

# 2005 HAIR SHEEP WORKSHOP @ VIRGINIA STATE UNIVERSITY

## Opportunities for Genetic Evaluation of Hair Sheep

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### Introduction

Recording of animal performance and use of resulting data for genetic evaluation are powerful tools for flock improvement. If performance recording occurs within the context of an organized program of collaboration and sharing of breeding stock, its impact is multiplied, providing opportunity for breed-wide genetic progress. The records that are to be collected should be those that support the production and breeding objectives of each individual breed, as defined by the breeders and by the needs of their customers. Much of the popularity that is currently enjoyed by hair sheep results from a unique combination of performance and fitness characteristics sometimes referred to as the "easy-care" complex. The establishment of performance recording and genetic evaluation programs for hair sheep breeds must recognize the importance of the easy-care complex and design recording procedures that will enhance, rather than compromise, these characteristics.

Programs for genetic evaluation of livestock such as the U.S. **National Sheep Improvement Program (NSIP)** provide a set of tools and procedures for prediction of genetic merit based on objective measurements of animal performance. These tools do not dictate which traits are to be improved but instead provide the information necessary to achieve progress toward previously defined breeding goals. The purpose of this presentation is thus to discuss the unique opportunities available for hair sheep in U.S. production systems and to highlight how genetic evaluation programs such as NSIP can be used to aid in realizing those opportunities.

### The U.S. National Sheep Improvement Program (NSIP)

NSIP was established in 1986 to provide genetic evaluation services to the American sheep industry. While initially restricted to within-flock evaluations, the program relatively quickly expanded to become a breed-centered program that now provides across-flock genetic evaluations for eight American sheep breeds (Table 1).

Breed	Number of		
	Flocks	Breeding Ewes	Live lambs
Targhee	15	1,614	2,598
Suffolk	23	1,114	1,891
Katahdin	19	1,076	1,985
Polypay	14	963	1,931
Columbia	7	378	603
Dorset	7	284	403
Rambouillet	1	133	196
Romney	2	139	222
<b>Total</b>	<b>88</b>	<b>5,701</b>	<b>9,829</b>

Predictions of genetic merit for recorded traits for all animals evaluated within each participating breed are reported as Expected Progeny Differences (EPD). The EPDs provided by NSIP are listed in Table 2, and encompass a wide range of production traits, including growth, maternal ability, prolificacy, and wool production and quality. As the name implies, the EPD provides estimates of expected differences in

progeny performance among current and prospective breeding animals. Each EPD is expressed in the same units as the trait that is being evaluated, and represents a compilation of all available production records on an animal and its relatives. Since related animals share genes in common, these production records, when properly weighted, provide the best available indicators of genetic merit.

<b>Table 2. National Sheep Improvement Program EPDs</b>	
<b>Weaning Weight EPD</b>	Provides an estimate of preweaning growth potential.
<b>Maternal Milk EPD</b>	Provides an indication of the genetic merit for mothering ability. This EPD primarily reflects genetic differences in ewe milk production potential as realized in her lambs. The maternal milk EPD is thus expressed in pounds of lamb weaned, not pounds of milk produced. It is derived by evaluating if individual ewes produce lambs that do better or worse than expected based on the weaning weight EPDs of the parents. Ewes whose lambs grow faster to weaning than predicted are assumed to be better milk producers whereas ewes whose lambs grow more slowly than predicted to weaning are assumed to produce less milk. This relationship between maternal milk EPD and actual milk production has been validated in beef cattle and is assumed to be similar in sheep, although other elements of maternal behavior may also be included in the maternal milk EPD. Selection for high maternal milk EPDs is anticipated to improve milk production and mothering ability in the flock.
<b>Milk plus Growth EPD</b>	Combines information on weaning weight and maternal milk EPDs to provide an index of the total anticipated contribution of an animal's daughters to lamb weaning weight. The milk plus growth EPD is calculated as the sum of the maternal milk EPD plus one half the weaning weight EPD. It recognizes that the genetic contribution of a ewe to the weaning weight of her lambs combines the effects of her milk production (measured by the maternal milk EPD) and a sample one half of her genes for preweaning growth potential (measured by the weaning weight EPD). Because the milk plus growth EPD is calculated from two other EPDs, an accuracy value is not reported for this EPD.
<b>Number Born or Percent Lamb Crop EPD</b>	Evaluates genetic potential for prolificacy. This EPD is expressed as numbers of lambs born per 100 ewes lambing. An EPD of +5.0 for percent lamb crop thus indicates that an animal is expected to produce daughters who will have an average of .05 more lambs at each lambing, or 5.0 more lambs per 100 lambings, than an average ewe. Selection on percent lamb crop EPD is expected to increase prolificacy in the flock.

<b>Fleece Weight EPD</b>	Provides an estimate of the animal's genetic potential for wool production. It is based primarily on yearling wool production, although some records on older animals have also been used to derive the fleece weight EPD.
<b>Fleece Grade EPD</b>	Based on fiber diameter measurements, usually taken at 1 year of age. It provides an estimate of genetic merit for fleece quality. Note that animals with finer fleeces have negative values for the fleece grade EPD. Negative values for fleece grade EPD are thus desired for this trait.
<b>Staple Length EPD</b>	Provides an indication of genetic potential for length of the wool fiber. Selection to increase staple length is recommended if fleeces do not have the staple length required for production of high-value worsted yarns.

The EPDs are most appropriately used to predict average differences in performance between pairs of animals. **Table 3** lists EPDs for a set of progeny-tested rams from one of the NSIP Sire Summaries. Thus for Postweaning Weight, values listed in the table indicate that progeny of Sire J are expected to average 6 pounds heavier at 120 days [5.7 - (-0.3)] than progeny of Sire I. Measurements of maternal and reproductive ability are based on the anticipated performance of the rams' daughters. Thus in comparing Sires J and G, the difference in Milk + Growth EPD predicts that Sire J's daughters, when saved as replacement ewes, will produce lambs that average 2.0 pound heavier at weaning [1.6 - (0.4)] than daughters of Sire G. Similarly, the Percent Lamb Crop EPD difference predicts that daughters of Sire J will produce 8.6 more lambs per 100 lambings than daughters of Sire G.

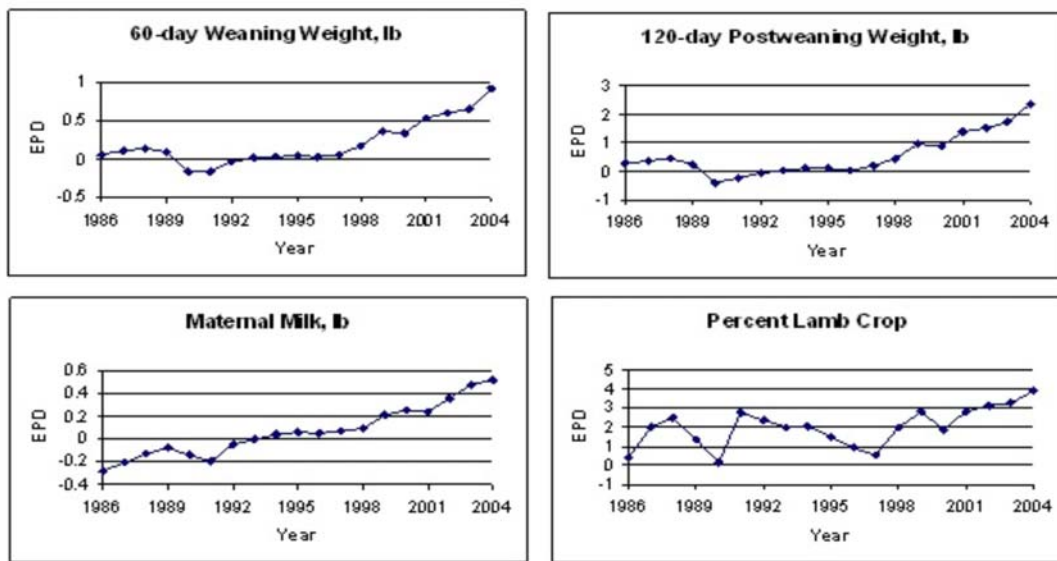
Tag	Sex	Birth year	Weaning weight EPD	Maternal milk EPD	Milk + growth EPD	Percent lamb crop EPD
A	Ram	1993	- 1.1	+ 0.1	- 0.5	+ 0.4
B	Ram	1993	+ 0.3	- 0.6	- 0.4	+ 1.4
C	Ram	1995	+ 0.6	+ 0.2	+ 0.5	+ 3.6
D	Ram	1996	- 1.1	- 0.1	- 0.6	- 2.4
E	Ram	1998	+ 1.7	+ 0.4	+ 1.3	+ 8.5
F	Ram	1999	+ 0.5	+ 0.2	+ 0.4	+ 0.3
G	Ram	2000	- 1.1	+ 0.2	- 0.4	- 3.5
H	Ram	2001	+ 0.4	+ 0.2	+ 0.4	- 2.2
J	Ram	2001	+ 0.3	***	***	***
K	Ram	2001	+ 2.3	+ 0.4	+ 1.6	+ 5.1

The EPDs are more than just tools to create genetic change; they are also tools to manage genetic change. One of the most striking observations associated with the NSIP genetic evaluation reports is the difficulty in finding individuals that excel in all the recorded traits. In the Suffolk breed, EPDs are calculated for four measurements: 60-day weaning weight, maternal milk, 120-day postweaning weight, and percent lamb crop. Of the 190 progeny-tested sires listed in the 2004 Suffolk sire summary, only 20 (11%) were above average for all four traits. In the Targhee breed, EPD are reported for seven traits (120-

d weaning weight, maternal milk, yearling weight, fleece weight, fiber diameter, staple length, and percent lamb crop), and of the 112 progeny-tested rams in the 2005 Targhee sire summary, only two were better than average for all seven EPDs.

The potential of genetic evaluation methods to manage genetic improvement can be seen in the genetic trends achieved by NSIP flocks. An example of genetic trends for the Polypay breed is shown in **FIGURE 1**. Values were derived by averaging EPDs of animals born in different years and plotting changes in mean EPD over time. These changes in EPD document rates of genetic change in participating flocks and indirectly provide information about the traits that are receiving the most selection emphasis. Genetic trends in the Polypay breed are generally consistent with its primary role as a relatively prolific maternal breed. Since 1996, weaning weight, maternal milk, and 120-d postweaning weight EPDs in Polypay sheep have increased at average rates of 0.5, 0.3, and 0.7% per year. By comparison, average rates of increase in weaning weight, maternal milk, and yearling weight EPDs for the six largest U.S. beef breeds over the past 20 year averaged approximately 0.4, 0.2, and 0.4% per year, and those achieved by the Angus breed were approximately 0.5, 0.3, and 0.6% per year. Thus while the sheep industry has bemoaned the limitations on rates of genetic improvement imposed by limited use of artificial insemination, opportunities still exist to capitalize on the shorter generation interval and greater fecundity of the sheep to achieve rates of genetic improvement comparable to those observed in beef cattle.

**Figure 1. Genetic Trend in NSIP Polypay Flocks**



### Using Genetic Evaluation in Hair Sheep Breeds

Genetic evaluation is a tool for managing genetic change. The optimal use of genetic evaluation methods in any breed thus requires development of a clearly stated breeding objective as a critical first step. The breeding objective is a statement of the genetic characteristics that need to be changed, that need to be maintained at or near their current level, or that can be ignored. As a hypothetical example, owners of Caribbean hair breeds such as the St. Croix and Barbados Blackbelly might wish to increase growth rate and carcass muscling while maintaining existing high levels of parasite resistance, prolificacy, and lamb survival but with no attention at all to fleece characteristics. Note that the choice of a breeding objective further depends on the role that the breeders perceive for their animals in the industry.

If the Katahdin is to be used in production of heavy-weight (120 lb) market lambs, its role will likely be that of a maternal breed for crossing with larger, leaner terminal sire breeds and the breeding objective will emphasize traits associated with ewe productivity, maternal ability, and easy-care traits. However, if the production system involves direct marketing of lighter (85 to 120 lb) purebred lambs to quality-conscious markets, the breeding objective will likely place some additional emphasis on growth and muscling.

The Dorper has been promoted as both a terminal sire breed for crossing with smaller, less-well-muscled hair breeds or as a maternal or general purpose breed that is particularly well adapted to the arid Southwestern U.S.A. These different roles will require different breeding objectives to optimize patterns of genetic change. The choice of a breeding objective is often a contentious issue. Breeds wish to compete across the widest possible spectrum of industry roles. Acceptance of a single breeding objective for the breed as a whole likely maximizes genetic progress, but may not be attainable if different sets of breeders choose to embrace different breeding objectives. However, the coupling of a carefully developed, economically based breeding objective with modern methods of genetic evaluation provides exciting opportunities for genetic improvement.