

Genetic Diversity in the Breed: Popular Sire, the Founder Effect, Genetic Bottleneck, and Maintaining a Healthy Gene Pool

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In any population, maintaining genetic diversity is an integral part of maintaining health in that population. While this can be reduced through both natural and artificial means, in dogs, genetic diversity is typically harmed by artificial selection and the breeding choices made by those responsible for the selection. This article aims to describe the common causes of genetic diversity loss and how they affect our breed.

It is important to recall that in any breed, all dogs within the breed are descended from a limited gene pool. We all know this to be true of the American Hairless Terrier; we can trace our lineages back to Josephine and the Rat Terriers used to found our breed. It is with this already limited gene pool we are working, and must be careful to maintain a healthy amount of diversity.

Some may ask: why does genetic diversity matter? Should we not be breeding towards the perfect representative of the breed, and propagating traits in dogs closest to that standard? And yes, we should, but not at the cost of health. As diversity decreases and alleles become more homozygous (inheriting the same genes from both mother and father), the incidence of disease becomes higher, and the ability to adapt to new diseases is reduced. The ability to recover from disease (genetic or environmental), either in individuals or the breed as a whole, stems from the genetic diversity of the organism or population.

Founder Effect

The Founder Effect is defined as the phenomenon in which a founding group of a population has become isolated from the parent population. This occurs in nature, such as when populations of animals become stranded from the parent population in some way. It also occurs artificially, when specific animals are chosen for either their specific traits or their relation to animals

with specific traits. Either naturally or artificially, the founding group has traits that vary in frequency from the parent population.

In the case of our breed, the obvious trait that occurs in higher frequency than in the original population is hairlessness. We have gone on to select for this trait, which in itself is a neutral trait. Caution must be taken, however, to ensure that we are not unintentionally selecting for a negative trait, such as a genetic disease, as it too may have occurred at a higher frequency in the parent population. It also should be noted that changes in frequency can also lower the prevalence of a trait; if a positive trait becomes less frequent, we run the risk of unintentionally losing that trait.

Genetic Bottleneck

Much like the Founder Effect, Genetic Bottleneck limits the range of diversity within the genetics of a population. It is defined as the sharp reduction of the size of a population through natural or artificial means. The two phenomena are very similar, both in appearance and effect, though Genetic Bottleneck occurs in an established population while Founder Effect occurs when isolating a new population.

Our breed has already sustained heavy losses several times throughout the history of the breed, the most harrowing of which was the tornado which took Bonnie and many of our best dogs from us, and we must take caution to avoid future losses. Much like Founder Effect, Genetic Bottleneck causes increased frequency of some traits and decreased frequency of others. This assortment occurs at random, so there is no promise what traits would be removed or kept. One important exception is in artificially created bottleneck where a trait is strongly selected against. For example, should a choice be made that all dogs with black hair are removed, all other traits would remain random, but black hair would

quickly be removed from the genetic library. A silly example, perhaps, but the same could easily be applied to other traits.

Popular Sire

Purebred breeders of all domestic species are often guilty of falling into the trap of Popular Sire syndrome. It is perhaps the most commonly discussed reducer of genetic diversity among breeders, whether you are speaking to breeders of cattle, horses, or dogs. It occurs when one stud is used in excess, perhaps because of his highly desirable structural traits, high win record, or even amount of advertising. Popular sires are popular for a reason – they are often great dogs or throw great puppies. However breeders have to be careful not to put all their eggs in one basket. Overuse of one stud causes his genes to be disproportionately prevalent within a population.

Many people have heard of the high number of relations to Genghis Khan among the human population: up to 1 in every 200 men is said to be a direct descendent of the Mongolian Warlord, according to Y-chromosome sequencing. In a smaller existing gene pool like a dog breed, a sire being used in high amounts can have a magnified effect. If even half your dogs all relate to the same sire, you are unlikely to be able to breed away from that sire. If that sire, unknown to anyone at the time, carried a gene for a negative trait, or genetic disease, it is likely that several generations down the line this recessive will start to show more and more within your population eventually displaying the disease or trait commonly within the population.

Contrary to Founder Effect or Genetic Bottleneck, Popular Sire does not reduce genetic diversity through loss of population. In this case, it reduces diversity through the overrepresentation of the genes

from a specific dog. We as breeders know that line- and in-breeding can set physical traits in our lines; we forget that homozygosity of traits comes with increasing homozygosity of genetic alleles. When every cross is essentially linebreeding, your entire population becomes closer related and less diverse in genetics.

Methods of Maintaining Diversity

The first step to maintaining diversity within our kennels and breed is to be aware of the situation. Awareness and caution can make a big difference in a breeding program. It is easy, for example, to remove a dog from a breeding program for a number of reasons – structure, health test results, temperament. Every breeding dog should be evaluated for their risks and potential benefits, and in no case should risks outweigh benefits. Not every dog should be bred, but potential breeding dogs should be evaluated, and their pros and cons weighed.

Hypothetically, let us say you have a dog in your kennel. He is two years old, has earned his conformation titles, perhaps gotten a few big wins. Structurally, he fits well your idea of the standard, and has a great temperament. You get his health test results, and he is a carrier of a genetic disease in which carriers do not display the disease. Do you remove this dog from your program? Some would say yes. But what risk does this dog have? If you breed him to a known clear, he can only produce carriers and clears. What benefits? He is a beautiful dog, has a great temperament, and could likely have a big benefit to the breed. So long as you use caution in choosing and breeding his offspring, this dog could easily be said to have benefits that outweigh the risks. With modern health testing, you could know what dogs are clears and carriers

before puppies are placed, and it would be easy to choose a beautiful puppy that is clear of that disease.

What if that same dog was affected? What if the disease was displayed in carriers, such as a dominant allele disease? How good would the dog have to be to make breeding him worth the benefits? Depending on the disease, perhaps there would not be any point that the risks outweigh the benefits, or perhaps there would be. Health testing is a tool to be used, not the be all, end all decision maker to breeding. Each individual breeder has to make these decisions for their own lines, but every breeder should keep the health of the whole breed in mind when making their choices.

Popular Sire is another phenomenon easy to avoid with open eyes. Popular sires are popular for a reason. Limiting just how popular can be done by either the stud's owner, or by the breeding community as a whole. If every breeder within a few generations has bred all their bitches to him or a relative of him, you have bred yourself into a trap. If a few dogs are bred to him and maintain a smaller population within the larger population, the magnification of his genetics will be smaller and more spread out as he slowly integrates the breed.

Even with our most careful breeding practices, sometimes we end up wishing we could go back to the population we had ten years ago or more. Modern technology continues to make a safeguard for the future easier in the improvements made to cryogenic freezing of canine sperm. By collecting and freezing even a few favorite dogs from each kennel, whether or not they have been proven while alive, we build a safety net for the future. Unfortunately, egg or embryo freezing is not yet a viable option in canines, so our boys are our only hope for a collection bank, but stored semen can

rescue a breed that is struggling down the road.

Finally, one of the most important things to keep in mind when maintaining the health and genetic diversity of the breed is open, honest communication among breeders. This is achieved through sharing all health testing results - even negative - on our dogs through OFA, and speaking honestly about any health, structural, or temperamental issues becoming evident in our dogs or lines. Human nature makes us unwilling to admit to our shortcomings; if a dog in our lines comes up with an issue, we often do not want to talk about it. If we remember that breeding is about improving the breed as a whole, and speak openly about concerns in our lines, we can work together to improve the breed and maintain the health of our dogs and genetics.

We all have our ideal dog, and it may be different than another breeder's, but health is something that can be easily agreed upon, and we can work together to improve and maintain our already very healthy breed.

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