

Pedigree Research and Analysis

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The importance of pedigree research and analysis

It is estimated that a dog's visible characteristics represent about 30% of his or her genetic makeup. Pedigree research and analysis can give some clues about those genes not visibly apparent when we look at a dog. This provides breeders with more information and improves their ability to make informed breeding decisions.

Pedigree Analysis

The mathematical analysis of a dog's pedigree can yield information that may be useful to breeders. There are numerous computer programs that will perform analysis of pedigrees and hypothetical matings. Some of the data that breeders may find useful include Coefficient of Inbreeding and Percent Blood. This information can help *improve* a breeder's judgment, but it will never substitute for it.

Coefficient of Inbreeding (COI)

COI is also called Wright's Coefficient. Coefficient of Inbreeding is defined as the mathematical probability that a gene will be homozygous (identical) by descent at any given locus. This value is only a probability, not a certainty, and does not account for selection for any given trait. COI is, however, an objective indicator of the degree of inbreeding that has taken place. For example: a first cousin breeding would have a COI of 6.25% (the probability that 1 in every 16 genes are identical by descent), and a half-sibling breeding would have a COI of 12.5% (the probability that 1 in every 8 genes are identical by descent). The degree of inbreeding is not always readily apparent by subjective review of a pedigree. Widely used dogs that are in virtually every pedigree can increase the COI over time, without intentionally inbreeding. This is referred to as *Background Inbreeding*.

How is the COI useful to breeders? Inbreeding is used by breeders to concentrate the genes of an ancestor or ancestors to achieve homozygosity for desired traits. It was by inbreeding that breeds were created, and it remains an important tool for breeders to leverage to increase the probability that the traits of an ancestor line bred or inbred upon will be passed to the descendants. However, it is important to remain cognizant of the level of inbreeding because nature has engineered a bit of a catch-22: The portion of the genome which controls immune response (called the Major Histocompatibility Complex, or MHC) does not work in the same way as other types of genes. MHC genes are never recessive. They are, in fact, co-dominant. This means that inbreeding reduces the breadth of immune response. Here is why:

The cells of a dog's (or any other higher organism's) immune system do not have individual genes that code for specific antibodies. Rather, each immune system cell has a lot of partial gene segments, which the cell puts together to manufacture a whole gene to code for the type of antibody needed to fight the current biologic or

carcinogenic threat. Immune system cells actually alter their own genes! This is the only way these cells can produce enough different types of antibodies to fight a broad range of diseases and cancers. If a dog is homozygous for an MHC gene (i.e. both alleles are the same), it has lost half of its building blocks to code for different types of antibodies at that locus, which diminishes breadth of immune response.

Along these same lines, there are studies correlating COI to longevity, but only when COI is computed using 10 generations was this correlation found to be statistically significant. One such study is "Longevity in the Standard Poodle" by John B. Armstrong, Ph.D. Dr. Armstrong found that Standard Poodles in the group with the lowest COI (< 6.25%) lived on the average 4 years longer than the group with the highest COI (> 25%).

A low COI is a piece of the puzzle, but it is no magic bullet, and no guarantee of health. There are many outcrosses, or even mixed breeds with health problems. What is probably far more important than knowing the degree of inbreeding is to know the traits of the dogs that are influential in a pedigree.

Percent Blood

Percent blood is an estimate of the percentage of a given ancestor's genes passed down to the descendant represented by the pedigree. This is calculated mathematically, and takes into account the number of times the ancestor appears in the pedigree, and in which generations. Percent Blood is a probability, not a certainty (except for the parents which certainly each contributed 50% of their genes to the offspring). Though each grandparent has 25 percent blood, it is theoretically possible that the descendant could get 0% of the maternal grand-sire's genes and 50% of the maternal grand-dam's genes—possible, but unlikely. Knowing which dogs have the highest percent blood in a pedigree, i.e. which dogs are likely to have the most genetic influence, can help a breeder prioritize which dogs to spend time researching.

An analysis of a 10 generation pedigree can sometimes produce surprising results. I did a pedigree analysis on one of my dogs, born in 2003. To my surprise, a dog born in 1969 was 16% blood, which means he probably contributed more of his genes to my dog than her great grandparent!

Pedigree Research

Once it is determined which dogs have the most genetic influence, it is time to begin researching the traits of these influential ancestors. It can be helpful to make a spreadsheet with notes on such things as: physical conformation, health /orthopedic clearances, age of death, cause of death, temperament, etc. A picture of each dog in the pedigree is also useful, especially if the ancestor has not been seen in person. Gathering and organizing information in this way, it is easier to evaluate the positive and negative traits of the influential dogs in a pedigree. This gives some clue as to what may be swimming in the gene pool of the dog represented by the pedigree. Knowing about siblings and progeny will provide an even more complete picture. The vertical pedigree is a valuable tool. In fact, OFA strongly advocates use of a vertical pedigree to evaluate breeding stock.

First hand information about various dogs is always best, and many of the old-time breeders in the Berner community have seen or owned the influential ancestors of today's dogs and are wonderful resources! Other sources of information include databases, websites, and various breed club publications. When possible, it is a good idea to verify information found on the internet.

Resources for Pedigree Research and Analysis

1. Pedigree Programs/Databases:
 - a. Breedmate <http://www.breedmate.com/>
 - b. Man's Best Friend Software – also has a monthly access database with Bernese Pedigrees <http://www.tbsnet.us/>
 - c. Animal Stackers – version I purchased in Europe has Bernese database available for download <http://www.animalstackers.com/site/>
 - d. BMDped – has a huge Bernese database. To purchase, contact Ron Smith <http://www.bmdped.com/>
 - e. Breeders Assistant <http://www.tenset.co.uk/ba/dog.html>
2. Databases/Registries
 - a. Orthopedic Foundation for Animals – open health registry <http://www.offa.org/>
 - b. Bernergarde – Open Bernese database with pedigrees and health information <http://www.bernergarde.org/>
 - c. Swedish Kennel Club website – has Bernese pedigrees and orthopedic clearances <http://www.kennet.skk.se/hunddata/>
 - d. Dutch Kennel Club and Bernese club websites -have Bernese pedigrees and health clearances. <http://www.bernersennen.nl/>
3. Miscellaneous
 - a. BMDCA yearbooks/other Bernese club stud books (German club, Swiss club)
 - b. Web pages for online translation: <http://www.skatelog.com/translate.htm>