as the coefficient of variation (CV) among individual wool fibers in a fleece sample. Animals with more uniform fleeces (lower CV) are desired, so negative EBVs are favored for this trait.
[Western Range Breeds; Maternal Wool Breeds]

- The **Fiber Curvature (CURV) EBV (°)** predicts 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.
[Western Range Breeds]

- LAMBPLAN also produces EBVs for clean fleece weight and staple strength in yearlings, hoggets, and adult ewes. These EBVs can be made available to NSIP producers who record these variables.

EBVs for Body Composition

- The **Fat Depth (CF) EBV (mm)** is an indicator of genetic differences in carcass fatness between the 12^{th} and 13^{th} ribs. It is derived from ultrasonic measurements of fat depth in live animals and adjusted to standard postweaning weight of 110 lb (55 kg) for Terminal and Maternal Wool breeds and a standard yearling weight of 187 lb (85 kg) for Western Range breeds. Animals with negative Fat Depth EBVs are expected to produce leaner progeny with lower, more desirable Yield Grades and are generally desirable. However, the emphasis placed on Fat Depth EBVs in individual breeding programs will depend on specifications, discounts, and premiums in current markets.
[Terminal Breeds; Maternal Wool Breeds; Western Range Breeds]

- The **Loin Muscle Depth (EMD) EBV (mm)** is an indicator of genetic differences in muscling. It is derived from ultrasonic measurements of loin muscle depth between the 12^{th} and 13^{th} ribs in live animals and adjusted to standard postweaning weight of 110 lb (55 kg) for Terminal and Maternal Wool breeds and a standard yearling weight of 187 lb (85 kg) for Western Range breeds. Animals with positive Loin Muscle Depth EBVs are expected to produce offspring with larger loin eyes and are generally desirable. However, the emphasis placed on Loin Muscle Depth EBVs in individual breeding programs depends on specifications, discounts, and premiums in current markets.
[Terminal Breeds; Maternal Wool Breeds; Western Range Breeds]

- Ultrasonic measurements for Terminal and Maternal Wool breeds can be reported at either early or late postweaning ages. However, in contrast to the situation for postweaning weights, only the first reported postweaning ultrasound measurements are used to derive Postweaning Fat Depth and Postweaning Loin Muscle Depth EBVs for Terminal and Maternal Wool breeds. Therefore, breeders should be sure that the most informative postweaning ultrasound record is also the first reported postweaning record.

- Measurements for later-maturing Western Range breeds can be reported at late postweaning, yearling, or hogget ages. However, late postweaning and yearling measurements are preferred. All 3 of these measurements contribute to the reported Yearling Fat Depth and Yearling Loin Muscle Depth EBVs in Western Range breeds.

- All scanning records must be accompanied by a body weight and recorded at the same time as (or at least within ± 7 days of) that body weight.

- Procedures to estimate EBVs for scanning traits in Western Range breeds were derived for ram lambs fed at a moderate to high plane of nutrition following weaning at 90 to 150 days of age and scanned at late postweaning, yearling, or hogget body weights of 110 to 265 lb (50 to 120 kg). Records from ram lambs scanned at lighter weights or ewe lambs maintained on lower planes of nutrition are not expected to yield valid EBVs.

EBVs for Reproduction

- The **Number of Lambs Born (NLB) EBV (%)** evaluates genetic potential for prolificacy. This EPD is expressed as numbers of lambs born per 100 ewes lambing. Ewes with EBVs of +10.0 for Number of Lambs Born are expected to have an average of 0.10 more lambs at each lambing, or 10.0 more lambs per 100 lambings, than average ewes, and their daughters are expected to have an average of 0.05 more lambs at each lambing compared to daughters of average ewes. Selection on Number of Lambs Born EBV is expected to increase prolificacy in the flock.

[All Breeds]

- The **Number of Lambs Weaned (NLW) EBV (%)** evaluates combined ewe effects on prolificacy and lamb survival to weaning. The NLW EBV is expressed as numbers of lambs weaned per 100 ewes lambing. Ewes with EBVs of +10.0 for Number of Lambs Weaned are expected to wean an average of 0.10 more lambs at each lambing, or 10.0 more lambs per 100 lambings, than average ewes, and their daughters are expected to wean an average of 0.05 more lambs at each lambing compared to daughters of average ewes. Selection on Number of Lambs Weaned EBV is expected to increase weaning rates in the flock.

[All Breeds]

- The **Scrotal Circumference (SC) EBV (cm)** may be used to improve breeding capacity in males and reproductive performance in females. Selection of animals with positive Scrotal Circumference EBVs is expected to be most useful in improving reproductive performance in ewe lambs and yearlings via desirable effects on rate of sexual maturation, but may also have small positive effects on numbers of lambs born and weaned by older ewes. Scrotal circumference measurements can be recorded at postweaning, yearling, and hogget ages. However, NSIP currently produces only Postweaning Scrotal Circumference EBVs for the relatively early-maturing Maternal Wool Breeds and Postweaning and Yearling Scrotal Circumference EBVs for the later-maturing Western Range Breeds.

[Maternal Wool Breeds; Western Range Breeds]

- Scrotal circumference measurements can be reported at early and late postweaning ages for Maternal Wool breeds and at late postweaning and yearling ages for Western Range breeds. Reporting of body weights is not mandatory for scrotal circumference measurements, but if both are recorded, the scrotal circumference must be recorded at the same time as (or at least within ± 7 days of) the corresponding 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. This will normally be the late postweaning measurement.

- LAMBPLAN normally expresses NLB and NLW EBVs on a "per ewe exposed" basis to include genetic differences in ewe fertility in these EBVs. In contrast, NSIP expresses these EBVs on a "per ewe lambing basis" because of 1) limited past NSIP data on ewe fertility and 2) concerns about combining genetic differences in different reproductive traits (fertility, prolificacy, lamb survival) into a single EBV. Optimum ways to express EBVs for reproduction is a topic of ongoing study.

EBVs for Parasite Resistance

- The **Worm Egg Count (WEC) EBV (%)** evaluates genetic merit for parasite resistance based on worm egg counts recorded at weaning or at early or late postweaning ages. Animals with low Worm Egg Count EBVs are expected to have greater parasite resistance, and selection to reduce Worm Egg Count EBVs is recommended in areas where internal parasites are a problem. Worm egg counts can also be recorded in yearlings, hoggets, or

adult (2-yr-old only) ewes, but these measurements are not currently used to derive EBVs. Most research would suggest that postweaning WEC EBVs are the most useful genetic indicator of parasite resistance, but studies with Katahdin sheep in the USA have shown that weaning worm egg counts provide useful information on parasite resistance in young lambs. Weaning and postweaning Worm Egg Count EBVs are strongly, but not perfectly, correlated and so convey slightly different information on patterns of development of parasite resistance. However, postweaning Worm Egg Count EBVs are likely adequate for most selection and marketing purposes.

[Hair Breeds]

- Postweaning worm egg counts can be reported at either the early or late postweaning age. Reporting of body weights is not mandatory for reporting worm egg counts, but if both are recorded, the worm egg count must be recorded at the same time as (or at least within ± 7 days of) the corresponding early or late postweaning weight. In contrast to the situation for postweaning weights, only the first reported postweaning worm egg count is used to derive EBVs. Therefore, breeders should be sure that the most informative postweaning worm egg count is also the first reported postweaning measurement.

NSIP/LAMBPLAN Selection Indexes

- The **Western Range Index (%)** was developed by NSIP to improve profitability in Targhee range flocks and is generally applicable to extensively managed Western range flocks with positive emphasis on both lamb and wool production. EBVs for the Western Range Index are estimated from Postweaning Weight, Maternal Weaning Weight, Yearling Weight, Yearling Fleece Weight, Yearling Fiber Diameter, and Number of Lambs Born EBVs as:

Western Range Index = P**WWT EBV + 0.26 x MWWT EBV - 0.26 x YWT EBV + 1.92 x YFW EBV**

– 0.47 x YFD EBV + 0.36 x NLB EBV

This index places major positive weight on early growth and ewe prolificacy and modest positive weight on increasing ewe maternal ability, increasing fleece weight, and reducing fiber diameter. Negative emphasis on yearling weight EBV is designed to limit increases in adult ewe weight but, because of the large positive correlation between Weaning Weight and Yearling Weight EBVs, is not expected to actually reduce yearling weights. Yearling Fleece Weight EBVs are expressed as percentages in NSIP/LAMBPLAN reports, but expressed in kilograms in deriving the Index. The Western Range Index was originally derived in $ but, in common with all LAMBPLAN indexes, is now expressed as a percentage of the mean. The Number of Lambs Born EBV is used in preference to the Number of Lambs Weaned EBV because of potential bias in Number of Lambs Weaned EBV from predation in Western range flocks.

[Western Range Breeds]

- The **Ewe Productivity Index (%)** combines EBVs for various traits into an index designed to maximize pounds of lambs weaned per ewe lambing. This index was originally derived by NSIP for the Katahdin and Polypay breeds, and EPDs for the index were estimated at the same time as other NSIP EPDs. Under NSIP/LAMBPLAN procedures, Ewe Productivity (EP) EBVs are now estimated from EBVs for other traits. The Katahdin (KT) Ewe Productivity EBV is used for all Hair breeds and estimated as:

KT EP EBV = 0.246 x WWT EBV + 2.226 x MWWT EBV + 0.406 x NLW EBV– 0.035 x NLB EBV

The Polypay (PP) Ewe Productivity EBV is used for all Maternal Wool breeds and estimated as:

PP EP EBV = 0.265 x WWT EBV + 1.200 x MWWT EBV + 0.406 x NLW EBV– 0.035 x NLB EBV

The Ewe Productivity indexes give substantial positive weight to Number of Lambs Weaned, Maternal Weaning Weight, and Weaning Weight EBVs. Small negative emphasis on Number of Lambs Born EBV favors ewes that wean large litters without losing any lambs. A ewe that produces twins and weans them both

will thus be favored over a ewe that has triplets but weans only two lambs. However, ewes that wean triplets will always have substantially higher index values than ewes that wean twins. Calculation of Ewe Productivity Indexes has changed slightly under NSIP/LAMBPLAN procedures, but the basic nature of the indexes, in terms of underlying assumptions and expected selection responses in component traits, is the same as it was under the original NSIP system. The Western Range Index was originally derived in pounds of lamb weaned per ewe lambing but, in common with all LAMBPLAN indexes, is now expressed as a percentage of the mean.

[Hair Breeds; Maternal Wool Breeds]

- **Carcass Plus** was developed in Australia to improve carcass value in Australian markets. Carcass Plus EBVs are calculated as:

  Carcass Plus EBV = 5.06 x PWWT EBV – 13.36 x Fat Depth EBV + 7.83 x Muscle Depth EBV

  Even though developed for Australian markets, Carcass Plus EBVs provide a reasonable assessment of value for Terminal Sire types in the USA.

  [Available for All Breeds, but mainly applicable to Terminal Sire Breeds]

- **LAMB 2020** was also developed in Australia as an alternative to Carcass Plus and designed to reflect projected demand for Australian lambs in 2020. LAMB 2020 EBVs are calculated as:

  LAMB 2020 EBV = 0.32 x WWT EBV + 0.47 x PWWT EBV – 0.21 x Birth Wt EBV –

  0.55 x Fat Depth EBV + 1.54 x Muscle Depth EBV – 0.04 PWEC EBV

  LAMB 2020 is designed to assess genetic merit in terminal sires used to produce 48 lb (22 kg) carcasses from Merino or Merino-crossbred ewes. It includes more variables than Carcass Plus, with positive consideration of Weaning Weight EBVs and negative consideration of Birth Weight and Postweaning Fecal Egg Count (PWEC) EBVs. LAMB 2020 also places less negative emphasis on Postweaning Fat Depth EBVs compared to Carcass Plus, in anticipation of diminishing returns from further reductions in carcass fat. The fact sheet "Lambplan terminal indexes for NSIP breeders" on the NSIP web site provides additional information on Carcass Plus and LAMB 2020 indexes (http://nsip.org/wordpress/wp-content/uploads/2011/04/Lambplan-Terminal-Indexes-for-NSIP-breeders.pdf).

  [Available for All Breeds, but mainly applicable to Terminal Sire Breeds]