Genetic Improvement and Crossbreeding in Meat Goats
Lessons in Animal Breeding for Goats Bred and Raised for Meat

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Appendix C. Understanding Breeding Value and Expected Progeny Difference

Estimates of Breeding Value

Just as genotypic values are not directly measurable, neither are breeding values. They can be predicted however. By using performance data, a prediction can be made. Acquiring accurate performance data on the farm or at central test stations is critically important for predicting genotypic value and breeding value. A prediction of a breeding value is known as an *estimated* breeding value or EBV.

Considering Progeny Difference

A buck and doe each pass on a sample half of their genes, and therefore a sample half of those genes to their offspring. Because breeding value consists of the sum of the independent (additive) effects of all of an individual's genes affecting some trait, any parent passes along, *on average*, half its breeding value to its offspring.

Half the buck or doe's breeding value for a trait is our expectation of what is inherited from the parent and is called *progeny difference* or *transmitting ability*.

Progeny Difference = ½ Breeding Value

Progeny difference is a very practical concept. It is the expected difference between the mean performance of, for example, a buck's progeny and the mean performance of all progeny --- if we assume the buck was mated to randomly chosen does. For example, if a particular buck has a progeny difference of +3 pounds for weaning weight, and we were careful to mate him to a cross-section of does, not just those that are believed to give a lot of milk, we can expect the weaning weight of his kids to average three pounds heavier than the average of kids born to all other bucks and does used.

Like breeding values, progeny differences are not directly measurable, but can be predicted from performance data. Again, collecting data (accurate and unbiased data) is a key in making genetic change. Such predictions are called, in most meat producing livestock, *Expected Progeny Differences* (EPDs). Other terms such as *Estimated Transmitting Abilities* (ETAs) are used in the case of milk or component yield from dairy goats.

It is useful to understand that a parent does transmit its progeny difference (exactly half its breeding value) to every offspring. A parent always passes along half its genes, but the genes that are transmitted constitute a *random sample* of the sire or dam's genes. Some individual samples are better than others, but taken together they represent a average sample of each parent. The distribution of progeny difference values can actually be visualized as the classical bell-shaped curve, with a few progeny getting extremely good samples or extremely unworthy samples but most progeny representing the average. It is impossible to control or predict whether a particular offspring will inherit a good, average or mediocre sample.

The additive nature of independent effects

The breeding value of any particular meat goat breeding animal is a function of the independent or additive gene effects. These effects are additive in the sense that the animal's breeding value is simply the sum of the independent gene effects. For example suppose a trait is affected by five loci, and the independent gene effect for the 10 genes at those loci are:

+30, -.6, +.2, +4.2, -1.4, -2.3, +.4, -.1, +9, -1.5 units

By adding these numbers together we can determine that the individual's breeding value for the trait is +5.8 units. Because of their additive nature, independent gene effects are often referred to as additive gene effects and some of the scientific literature is written that way.

There is a key relationship working here. An offspring's breeding value for a trait will be on average the average of its parent's breeding values for the trait. It is key because it allows you to predict the breeding values of members of the next generation based upon predictions of the breeding values of their parents.

An extension to this concept suggests that an offspring's own performance for a trait will be on average, the mean performance for the trait plus the average of its parent's breeding values for the trait. Mendelian sampling causes variation in the breeding values of progeny, and differences in environmental effects cause additional variation in progeny performance.

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