

The Shallow End of the Gene Pool

by D. Caroline Coile Ph.D.,
Susan Thorpe-Vargas Ph.D.,
& John Cargill M.S.

In 1987, two Americans, Jon Curby and Mike Work, embarked on a mission for their breed that would take them to Northeastern Zaire on a search for Basenjis in their native land. One by one they located dogs and bartered with their sometimes-reluctant tribal owners, until seven African-born Basenjis were loaded for the trip home.ⁱ In order for their mission to be a success, however, the dogs had to be able to contribute to the AKC gene pool. The impetus for their mission was the existence of certain genetic health problems in the AKC Basenji that had become widespread due to the breed's limited gene pool. If these dogs could contribute to their genome, it might be the answer to the breed's problems, but without pedigrees, little chance for AKC registration existed.

Their best chance lay in a roundabout route, by trying to register the dogs with a foreign kennel club with less strict pedigree requirements, and then trying to register the dogs' descendents (after three generations) with the AKC. No guarantees existed as to whether the scheme would really work. It appeared the ability of these dogs to contribute to the AKC gene pool was uncertain, and at best, years in the future. In the end, perhaps they took the least likely yet most logical approach: a direct appeal to the AKC.ⁱⁱ The AKC approved the opening of the studbook to imports from this and a subsequent expedition, pending the approval of the Basenji Club of America, which was given in 1988.

Yet many questions remained. How would they deal with the fact that most of the imports were brindle patterned, a pattern not even allowed by their AKC standard? How would these dogs straight from the bush be accepted in American breeding programs? Would the influx of their genes sully their descendants and make them less competitive in the show ring? Recognizing that brindle was actually the most prevalent pattern in its native Africa, the Basenji Club of America amended its standard to allow brindle patterning, and many breeders soon considered their brindle Basenji's coloration a badge of pride. There was no compromise of quality—the top show basenji, in fact the top hound in America for 1997, was a brindle Basenji. Most important of all, the new Basenji genes have so far proven to be free of the hereditary problems that had beset the breed.

Roots

Basenjis are far from being the only breed to suffer from genetic health problems caused in great part by small gene pools. Purebred dogs have gained the reputation as genetic disasters. Many breeds count fewer than 50 dogs as their foundation stock—a number that would send shudders up the spine of any ecologist seeking to save an endangered species. Breeding schemes for endangered species focus on increasing the gene pool as much as possible by integrating all available animals. In many of our breeds of dogs, the gene pool is out there—we just can't jump in because of AKC policies.

The AKC was established in 1884 and is a tax-exempt not-for-profit organization (IRS 501.c.(4) corporation), with the stated purpose of protecting and advancing purebred dogs. Part of its charter states that its objectives are "generally to do everything to advance the study, breeding, exhibiting, running, and maintenance of the purity of thoroughbred dogs". These were noble aspirations for their time—indeed, for any time. One of the principal means by which they sought to meet their objectives was through the maintenance of a studbook with pedigree records of all registered stock. Little could the founders have foreseen that in a little over a century well over a million dogs would be registered with the AKC each year.

Nor could they have foreseen the effects a century of restricted breeding practices would have on some of these individuals. This was not their fault; recall that in 1884 Gregor Mendel's genetic findings (though published) were still unknown; population genetics theories had yet to be postulated; chromosomes had yet to be discovered; DNA hadn't even been envisioned. Darwin's theory of selection and evolution were known, however, and in that light, it seemed the obvious path to their goals was through relatively closed breeding schemes founded by the best individuals. There was no reason to suspect that such a strict adherence to a policy of genetic exclusion might ultimately harm the breeds they had gathered to promote.

The past century has seen a revolution in our understanding of genetics and health. We now understand the basis for the problems limited foundation stock can—and has—caused. We have frozen semen that makes it possible to import genes from all parts of the world without shipping dogs. Yet, AKC still adheres to policies that make it virtually impossible for new genes—whether carried in living dogs or freezing canisters—to be introduced.

We cannot hold the AKC totally to blame. With a whole world of dogs at our disposal, it might seem a simple matter to integrate new genetic material into the AKC gene pool. As a registration body, the AKC has the obligation to guard the integrity of the studbook and question the validity of any claims of pure breeding of unregistered dogs. Many registered dogs with sufficient proof of ancestry for AKC purposes do exist in other parts of the world. The problem stems from the fact that the exhibition and registry of purebred dogs began in only a few areas of the world. Many dogs in other national kennel clubs, now involved in purebred dog registration, actually descend from the very same foundation stock that the AKC dogs do. Using genes from these dogs will not have the desired effect of significantly enlarging the gene pool.

The ability to go back to stock from a breed's country of origin (COO) in order to expand the gene pool is a process known as introgression. The basic tenants of the AKC make such a process difficult to impossible for dogs originating in most "non-western" societies unless special exceptions are made. Many COO dogs come from countries in which registries do not exist, or do not meet the AKC's specific standards. In the early development of many breeds, the AKC often facilitated expansion of the gene pool. Most recent attempts to introduce new genetic material by the registration of COO stock have met with the AKC's steadfast position that unregistered stock cannot be directly integrated into the studbook. The AKC will sometimes make exceptions in the face of compelling health or medical reasons. In such cases the parent breed club must vote in favor of such a step and then petition the AKC to open the studbook for a brief time.

The Saluki, for example, is an ancient breed that still exists throughout its native Middle East today. Its Bedouin owners can recite its pedigree for generations, but such is not acceptable proof of purity for the purposes of AKC registration. The AKC Saluki is derived in most part from a small number of founding dogs brought to England around the 1920s. In 1945, two Salukis bred by King Ibn Saud came to this country and after some persuasion, the AKC made a special ruling whereby descendants removed by three generations from these imports could be registered, as long as the generations in between were always bred to registered stock. Today, imported COO Salukis are formidable competitors in coursing trials. Attempts to gain AKC recognition for these dogs, however, have been unsuccessful, largely because of a lack of consensus by the parent club as well as the lack of any overwhelming genetic problems that would lend urgency to the matter.

In the Cross Fire

In some breeds, no COO stock exists, or that which does exist shares the same problems as the AKC stock. In such cases, crosses to other breeds may be the only way to introduce new genes. Early in the creation of breeds, such crosses were commonplace. For example, although the Shih Tzu is an ancient breed, at the beginning of this century the breed is thought to have become extinct in China. Modern Shih Tzu descend from seven dogs and seven bitches, one of which was not a Shih Tzu, but a Pekingese. This cross occurred in 1952, long before AKC recognition of the breed.

While the early registration bodies sometimes sanctioned crosses to other breeds, after a breed is established, they allowed crosses only in the rarest of circumstances. The Dalmatian is a breed with a genetic predisposition for abnormal uric acid metabolism that leads to painful and debilitating stone formation. In 1988, at the behest of the board of directors of the Dalmatian parent club, and with the approval of the AKC, a cross was made to a Pointer in an attempt to introduce the genes for normal uric acid metabolism into the Dalmatian genome.ⁱⁱⁱ The plan was to breed the normal progeny of this initial cross back to Dalmatians, continuing for many generations until their descendants were essentially Dalmatians with no trace of Pointer (except for the normal uric acid metabolism). With each backcross (crossing the mixed progeny back to pure Dalmatians,) the proportion of Pointer chromosomes would decrease by one half. This is a common plan for the introduction of a new gene into another population, although several factors can slow or halt its progress. These factors include linkage; wherein the trait being selected for is on the same chromosome as other traits that may be essential for type. If, for example, the trait for normal uric acid metabolism was on the same chromosome as the trait for patches, acceptable in Pointers but not in Dals, a decision for health would also be a decision against type. Even so, in time, the Pointer derived chromosome bearing the introduced allele will cross over and exchange genetic material with its homologous Dalmatian derived chromosome and hopefully breed true for the Dalmatian type without the metabolic defect. This did not happen, though. The descendants with normal uric acid metabolism tended to have ticking, instead of spotting, suggesting the possibility of either linkage or pleiotropic effects. Pleiotropic effects are those where one gene causes several diverse effects.

Further problems arose with a change in consensus about the project within the Dalmatian Club of America. The club subsequently objected to the registration of the crossbred progeny and lifted the registration privileges for these dogs. Thus, although the experiment was a medical success, it was not successful from the viewpoint of maintaining Dalmatian type or achieving widespread acceptance. The important lesson in this case, however, is not that the venture failed, but that the AKC had the foresight to approve it in the first place.

Perhaps the most important lesson was one of requiring full consensus of all parent club members before undertaking a project of this nature. The AKC now requires a full membership vote from the parent club before granting approval. One of the rarest breeds in America is the Wirehaired Pointing Griffon. In the 1980s, the breed's limited gene pool resulted in the decision by some breeders to cross the breed with the Cesky Fousek, a European breed. Griffon breeders did not universally approve the project and the AKC did not grant recognition to the resultant dogs. Breeders have the liberty of choosing the direction of their own breeding programs. If they choose to cross their dogs to another breed without a priori parent club and AKC approval, they cannot expect AKC recognition of their stock—no matter how good their intentions.

While it is clear that in some cases the AKC will consider "breaking the rules" in order to promote genetic health and diversity, no set guidelines seem to exist by which a parent club can petition for such an exception. Shouldn't a published set of criteria be available so that breed clubs know at what point they may reasonably resort to this step? Should the breed club or the AKC be the final authority when deciding if such exceptions are to be made?

Gene Pools and Polls

Unfortunately, few breed club members have the proper background in genetics to make these decisions. Some clubs have large health committees, headed by fanciers with a good knowledge of medicine, genetics, research and the breed, but by far the vast majority do not. Most people with the time to do club work are not at the forefront of research. Well-intentioned, but unqualified fanciers typically head breed health committees. Further, in many breed clubs "political" actions can force qualified people from committee seats, or prevent them from participating. Club politics may also influence what diseases those in power deem worthy of funding. In fact, with some notable exceptions, breed-club health committees have

produced disappointing results.

Breed-club health surveys fail largely because of reluctance of breeders to discuss problems of a possible hereditary nature with their competitors. On more than one occasion, those in charge of compiling data have divulged confidential information. Since the essential problem in data collection is one of mistrust of fellow breed members, at the simplest level parent clubs could agree to trade their medical data recording duties. This means that a member of another breed club, and vice versa would collect data from one breed. The two breeds would optimally have about the same number of registrations and a priori identified health problems. This set-up would remove much of the temptation to divulge information, since the data collector should not be acquainted with people owning the other breed. This is a better, though far from perfect, solution for a breed by breed tabulation.

Even better are all-breed data collection centers independent of parent clubs. These registries are either open or closed. In an open registry, information on a given animal is generally available to the public. Such registries are valuable for making pedigree-based breeding decisions. The Institute for Genetic Disease Control in Animals (GDC) collects data on both normal and affected dogs and makes it available to breeders, scientists, and veterinarians.^{iv} This system is an open registry, meaning that dog identities are not confidential, but instead available to people seeking information. In the ideal world, this is the type of registry that is needed, because not only is information tabulated on the individual dog but also the animal's relatives. In this less than ideal world, many breeders resist open registries out of the fear that they will be the only ones in their breed to report any problems, and subsequently lose puppy buyers and stud requests to breeders who are not as honest.

In a closed registry the identification of a particular animal is not generally available, or is available only if that animal has normal results. Such registries have been criticized because some breeders feel that only half the story is being told. On the other hand, breeders with dogs certified as normal from these organizations can boast such certification, leaving those without under a veil of suspicion. The most well-known of these registries are the Orthopedic Foundation for Animals (OFA, which collects data on hip dysplasia, elbow dysplasia, patellar luxation, craniomandibular osteopathy, cardiac function, thyroid function, and a number of breed specific disorders) and the Canine Eye Registration Foundation (CERF, which certifies dogs free of heritable eye defects). Besides certifying normal animals, these registries maintain a closed database on all animals, whether normal or abnormal.^{v-vi} OFA has over 500, 000 dogs in its registry.

Other closed registries exist solely for research purposes, and in an effort to attract as many participants offer the promise of privacy. The Veterinary Medical Data Base contains over 5,800,000 records of animals submitted from the 24 veterinary schools in North America since 1964. It is not a genetic registry, but does record cases by breed and other variables. Researchers and veterinarians can search this database for a nominal fee.

With the advent of simple DNA collection, DNA based databases have been developed. The Veterinary Genetics Laboratory (VGL) at the University of California, Davis is collecting DNA samples in an effort to establish a genetic profile for each breed, as well as investigate particular disorders. Current research is aimed at locating DNA markers of immune-mediated disease in Akitas and Weimaraners, with the eventual goal of expanding this effort to other breeds.

Once collected, interpretation of data is still not within the range of abilities of most dog breeders. Geneticists have received extensive training to become proficient at analyzing data; it is presumptuous to imagine that a breeder can do the same by reading a genetics book. Similarly, all the genetic research in the world is of little value if the information isn't disseminated and widely available to the dog owning and breeding public. Again, this is currently left to breed club members or local veterinarians. Breed clubs, from time to time have imposed devastatingly wrong breeding guidelines.

Such guidelines resulted from incorrect interpretation of research results coupled with a basic misunderstanding of population genetics. Breeders with a particular problem are reluctant to enlist the help of other breeders for fear that they will damage the reputation of their line. Although this is changing, they are also reluctant to ask their veterinarian because the typical clinician is not well versed in genetic principles and tends to suggest "neuter it" as the safest answer.

In order to maximize the genetic diversity still available, the fancy needs trained geneticists with backgrounds in population genetics to consult with breeders. The possibility of a professionally staffed AKC backed Genetic Counseling Hotline has been suggested.^{vii} Geneticists armed with an understanding of veterinary medicine, purebred dogs, population genetics, and data acquisition and analysis could address the concerns of dog breeders and owners alike. This office would be able to answer questions about the prevalence of health problems within a breed, their hereditary nature and the current research regarding that problem. It could offer advice about risks involved in contemplated breedings. Although this information center could not function as a basic genetics course, it could publish brochures on the subject and direct people to sources of information. At the minimum, this venture would require about \$100,000 per year for qualified personnel and proper facilities.

Show Me the Money!

Funding often depends on the generosity of breed fanciers, but in a hobby in which the money flow is always outward, it seems to be asking a lot of breeders to dispose of yet more of their funds, no matter how lofty the goal. This is not to say that breeders and owners should absolve themselves of financial responsibility for their breed. On the contrary, the dog fancy is made up of several wealthy individuals who routinely spend in excess of \$100,000 annually campaigning a show dog. They do this not for any hope of financial compensation, but of recognition within the dog fancy. If only some of this money was funneled toward breed health research instead of magazine advertisements, imagine how much greater their recognition and contribution to the world of dogs would be. To be fair, many of these exhibitors do pay their share, but do so with very little recognition. Contributors to research funds should be published in a prominent location (and some are), in order to publicly acknowledge those who have contributed and motivate those names that are prominently missing.

These wealthy exhibitors are the exception in the dog world, however. Most dog breeders are people of modest means who lose money with every litter they produce; the only one that consistently makes money with every litter is the AKC. AKC's income comes from the registration of purebred dogs. At no time has the public ever been so aware and suspicious of the health problems in pure-breeds, and if this suspicion continues, the AKC stands to lose revenue as fewer people opt to buy an AKC registered health risk. The last decade has seen the greatest advances ever in canine hereditary health research. The establishment of the AKC Canine Health Foundation (CHF) in 1995 has finally provided a means by which breed clubs can obtain guidance in fund raising, health survey creation, and research project selection. The CHF has undoubtedly been the greatest contribution the AKC has made toward the health of dogs, yet many fanciers complain that it represents only a minimal effort undertaken as a public relations show. There can be no doubt that the CHF has already made significant contributions toward research and education. Although emphasis has been upon interacting with parent clubs, the CHF is still available to the individual breeder. The Foundation is especially useful at monitoring and assessment of ongoing projects. This insures that research dollars will not be wasted in nonproductive areas.

The dog-owning public tends to look to the AKC for guidance on dog-related topics, including genetic health matters. Isn't it natural that they should also be able to get that guidance when they ask for it? Where can a dog owner turn for advice when the possibility of a genetic disease arises? In 1997, the CHF received \$450,000 in donations from fanciers, clubs, and corporations, and \$800,000 from the AKC.^{viii} This will go up to almost a million dollars in 1998, but that is still not enough.

AKC has enjoyed an average annual surplus of about \$5,000,000 for the past five years.^{ix} Having amassed significant unrestricted non-capital assets, the AKC could choose to apply these surpluses to additional health or genetic research. We suggest that AKC has no unfunded requirement more necessary than genetic research and advisement.

In particular, we suggest that two areas are seriously in need of AKC funding. The first is an all-breed closed registry, so that data collection and interpretation is taken out of the hands of the individual breed clubs. The second is a Genetics Counseling Hotline staffed by paid, qualified, personnel having no connections with dog competition or breeding. Not only have breed-club data collection efforts tended to fail, but the time and effort involved in re-inventing the process in every AKC breed is wasteful. Analyses involving multiple breeds might more readily reveal genetic relationships that would take longer to become apparent within single breeds.

If the AKC refuses to fund such vital projects from its current surplus, perhaps it is time for dog breeders and owners to share the responsibility equitably. As any dog owner well knows, owning a dog is expensive, and owning a sick dog can be devastatingly so. One of the least expensive things an owner or breeder pays for in the life of an AKC registered dog is the registration of that dog. Most hobby owner and breeders would not object to adding an additional dollar or two to their

registration fees if they knew that money would be specifically earmarked for canine health. In 1997 the AKC registered 564,155 litters and 1,307,352 dogs; an additional \$1 per registration would amount to \$1,871,507 toward canine health.^x

It is time that the AKC realizes that it cannot expect club members to act as scientists and philanthropists. It needs to shoulder the responsibility for the dogs that make up its income and for the diseases that its registration policies—no matter how well intentioned—may have helped to create. There is a lot of frustration among breeders and elsewhere about the AKC's relative inaction with regard to health matters—but it is also important to recognize the reasons behind its lack of initiative. A major reason for the inherent conservative nature of the AKC lies within its structure as a "club of clubs. Parent clubs send delegates, from diverse backgrounds, who represent people of widely differing opinions and experiences. It is no easy task to obtain consensus with such a population. Recognize that the AKC is "us" and we are "them." To effect change will require a major change in the fancy. We all know breed club politics—even picking National Specialty judges is controversial; how are we to agree on what constitutes appropriate health screening for our breeds. The next article in this series will address this problem.

i Jon Curby—Kibushi Kennels and Mike Work—Sirius Kennels.

ii Jim Crowley, AKC Secretary. Personal Communication. March, 1998.

iii Ibid.

iv Institute for Genetic Disease Control in Animals, P.O. Box 222, Davis, CA 95617, (916) 756-6773, e-mail Martin Packard at mpackard@mcimail.com.

v Orthopedic Foundation for Animals, 2300 Nifong Blvd., Columbia, MO 65201, (573)-442-0418, <http://www.prodogs.com/chn/ofa>.

vi Canine Eye Registration Foundation, Veterinary Medical Database, Department of Veterinary Clinical Science, School of Veterinary Medicine, Purdue University, West Lafayette, IN 47907, <http://www.vet.purdue.edu/~yshen/cerf.html>.

vii

viii Debby Lynch, EVP AKC Canine Health Foundation. Personal Communication, March, 1998

ix American Kennel Club 1997 Annual Report

x Ibid.