

The Lesson of Freckles

Adjusted Weights, EPDs and the Mystery of Motherhood

By Richard Gilbert

My wife and I waded into a pen of baaing ewe lambs inside a barn on the Getz Farm outside of Springfield, Ohio. We were buying lambs to expand our sheep flock. We had no records to guide us—no lamb weights to indicate growth rates, no production records of their mothers, not even ear tags to indicate a lamb's parentage.

In the waning days of the Getz Farm, home to sheep and shepherds for three generations, there was little information concerning the animals that made up what might be the old farm's last lamb crop.

Farmers often are too busy, or too overwhelmed at key points, to record data for later analysis. Or their smudged notes, scrawled in the heat of battle and jammed onto a rusty nail in the barn, have become almost useless when retrieved months later from the cobwebs and dust.

Without information, we were guessing which ewe lambs would mature into productive ewes. We were evaluating the lambs by appearance and mostly by size.

This is the poorest way to select sheep—or any other livestock for that matter—and the most common. People gravitate to big animals. Some people develop an eye for good conformation. Unfortunately, conformation is of minor economic importance compared with maternal performance. The vital traits of fertility, prolificacy, and mothering ability cannot be appraised visually.

The most profitable ewe in a flock might be sway-backed, nar-

row-bodied, and cow-hocked. She might be big, little, or medium-sized. She is probably average looking, with decent conformation and high maternal ability that came together through random genetic assortment—chance. She *might* also have a straight top line and pleasing proportions, the reward for decades of breeding effort to unite muscling and structural correctness with the qualities of motherhood.

It was early summer. The Katahdin ewes at the Getz farm had lambed in the barn in January and February. Their lambs looked wonderful in comparison to my lambs born on pasture three to four months later. In the

end, we bought 12 big ewe lambs that summer afternoon.

Three of the ewe lambs grew into sheep distinctive enough to earn names. "Fancy" was big and flashy; she was chocolate brown with a face marked with a white blaze. "Friendly" was a snow-white ewe, long bodied, with a wide, pink muzzle and an outgoing personality. "Freckles" matured as the smallest of the three, a rather dumpy little ewe in comparison to her flashy flock mates. Freckles had short legs and a big belly; she was white with a spray of black spots across her face.

Bred in early December to the same ram, the three ewes lambed in spring 2001 as yearlings. Freckles lambed first, with twins, a ram and a ewe. Five days later, Fancy

had a single lamb, a large ram. That same morning, Friendly had twins, both rams. I learned in later years to pay close attention to a yearling that twinned and did a good job of raising her lambs.

Multiple lambs are difficult for a yearling to raise because she is inexperienced, still growing herself, and produces less milk than a mature ewe. Most shepherds would rather see a yearling have a nice single lamb. But in order for a flock to achieve a 200-percent lamb crop, about half the yearlings must twin and a few older ewes must have triplets.

Basic sire information for groups of lambs is important to prevent unwanted inbreeding. But of equal importance is knowing how many lambs a ewe gave birth to and how many she raised. This is one of the problems with picking out large and appealing lambs when a ewe's production is not recorded: The shepherd usually is picking singles nursed by older ewes.

Singletons always grow larger and look nicer but result in less total weight to sell than twins. With typical production costs and meat prices, each ewe must twin in order for the farmer to make money. The first lamb covers the expenses and the second produces profit.

Ewes have two teats and should be capable of raising more than one lamb. Yet it took centuries of selection by shepherds to achieve consistent lambing rates of greater than one lamb from each ewe. That reproductive progress is always in danger of being lost. English shepherd Thomas Tusser (1524-1580), the author of *Five Hundred Pointes of Good Husbandry*, wrote a poem

"...We were evaluating the lambs by appearance and mostly by size. This is the poorest way to select sheep—or any other livestock for that matter—and the most common...."

about this to guide the selective breeding of sheep:

Ewes yearly by twinning rich masters do make

The lambs of such twinners for breeders do take.

Tusser captured in his pithy rhyme an important genetic insight, as well as what was economic wisdom even in Tudor times. Moreover, a moment's reflection reveals that keeping records is the vital step toward taking his advice. By knowing his ewes well and recording their production as they lambed (and probably by some means of marking their offspring), the wise shepherd of antiquity retained lambs that would grow into fertile and prolific ewes.

Freckles, Fancy, and Friendly raised all their lambs their first time out. I had tagged all my lambs at birth and knew which lambs went with which ewes; I knew which ram had sired which lambs. My system was simple but effective.

In the pasture, I carried in my shirt pocket a small, spiral-bound Oxford notebook with thick, notecard pages and recorded ewe birthing dates, the tag numbers and sex of lambs, and sire information. I also gave a mothering score to each ewe.

In the fall, I tried to evaluate the lambs, to determine which ewe lambs to keep and which to sell. I know this, because I filled six lined notebook pages with notes—tag numbers and dates and impressions. There apparently was a system when the notes were made, but it is difficult to ascertain now. The biggest failure was in taking the weights of some lambs (why not

all?) but failing to record the date of the weighing.

Knowing the age of lambs at weighing is very important in evaluating them, their mother, and their sire. It would have been late summer or fall, and I am sure at the time I did not realize I would look back at my records months or years later. In the end, I kept Freckles' ewe lamb. But it was clear my selection process needed to be more systematic.

As someone interested in creating more ewes that were docile, successful mothers, I should have been taking 60-day weights from the start. Some backsliding is inevitable without constant selection by the shepherd—domestic animals always regress toward average and worse performance without selection pressure.

The three named Getz ewes, bred to my most promising Katahdin ram, all twinned again in mid-May 2002. I took lamb birth weights that year and weighed



the lambs again when I weaned them at the beginning of August. This system was much improved. I took each lamb's weight on the same day—although my weighing fell somewhere between the traditional 60-day weaning weight and the 120-day post-weaning weight evaluation points.

I ranked my ewes according to the total weight of their lambs on that August day. Ewes in the top group had one-hundred or more pounds of lamb. Friendly was the highest-ranked of the year 2000-born ewe cohort, with lambs that weighed 112 pounds together; Fancy's twins weighed 103 pounds; Freckles was in the second rank of ewes with ninety-nine pounds between her twins.

Mothering differences in the ewes became clearer in April 2003. Friendly lambed first, with nice twins weighing about nine pounds each; she paid close attention to them. Eight days later, Freckles had her first set of triplets, a wriggling batch of newborns that weighed almost twenty-three pounds.

Two days later, Fancy had triplets, all ewes, but the biggest ewe lamb—a whopper weighing more than ten pounds—died during birth. Fancy did not clean her surviving lambs, which sat on the ground dressed in a slimy film of placenta. Fancy was unconcernedly grazing near the sodden twins when I came upon the scene.

Freckles had really begun to shine. Her mothering ability was impressive. Unlike Fancy and her ilk, Freckles never seemed to have a lost lamb crying for her in the far corner of a paddock. Freckles and her brood moved together, as if welded.

Some ewes that had triplets tried hard to raise them but failed. Those ewes did not appear able to keep track of three lambs, or they lacked other mothering skills, or they did not seem to have enough milk. Other ewes would reject a triplet, or passively allow it to fall behind and die, without my intervention.

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Triplet lambs are smaller at birth than twins, and often the smallest triplet will not get enough milk; its stronger siblings shove it aside and take the teat. For these reasons, many shepherds want only twins. Triplets, overall, are a management headache in many farm situations. Often a triplet gets pulled off the ewe and raised artificially – but bottle babies are a lot of labor and need expensive milk replacer.

I was not sure I wanted a lot of triplets, but I knew I wanted more ewes like Freckles. If a ewe had triplets, I wanted her to raise them. I could not imagine Freckles rejecting a lamb. Moreover, she seemed to look out for all of her triplets equally. Freckles sailed through motherhood.

When I took 60-day lamb weights, Freckles' triplet litter weighed 99 pounds. I still had not learned how impressive that accomplishment was on pasture with no creep feed for the lambs. At the time, I admired Friendly's big twins even as I praised Freckles' amazing mothering ability. Friendly's twins, a ram and a ewe, together weighed 94 pounds.

Fancy's twins weighed 75 pounds, but to make up for her dead lamb I had grafted to her an additional lamb that weighed in at 24 pounds. So she was raising triplets, and her litter totaled 99 pounds.

But it appeared to me that Fancy may have rejected the grafted lamb, which had learned to steal milk from other ewes to survive. I had clouded the picture in being able to evaluate Fancy and was unwilling to give her full credit or blame. She was on probation.

By early August, Freckles' triplet litter weighed 138 pounds, beginning to show the income advantage that accrues to triplets even when the lambs are smaller

individually (her largest lamb, a 49-pound ewe, weighed 10 pounds less than Friendly's ewe lamb). Friendly's twins weighed 128 pounds; her ram lamb was particularly nice at 69 pounds.

One of the first breakthroughs in attempting to deal with the challenge of making fair genetic comparisons between ewes was the use of "adjusted weights." The idea was to figure out a way to compare lambs that were born on different days, whose mothers were of different ages, and whose gender was different.

On-farm programs for the improvement of sheep in the United States were initiated at the University of Wisconsin in 1950, with an extension specialist hired to conduct the program. Research had shown that weight adjustment for type of birth, age of dam and age of lamb at time of weighing would improve selection accuracy by one-third over selection using unadjusted weights.

This method of leveling the playing field allows a shepherd to compare the dainty ewe lamb raised by a yearling mother to the husky twin lambs, a ram and a ewe, raised by a four-year-old ewe in her prime. Without adjustment, most likely the shepherd picks the lamb from the older mother, even though in one year the yearling's lamb will be the same size, or larger.

The yearling's lamb may become a more productive ewe. In fact, if the shepherd has been making genetic progress, the yearling should be a better ewe than the four-year-old ewe – and her lamb will be better still. But there's that size difference: Even a five-pound disparity between two lambs makes a huge difference in how lambs appear at a young age.

First published in 1970, the *Sheep Production Handbook* of the Sheep Industry Association is the most complete standard reference for shepherds and lists formulas necessary for adjusted weights. The first step is to correct the weaning weight to a standard age, in this case 60 days.

The adjusted age is used with corrections for ewe age, breed of ewe, birth and rearing type (for example, twin-born and twin-raised Katahdin) and the gender of the lambs to give the adjusted weight. Ram lambs and ewe lambs have different adjustment factors, because males grow faster. The written formula for adjusting weights is easy to use if followed step-by-step.

I used this assessment method to compare Freckles' 2003 triplets to Friendly's twins of the same year. At the 60-day weighing point, Freckles' triplet litter weighed 99 pounds on my scale. Friendly's older twins weighed 94 pounds.

What were the adjusted litter weights? Adjusting for the age of the lambs was important here, because Friendly's lambs were eight days older. Adjusting for the type of rearing was even more significant – triplets vs. twins – and an adjustment needed to be made as well as for the gender of the lambs.

The result was surprising, given the actual weights and the pleasing appearance of the stocky twins: Freckles' adjusted litter weight was more than 120 pounds. Friendly's comparable total was 87 pounds.

But farmers sell actual pounds, not adjusted pounds, and the actual weights were very close. Still, Freckles produced a five-pound advantage at 60 days, which means her smaller lambs would

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bring more at market, especially if they grew well after weaning.

Clearly, Freckles was the more productive ewe, with exceptional mothering ability. If one of the ewes were to be sold, it should be Friendly, not Freckles. Actually, the ewe to sell would be Fancy, of course. Freckles' two ewe lambs should be considered for retention, especially if prolificacy is needed in the flock.

The adjusted weight of Freckles' largest triplet ewe lamb was just under 43 pounds; her smaller ewe lamb was almost 42 pounds, adjusted. The adjusted weight of Friendly's ewe lamb, which had a much easier life as a twin, was 43 pounds.

Using adjusted weights does require a person to think, to use records, and to exercise willpower — one must accept the results of the formula and act upon them, regardless of what his eyes are telling him.

Consequently, top ram and ewe lambs should be picked first on paper at the kitchen table. Selection at the barn should then be made on the basis of conformation, not size, from the top group of lambs.

It goes against human nature to believe the numbers instead of the eyes. It is somewhat like a pilot learning to trust his instruments rather than his gut feelings. Many a pilot has flown his airplane into the ground rather than believe his

gauges. Many farmers steadily lose productivity in their livestock because they will not collect, use, or believe records.

Freckles' 34-pound ewe lamb was "really" 43 pounds, genetically speaking. Friendly's stocky 44-pound ewe lamb was "really" 43 pounds as well. They probably would grow into ewes of comparable size.

We know that Freckles' litter earned us a bit more. Even someone who does not want triplets should retain Freckles' daughters to foster mothering ability in the flock and to keep selection pressure favoring at least a 200-percent lamb crop. Shepherds who have used adjusted weights to select breeding stock have transformed their flocks.

As a fanatic about selective breeding, I wanted for my flock an even more powerful evaluation than adjusted weights. In the fall of 2003, I enrolled in the National Sheep Improvement Program, established in 1986 to provide computer analysis of flock performance for evaluation of such important qualities as prolificacy, innate growing ability, and ewe milking ability.

NSIP first compares animals that are contemporaries in the same operation and that are managed the same way. Then the computer compares those lambs with the performance of lambs on other farms. Genetic links between farms, such as related ewes or rams, increase accuracy.

Raw weight differences between animals on different farms are not as important as is relative performance. A big lamb that was fed grain on your farm might or might not be "better" than my smaller, grass-fed lamb. The computer makes many more adjustments than you can make with pencil and paper.

The result of this analysis is a report that lists a numerical value for each trait. These "expected progeny differences," commonly called EPDs, are the expected difference between the performance of an animal's progeny and the average performance for all the animals in the breed.

With an EPD of zero being average, a 60-day EPD of plus one pound means that the animal is expected to be a pound heavier than average at that age. The animal would be expected to pass along half of this enhanced growing ability, on average, to its offspring.

These may seem like small amounts, but pounds add up. If each ewe weans, on average, an additional ten pounds worth even ten dollars more, a farmer's income will leap — especially if he has hundreds of ewes or thousands of ewes. These small increments also will compound over the years. Making 10-percent more accurate selection choices each year for 10 years will increase profit and the genetic value of breeding stock.

An Australian study showed that informed selection of maternal sires to increase the ewe flock's fertility, prolificacy, milking ability, and transmission of growing ability and carcass traits could actually increase the return per ewe

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by \$50. That is an extra \$50,000 a year for a farmer running 1,000 ewes of superior genetics.

EPDs can be used as well to pinpoint problems: A ram that sires lambs that grow at average rates (or worse, below average for the breed), or whose daughters produce inadequate milk, will be found out. EPDs can be used to balance matings, so that animals with the same weakness are not paired.

In 1872, Charles Darwin wrote, "If selection consisted merely of separating some very distinct variety, and breeding from it, the principle would be so obvious as hardly to be worth notice; but its importance consists in the great effect produced by the accumulation in one direction, during successive generations, of differences absolutely inappreciable to the uneducated eye."

Darwin undoubtedly was commenting on small physical differences in animals instead of small differences in growing or milking ability. He was praising animal breeders, who see animals differently, more keenly, discerning slight variations missed by the "uneducated" viewer.

But there is no better articulation of the power of computer analysis than Darwin's statement, for what he said is even more true of such performance

differences as growth rate and milking ability.

The sad fact for livestock breeders is that most differences between two animals being compared are due to environmental factors, not genes. Again, what one sees is *not* what one gets. For instance, less than 25 percent of the size variation between two animals at weaning is said to be due to genetic differences.

EPDs are 75- to 100-percent more accurate than adjusted weights as predictors of breeding value. Computers can make many more adjustments than can the shepherd at his kitchen table, including taking into account the relationships of animals, rearing methods, and the heritability of traits.

I had submitted birth and rearing records for 2002 and 2003 for analysis and was eager for the results. I was surprised. Freckles' numbers did not look good. In fact, she was ranked as slightly below average across the board for 60- and 120-day growth and for milking ability. (Yes, the computers can calculate how much of the lamb's growth came from milk and how much from the lamb's innate ability to grow.)

With the exception of prolificacy, where her numbers were among the highest in the flock (remember, she twinned as a yearling, twinned again, and then had triplets), Freckles was — on paper — a very average ewe.

Friendly and Fancy? They were above average across the board. In fact, as Fancy had given birth to triplets, her prolificacy was rated as high as Freckles'.

I was indignant with these results and

talked with Jim Morgan, Ph.D., our data coordinator, the person who collects information from participating Katahdin flocks and conveys it to the NSIP for analysis. Jim listened patiently while I extolled Freckles' virtues.

What could he say? A farmer was upset about one ewe's rankings. Jim had data on more than 1,000 ewes to corral. Ram rankings are a much more serious situation, since rams affect so many lambs, and a lowly ranked ram could affect a breeder's sales.

Jim explained that the NSIP was working on an EPD for Katahdins for ewe productivity. He said Freckles might look different on paper with that EPD.

The gap between Freckles' mothering ability and her numbers tormented me that winter. Our existing EPDs emphasized growth rates — and farmers like me focused on those numbers.

EPDs first were used to increase milk production in dairy cows. In fact, after using EPDs for 25 years, dairymen had increased milk production by 100 percent. Even with the prevalence of artificial insemination, the previous 50 years had increased production by only 25 percent.

The methodology and data analysis that creates EPDs is called Best Linear Unbiased Prediction — BLUP, for short. BLUP separates genetics from environment by comparing animals growing up or producing together on the same farm; it checks the performance of relatives on other farms; and it performs adjustments for such factors as season of the year, heritability of traits, age of dams, sex, and litter size.

The concept was developed in the 1950s, but computers were not powerful enough to analyze large sets of performance data until the

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1980s. By 1985, BLUP technology had become indispensable for many seedstock breeders.

BLUP excels at measuring outputs – weight on the scale and milk in the bucket. Where are such vital traits as fitness for a given environment – survival – and mothering ability?

In 1985, a researcher at the U.S. Sheep Experiment Station in DuBois, Idaho, analyzed ewe behavior between the birth process and first nursing. He identified 17 distinct behavior patterns.

From the time a lamb hits the ground, and maybe before, the lamb and the ewe are communicating – or not. The soft grunts of the ewe, the bleats of the lamb, eye contact, body language, and the ewe licking the lamb all must come into play. But 17 things going on – before a lamb even nurses? Amazing.

“Further studies are needed before effective selection criteria can be established. In the meantime, docile, easily handled, easy care ewes that produce heavy litters will be profitable and should be favored as parental candidates for generating future . . . flock replacements,” wrote Ohio sheep geneticist Charles Parker, Ph.D., in a paper that cited the DuBois study.

He had described Freckles. Fancy and Friendly were more impressive looking. A sheep judge would favor them over Freckles. But Freckles ovulated and mothered like mad. I looked at her numbers. How was she able to raise decent lambs with below-average milk production and growth to impart?

According to Jim, the NSIP experts and their computers would try to quantify her maternal performance. At least one graduate student was on the case. The peak of 20th-century genetic knowledge

and computing power was being brought to bear. BLUP was gearing up for its encounter with Freckles, who chewed her cud without apparent concern.

Spring 2004 arrived. On April 11, Freckles delivered another set of triplets, two rams and a ewe. As always she was attentive. Her newborn lambs weighed just under 25 pounds.

Three days later, Friendly and Fancy lambled. Friendly gave birth to a single lamb. That was not good, not good at all, for one of my biggest four-year-old ewes to single.

Fancy had triplets, beautiful ewe lambs weighing almost 25 pounds. I wrote on her card, “An indifferent mother.” Indeed, Fancy soon rejected one of her ewe lambs, forcing us to raise “Juno,” as my daughter named her, on the bottle.

During that growing season, I thought about Freckles’ poor ranking as I watched her raise triplets as easily as Friendly raised her single lamb. The vision of a flock of Freckles clones came to mind.

I talked to Jim and gave him a hard time. “If a person had a whole flock like Freckles, he would make a lot of money,” I declared. “They would all have triplets, never reject a lamb, never lose a lamb. They would be smaller ewes, so you’d breed them to a Texel or Suffolk . . .”

Jim did not have a lot to say. I was beating a dead horse. The answer was more obvious to him than it was to me: growth EPDs are one measure. Mothering ability is something else.

He had lost sleep over this, over using the same kind of EPDs for Katahdins as are used for Suffolks. “We may have the ewe productivity EPD this year,” Jim said. “Freckles may look dif-

ferent then.”

Dr. Parker was a long-time advocate of such an EPD. He had revised Tusser’s 450-year-old poem, which advises shepherds to pick replacements from twins, to read:

*Ewes yearly twin raisers rich
masters do make.*

*Lambs from such raisers for
breeders go take.*

He had described Freckles, again – except she had the ability to raise triplets successfully. In late summer, Jim emailed me an Excel file with growth and milk EPDs – and the new ewe productivity EPDs.

Freckles’ growth and milk EPDs were still mediocre. Then I sorted the data for my ewes and lambs based on the new pounds-of-lamb-weaned EPD: *Freckles was number one in the flock!*

She would be expected to wean more than three pounds of lamb above average, this EPD predicted. That number would jump the next year to +5.5 pounds. Moreover, her daughters would be expected to wean more pounds of lamb than average.

Freckles was vindicated. I was embarrassed. I had known by observation and data that Freckles was an amazing mother. I had under-valued her because she was not large. And, on easily quantified traits in isolation, she was one of the worst ewes in the flock.

Evaluated in terms of her repeated success, using an index that rewards ewes for weaning more lambs, Freckles looked a lot different. This composite measure fosters selection for excellent maternal behavior, lamb vigor, optimum prolificacy and potentially even disease resistance. In short, an index can help select for biological fitness and profitability for a given production system.

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Without explaining the mystery of Freckles' mothering ability, the computers rewarded it by quantifying her true value: the potential to produce more pounds of lamb than any ewe in my flock.

The beautiful Fancy? She ranked 29th. Friendly, penalized for having a single lamb in her prime, ranked a dismal 127th.

Freckles showed me how easily humans are misled by the emotional reward of bigger animals and bigger numbers. Bigger is not better, not unless it succeeds in the larger

context. For animal exhibitors, the show ring is the larger context, the purple ribbon the reward.

For a profit-oriented lamb producer, the larger context is his farm, his production system, his bottom line. For my fescue-covered hills, for rearing lambs on pasture alone, and for bringing in more lambs to sell, ewes like Freckles are what I need.

Freckles has taught me that such ewes are what I *want* as well.

Freckles raised triplets again in 2005 and twins in 2006. Richard Gilbert works in publishing and takes instructions from Freckles on his farm near Athens, Ohio.