**Browsing Academy**

# POPULATION GENETICS

An important question, but not the only one that needs to be addressed before getting into the goat business, purchasing goats or constructing facilities (fences, shelters) is "What is the best breed for my production purpose (goals and objectives)?" Please note that goal(s) and objective(s) are established first!! These are crucial as they will vary epending upon environmental conditions and constraints (location, climate, topography), type of vegetation available (pasture, range, brush ), and will be determining factors in the direction of your genetic selection, breeding program and sourcing for breeding stock. The next step is to determine the movement of improved genetics toward goats that are "better" than the average goat. Designing a breeding program with objectives so your customers obtain the best animal to produce profitability or "end-consumer" satisfaction is vital to successful economics. To accomplish the above, one has to have a well t-out and researched plan with the personal fortitude to persevere through a ruthless culling program and the tenacity to adhere to your genetic selection beliefs.

The most relevant example of "Population Genetics" is the KIKO composite breed itself. The breeding regime was developed by Garrick Batten (New Zealand) to take advantage of the large feral doe base dynamics as a breeding and genetic improvement tool. Feral does are small in stature with an amazing ability to survive adverse climatic conditions, demanding nutritional constraints without supplemental feeding, and reproduce. In crossbreeding with dairy breed bucks that met the physical size and meat production criteria established by the breeder, milk production of the selected feral does was enhanced.

Goats produced under extreme environmental and vegetative constraints are naturally selected for soundness in conformation, structurally correct feet and legs, fertility, milk production (good udder and teat conformation) and temperament. Consequently, there are both polled and horned genetics in the KIKO breed as well as a range of coat colors with white being the most dominant. Initially, there was no set breed type since the 'breed', now known as the KIKO was selected solely for (1) survivability and (2) growth rate under commercially farmed hill country conditions on the South Island of New Zealand.

With replacement selections from the F2 and F3 generations, the liveweights of the kids increased; kid growth rate increased as did their ability to survive under New Zealand hill country pastoral conditions. The KIKO was then tested for performance under the conditions established for the breed.

The breeding flock was farmed on steep hill country and managed with minimal inputs such as internal parasite drenching. The does were expected to twin at first kidding and rear twins at subsequent kiddings. They were pressured by a higher stocking rate and culled ruthlessly. Five month liveweights of kids were used as an initial selection point (weaning at 4 months) as it is a measure of maternal ability. At eight months, liveweights were a good indication of the weanoffs' ability to obtain growth rate from vegetation on their own accord and at fifteen months, the liveweight was used to select replacement stock. By that point in time, the offspring had become environmentally adapted, they had survived and had a high growth rate – the major characteristic traits selected for the breed. Therefore, successful completion of the performance tests under stressful conditions by four generations has evolved the new breed – the KIKO meat goat.

Population genetics is therefore defined as studying the factors that affect gene and genotypic frequencies in a population. As Garrick notes – "It is using the power of the population with accurate records and evaluation to keep selecting the best regardless of their parentage". The major concern is working with the population as a whole; identifying the superior and inferior genetic carriers. By having the capability to select goats with superior genetics from a large population, variations in the genetics of that group of goats can be implemented toward production progress. This involves accurate and timely record keeping so that sound genetic selection judgements can be made, selection pressure applied, and the rate of genetic improvement hastened. Selection of only a few economic traits to improve efficiency will speedup progress toward improving meat goat production.

There are other factors that affect the rate of improvement from selection:

- **Heritability** – A measure of strength of the relationship between breeding vallues (value of an individual as a genetic parent) and phenotypic values (measured level of performance for a trait in an individual) for a trait in a population. (Table 1. Heritability Estimates for Various Production Traits).
- **Repeatability** – A measure of the strength (consistency, reliability) of the relationship between repeated records (repeated phenotypic values) for a trait in a population.
- **Selection Differential** – The difference between the mean performances of the individuals selected to be parents and the average performance of all potential parents for the selected trait.
- **Genetic Correlation** – A measure of the strength (consistency, reliability) of the relationship between breeding values for one trait and breeding values for another trait.
- **Generation Interval** – The amount of time necessary or required to replace one generation with the next.
- **Number and specificity** (interactions) of traits selected.
- **Accuracy** of production and progeny records and accuracy of selection.
- **Age** at selection or selection intensity.
- **Caliber** of sires used in the breeding program minimizing genetic variation.
- **Environmental effect** – external factors that have an impact on goat performance.

The production characteristic traits selected have to be carefully chosen based upon criteria for performance characteristics and economic feasibility in meat goats. The criteria used by Goats Unlimited: "Number One" – adaptability to climatic, environmental and native vegetation conditions, 2) the reproductive efficiency of the individuals within the mob and the mob as a production unit, 3) growth rate of offspring at weaning, 8 months and 15 months of age and 4) carcass merit – quality grade and yield.

To continue making genetic progress, evaluate the population(s) of goats that are available and select the individual(s) that will make the most genetic difference in progress toward your goals. Heritability, repeatability and heterosis are important but so is lack of variability in specifically selected production factors – a finely drawn line. Progeny performance measured against selection criteria through records and data analysis enables a producer to make progressive genetic decisions.

Suggested Resources


Batten, Garrick. 2000. Making Genes Work for You *in* Simply Goats, Chapter 10, pp. 63-68, published by Meat New Zealand Goat Council.

Batten, Garrick. 1998. Where did they come from (Kikos)? Goat Rancher, May 1998, pp. 9-11.

Batten, Garrick. 1987. A New Meat Goat Breed *in* proceedings of the IV International Conference on Goats, Volume II, p. 1330, Brasilia, Brasil.

Bourdon, R.M. 1997. Genes in Populations *in* Understanding Animal Breeding, Chapter 4, pp. 48-65.

Coblentz, B.E. 1977. Some Range Relationships of Feral Goats on Santa Catalina Island, California. J. Range Management, Volume 30, No. 6, pp. 415-419.

Gardner, E.J. Population Genetics *in* Principles of Genetics, Chapter 16, pp. 377-402.

Loos, Trent. 2003. Alaska Trip: A Glimpse into Cattle 'Evolution' in Absence of Humans. www.meatingplace.com.

Peischel, A. 2001. Making a Better Kiko. Goat Rancher, May 2001, pp. 11-14.


 

Table 1. Heritability Estimates for Various Production Traits

| Traits | Heritability % |
|---|---|
| Birth Interval | 0.5 to 10 |
| Birth Weight | 30 to 40 |
| Number Born | 15 |
| Motherability | 40 |
| Weaning Weight | 20 to 30 |
| Yearling Weight | 40 |
| Mature Weight | 65 |
| Milk Yield | 25 |
| Milk Fat (percent) | 55 |
| Milk Protein (percent) | 50 |
| Udder Support | 20 |
| Teat Placement | 30 |
| Feed Conversion | 40 |
| Stature (conformation / frame) | 45 to 50 |
| Rear Legs | 15 |
| Wither Height | 40 |
| Cannon Bone Circumference | 45 |
| Carcass Weight | 45 to 50 |
| Quality Grade | 40 |
| Fat Depth | 40 to 45 |
| Ribeye (loin) Area | 40 to 45 |
| Cutability (percent) | 25 to 30 |
| Muscling | 40 to 45 |
| Temperament | 25 |
| Scrotal Circumference | 50 |

* Collective information based on various research studies

(Low heritability 10 to 20%; Moderate heritability 25 to 45%;
High heritability 50 to 70 %)