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DNA Sequence in Hand, Dog Geneticists Aim to Build a Better Pooch

by EMILY ANTHES • September 7, 2004

The ancient relationship between people and dogs can be characterized as one long genetic experiment, one that began as soon as humans started breeding dogs for their ability to herd, hunt, or protect. But in another sense, the great canine experiment is just beginning.

This summer, researchers at the Broad Institute in Cambridge unveiled the map of the dog genome, sequencing the genes of a female boxer named Tasha. About the same length as the human genome, the dog's DNA adds to the growing library of organisms that have been sequenced—the dog is the fourth mammal to have had its genome sequenced, joining the human, mouse, and rat.

But for the small but growing community of dog geneticists, from breeders to veterinary researchers, it marks a more significant milestone.

"This has been the biggest step forward for us in research," said Dr. Gustavo Aguirre, a professor in the department of animal health at Cornell University, who is working to develop genetic tests for inherited eye diseases in dogs. "Having available the sequence will shorten the search for genes and mutations incredibly."

The field of dog genetics has grown into a multimillion-dollar research enterprise, using the new tools of genomics technology and fueled by donations from the American Kennel Club and guide-dog breeders. A \$30 million grant funded the sequencing of the dog genome and the real work, locating the genes that code for diseases, is just beginning.

It took approximately \$5 million to identify the gene for a common blood clotting disorder in dogs, said John Duffendack, the president of VetGen, a veterinary genetics company. Multiply that figure by the approximately 400 inherited canine diseases researchers have identified, and canine genetics looks like a potentially formidable industry especially if researchers succeed in finding the genetic roots of common health problems such as hip dysplasia, blindness, and epilepsy.

Breeders today have developed some technological screening techniques to help them breed dogs with desirable health profiles, but breeding still remains largely a trial-and-error system that would be familiar to dog owners decades ago. If a breeder wants to eliminate a certain trait, like epilepsy, from future litters of dogs, he or she must remove the affected dog from the breeding population and then, to be safe, remove its parents and littermates as well.

But once researchers can pinpoint which genes are connected to epilepsy, breeders will be able to test their dogs for the genes, and avoid breeding only the ones with the troublesome DNA. The way selective breeding is done now narrows the gene pool, potentially making other genetic

diseases more common. Genetic screening could help minimize this problem by keeping more dogs in the breeding population.

"You don't have to eliminate the disease, you just have to breed dogs selectively so that the disease just doesn't crop up," Aguirre said. "You can maintain genetic diversity."

Schools that train guide dogs for the blind are particularly interested in the implications of canine genomics. They hope the sequencing of the genome and the identification of disease genes will allow them to breed healthier dogs and more effectively screen out those who may fall ill during their service lives. It takes two years, \$35,000, and lots of effort to train a guide dog, said Jane Russenberger, the director of breeding for Guiding Eyes for the Blind. Only half the puppies finish training the rest are dismissed for medical or temperamental reasons.

"We are so anxious to hit it on the mark more often," Russenberger said.

Guide dog schools have been a driving force in genetic research, donating funds and dog DNA samples to Aguirre's lab, among others. The Seeing Eye, a guide dog school in New Jersey, has made donations to Aguirre's research on the genetics of progressive retinal atrophy, a serious disease that causes blindness in dogs.

Canine genetics also holds more superficial promise. VetGen can read Labrador retrievers' hidden color genes, at a cost of \$85 per test, enabling breeders to yield litters with the desired combination of black, yellow, and brown puppies.

Breeders are also looking at the possibility of using genetics to fine-tune a dog's temperament. They can already mix a Labrador and a poodle to create a labradoodle, which is reputed to have the intelligence and hypoallergenic hair of a poodle and the friendliness of a lab. Essentially just a carefully planned mutt, the labradoodle has caught on, suggesting an American public eager for design-your-own dogs. Soon, genetic research may make it possible to more effectively engineer dog populations with other desirable traits. For instance, it may be possible to breed dogs that are more confident, less distractible, and less anxious.

"We do have to fight some of the natural traits," Russenberger said.

The danger is that, even armed with new genetic knowledge, breeders trying to accentuate certain desirable traits may unwittingly concentrate genes for some negative traits, said Patricia Olson, the executive director of the Morris Animal Foundation.

"You might be trying to create an introvert and the dog could become really anxious," she said. "I think we've got to be really, really careful, but the potential is there."

And whatever breeders do, sometimes a dog will just be a dog.

"You're not going to get a dog to not be interested in food," said Ken Rosenthal, president of The Seeing Eye and chairman of the International Guide Dog Federation. "That's a matter of discipline, not genetics."