



Why You Need Population Genetics: the "Elevator Pitch"

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- 1) All the useful genetic variation your breed will ever have was in the dogs that founded the breed. This genetic diversity is finite.
- 2) Each generation, alleles can be lost by chance (this is called "genetic drift") and also through artificial selection by breeders, who select for dogs with the traits they like and remove other dogs from the breeding population.
- 3) Because the stud book is closed, genes that are lost cannot be replaced.
- 4) So, from the moment a breed is founded and the stud book is closed, loss of genetic diversity over time is inevitable and relentless.
- 5) You cannot remove just a single gene from a population. You must remove an entire dog and all the genes it has.
- 6) You cannot select for or against a single gene, because genes tend to move in groups with other genes (this is called "linkage"). If you select for (or against) one, you select for (or against) them all.
- 7) Breeding for homozygosity of some traits breeds for homozygosity of all traits. Homozygosity is the kiss of death to the immune system. And by the way, as genetic variability decreases, so does the ability of the breeder to improve a breed through selection, because selection requires variability.
- 8) The consequences of inbreeding (in all animals) are insidious but obvious if you look - decreased fertility, difficulty whelping, smaller litters, higher puppy mortality, puppies that don't thrive, shorter lifespan, etc. Genetically healthy dogs should get pregnant if mated. They should have large litters of robust puppies, with low pup mortality. Animals that cannot produce viable offspring are removed by natural selection.
- 9) Mutations of dominant genes are removed from the population if they reduce fitness. Mutations of recessive alleles have no effect unless they are homozygous. So rare alleles are not removed, they are inherited from one generation to the next, and every animal has them. Lots of 'em.
- 10) If you create a bunch of puppies from your favorite sire, you are making dozens of copies of all of the bad alleles in that dog (which were never a problem before because they were recessive; see 9) and spewing them out into the population. Now, a (previously) rare mutation will become common, its frequency in the population increases, and the chances go up that some puppy will be produced that is homozygous (has two copies of that bad allele) - and homozygous recessive alleles are no longer silent.
- 11) So, genetic disorders caused by recessive alleles don't "suddenly appear" in a breed. The defective gene was probably there all along. Make a zillion copies, and suddenly you have a disease.
- 12) Using DNA testing to try to remove disease genes from the breed will not make dogs healthier (see 2, 5, and 6).
- 13) The breed will continue to lose genes every generation (by chance or selection) until the gene pool no longer has the genes necessary to build a healthy dog.
- 14) At this point, the breed might look wonderful (because of selection for type), but it will suffer from the ill effects of genetic impoverishment - inbreeding depression, diseases caused by recessive alleles, increased risk for cancer, etc.
- 16) The health of individual dogs cannot be improved without improving the genetic health of the breed. The only way to improve the genetic health of the breed is to manage the health of the breed's gene pool.
- 17) Population genetics provides tools for the genetic management of breeds or other groups of animals. Breeders CAN improve the health of the dogs they breed if they understand and use them.

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