# The Downside of Inbreeding: It's Time For a New Approach

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*"Inbreeding was once a valuable tool in shaping today's breeds. As these have now reached a high degree of homogeneity, it has lost its importance and turned into a fatal and disastrous habit."* - Hellmuth Wachtel, PhD

Inbreeding (which, for the purposes of this article, includes "linebreeding" ) has been the rule in dog breeding for the better part of two centuries. Before that, breeders bred "like-to-like." Records may or may not have been kept, depending on the literacy, social status or interest of the breeder. Pedigrees were of marginal interest, if they were considered at all. Registries, as we know them now, did not exist. New individuals might be introduced to the breeding pool at any time, so long as they displayed characteristics that the breeder wanted to perpetuate. Even an unplanned mating with a dog that would never have been deliberately selected might be shrugged off so long as some of the offspring proved useful.

In the nineteenth century, prominent European breeders of various domestic species, including dogs, became interested in maintaining the "purity" of their bloodlines. They had no knowledge of genetics, indeed the science had yet to be born. Their breeding theories were a reflection of social attitudes of the times. It should also be kept in mind that these individuals were mostly wealthy men whose human pedigrees were considered better than those of "common" people. As pedigrees became more important, so did the regular appearance of significant names in those pedigrees. Eventually registries were established to keep official records. At some point, virtually all dog registries became closed. Most of this occurred before breeders had even a rudimentary knowledge of genetic science.

At first, inbreeding proved beneficial. Breeders learned that by mating related individuals of the desired type, the resulting quality and uniformity of the offspring improved As people began to learn basic genetics in the early part of this century, they deliberately sought to fix desired traits, particularly in production livestock, by breeding near relatives. This practice continues to the present day. A sire will be "progeny-tested" by being bred to a group of his daughters. If the offspring measure up, he will be kept for stud. If they don't, everybody goes to market. This drastic culling serves its purpose in livestock, but it is impractical and unacceptable in companion animals such as dogs.

Nature goes to great lengths to discourage inbreeding. Related animals rarely mate, which prevents genes for diseases and defects from coming together with any great frequency. Wild animals have a variety of behaviors which will eliminate or severely restrict inbreeding. In wolves, the species most closely related to dogs, only the alpha pair will breed. Pups stay with the pack for their first year. After that time they must find a place, often low-ranking, within the adult hierarchy. If a yearling cannot accept this or it becomes the brunt of too much negative social interaction, it will disperse. Dispersers may have to travel many miles before they can find an available territory and a mate, if they can find them at all. Those individuals which do not disperse will not be breeders unless they should someday attain alpha status, so the breeding of relatives is unlikely.

Sometimes circumstances give animals no choice but to mate with relatives. If those conditions persist for any length of time they create a "genetic bottleneck." The wolves of Isle Royale in Lake Michigan descend from a very small number of animals which crossed from the mainland decades ago during a hard winter when the lake froze over. Their present-day descendants have proved more than usually vulnerable to an assortment of diseases and parasites. When canine parvovirus reached Isle Royale, the wolf population plummeted so badly that some observers at the time feared the wolves would die out entirely.

In recent years, purebred dogs have experienced increasing problems with hereditary diseases and defects. The causes are complex, including genetic load, the presence of lethal equivalents in all individuals, genetic bottlenecks, closed gene pools, gene pool fragmentation, and genetic drift, but all are attributable to inbreeding.

Thanks to closed registries, breeds form exclusive gene pools. All gene pools, no matter how large or diverse, will have a genetic load – the difference between the fittest possible genotype and the average fitness of the population. "Fitness" is the individual's over-all health, vigor and ability. It may or may not directly relate to traits breeders select for. (The English Bulldog, for instance, has an "ideal" physical form which virtually precludes females from being able to naturally whelp their young.) The greater the genetic load, the more genetic difficulties members of a breed are likely to suffer. In a closed gene pool, the situation may remain stable or deteriorate. It cannot get better.

Each individual within a breed also carries it's own kind of load – four or five genes for potentially fatal diseases or defects. These are called "lethal equivalents." In most cases they will not affect the individual carrying them because a single allele, or form of the

gene, will be insufficient to cause the problem. But when relatives are mated, the odds of matching up those alleles increases and as does the frequency the disease.

Every population must deal with genetic load and lethal equivalents, but when the population is prevented having genetic exchange with other similar populations, genetic diversity within the population begins to diminish. Some of this may be beyond anyone's control. A breed's function may have become obsolete, resulting in only a few surviving members. This was the case with the Portuguese Water Dog. All present-day PWDs descend from a handful of dogs. Social, political or environmental difficulties may also preclude breeding, causing populations to crash. Many breeds experienced a genetic bottleneck at the time of World War II. With much of the world at war, dog breeding was not a high priority and populations in areas of military action were often wiped out or severely depleted. In such a situation, breeders can only make do with what remains. It's a tough row to hoe for the truly rare breeds, especially since the prevailing attitude that breeds must be kept "pure" prevents supplementing with fresh genetic material from similar, less impacted, populations.

Breed gene pools can fragmented into so many gene puddles when they are arbitrarily split along size, color or coat-type lines, with dogs of one color or variety prohibited from mating with those of another. No matter how diverse a breed may have been before such distinctions were made, afterwards breeders have fewer options when choosing mates and the eventual result will be increased inbreeding because there isn't anywhere else to go. One striking example of this is the Belgian Sheepdog in the United States. Outside the US this breed contains four varieties, all of which might occur in a single litter. The American Kennel Club lists three of varieties as entirely separate breeds. The fourth isn't even recognized. In the US they cannot be interbred though throughout the rest of the world, they can.

Changes in social conditions may also fragment breed gene pools. The Australian Shepherd was originally a working ranch and farm dog. Today there are far more Aussies than there are "jobs" on farms and ranches; so most are companion animals. Over the past three decades, the breed has clearly split between working and conformation strains with a third, smaller, category of "versatility" animals whose breeders work toward a multi-purpose animal .There is also a population of "mini" Aussies—dogs whose size is below the breed norm. They are often registered as Australian Shepherds along with listing in a registry for minis. There is very little breeding between these various sub-groups though all trace back to more-or-less overlapping sets of founder animals.

One of the results of gene pool fragmentation is loss of alleles that may exist in the breed but didn't happen to occur in the founders for that variety. Genetic drift can cause further loss. Genes not being specifically selected for tend to "drift" out of the gene pool. Many of these will be for things so subtle they might never come to a breeder's direct attention. A dog has some 100,000 genes, only a relative few of which are for things we can readily observe or measure. Many of these genes cause minor variations in form or bodily function. Cumulative losses of such genes through genetic drift can reduce overall health and fitness without presenting consistent or identifiable signs; a dog may seem to be a poor keeper, unusually subject to minor ailments, or lacking in endurance. Even "typical" breed behaviors, such as herding ability, can be diminished in this manner, if breeders are not using the behavior as part of their selection criteria.

The use of popular sires, particularly multiple generations of them, can accelerate loss of alleles. A dog can only have a maximum of two alleles for any given gene. Excessive use of a single individual will skew the gene pool toward the alleles that dog happened to carry. Obviously, such a dog gets heavy use because he has desirable traits. Genes for those traits will become more common, but so will those for his lethal equivalents and more subtle ills. And if a deleterious gene is "linked" (sits close on the chromosome) to a desired gene the sire carries, the breed may suddenly find itself riddled with the problem that bad gene causes. It won't be easy to eliminate unless breeders are also willing to give up the linked desired trait.

Proponents of inbreeding often point out that mongrels have more genetic problems than purebreds. While it is true that mongrels, as a group, have more individual kinds of diseases and defects than any single pure breed, it must be remembered that each breed represents only a portion of the canine gene pool, whereas mongrels encompass all of it. If mongrels' defects are compared to those found among all pure breeds, the discrepancy disappears. Since mongrels usually are the result of random, unplanned breeding, the incidence of defects is low in the overall population. In pure breeds many of those same defects are common. For instance, progressive retinal atrophy and collie eye anomaly are rare in mongrels. Incidence of both is high in Collies.

It is becoming more and more apparent that the short-term gains of inbreeding are outweighed by its long-term costs. Present-day breeders need to re-think their strategy. Assortative mating—the mating of phenotypically similar but unrelated or less-related individuals—will allow breeders to reach their breeding goals while reducing the loss of alleles in the over-all population. To accomplish this it is vital that each breeder has a thorough knowledge of breed pedigrees. The typical three to five generation pedigree may indicate few, if any, common ancestors. But what happens if the pedigree is extended a few more generations? If two dogs share no ancestors for four generations, but share many in the 5th, 6th and so on, breeding them would be inbreeding.

All members of a single breed are, of course, related to some degree, though how much varies from breed to breed. Somewhere back in each breed's history there is a group of founders from whom all present-day dogs descend. Portuguese Water Dogs have

very few, Australian Shepherds have quite a number, though not every Aussie goes back to all of them. It is important to know who the founder individuals were, particularly if the breed is rare, split into varieties or experienced a significant bottleneck at some point in its history. A large number of founders allows for greater diversity (assuming those founders were, themselves, unrelated), but if some are heavily represented in comparison to others due to inbreeding on their descendents, diversity is at risk. Breeders should strive to increase the representation of the neglected founders whenever possible.

Calculation of inbreeding coefficients will give an indication of how inbred a dog or a prospective cross is. Knowing these numbers enables the breeder to make choices that will reduce inbreeding. Good books on animal breeding will have a section explaining how this is done, but calculating them by hand becomes cumbersome when working with a full pedigree. There are pedigree programs on the market which will perform these calculations.

Perhaps the most important issue is making health a top priority. It is obvious even to those who promote inbreeding that screening for genetic diseases and not breeding affected individuals is important. As tests become available which will detect carriers of genetic problems, they should be put to use. However, carrier status should not automatically preclude breeding of otherwise good individuals. Care should be taken that they aren't bred to other carriers and those who buy puppies from a carrier parent should be advised to screen the pup if they want to breed it. But eliminating proven carriers as breeding stock is throwing our their many good genes while avoiding one bad one.

Australian Shepherd breeders are doing this with Pelger-Huet Anomaly. PHA is lethal to offspring that inherit two copies of the gene, resulting in reduced litter size and neonatal deaths. Carriers rarely suffer any effects. Knowledgeable breeders use a blood test to screen and carriers are bred to non-carriers. Less specific aspects of health must also be considered. A dog that is a "hard keeper, or repeatedly comes down with one minor ill or another should not be a breeding prospect. These individuals likely carry a surplus of genes which individually have only a small negative effect on health but cumulatively have produced an unthrifty individual.

A common result of inbreeding is "inbreeding depression," typified by small litter size or difficulty producing or rearing young. Bitches from families that consistently produce small litters may be suffering inbreeding depression. Animals which can only be bred or raise their puppies if they receive extraordinary human assistance are poor breeding candidates. This is not to say that people shouldn't properly house and care for their animals, but if a dog is indifferent to bitches in standing heat or a bitch needs to be physically restrained to keep her from resorting to fight or flight in an attempt to prevent mating, or won't settle without veterinary intervention, or is apt to kill or damage her puppies through intent or neglect, these are signs of inbreeding depression and that animal shouldn't be bred. Breeders should not go to excessive, near surgical, lengths to control the environment for newborns, nor should they use heroic measures to keep failing whelps alive. (For those who find this too callous: Save them if you will, but don't breed them.)

Inbreeding gave us the many breeds of dog we enjoy today, but its time is past. If purebred dogs are to remain viable into the next century breeders need to rethink their strategy and work toward their goals with more emphasis on over-all health and concerted efforts to reduce the level of inbreeding in their dogs.