

Genetic diversity -seminar with Pieter Oliehoek.

The Danish kennel club, DKK, held together with the Danish Kooikerclub a seminar 2019 March 9 on genetic diversity/variation in dog populations. This is a subject that concerns a lot of breeders, and the seminar was visited by a lot of people. The main lecture was given by the Dutch lecturer Pieter Oliehoek and at the end Helle Friis Prochowsky finished it by giving the lecture a Danish perspective.

This text is by Helle Friis Prochowsky, veterinarian, Ph.D and special consultant with DKK. It is printed and translated by Ingbritt Sannel with the permission of DKK.

The dog was the first animal that was domesticated by us humans. Our forefathers were early aware of the many ways a dog could be useful, and many different dog types or “breeds” were created. Generation after generation we have decided what individuals would be allowed to give their genes on to the next generation. This has given us a lot of fantastic breeds, but in doing this we have also lost we have also lost some parts of the important genetic variation - or diversity. We know now that genetic variation is important for a population’s general health and fertility. The variation, once lost, will not come back, unless we involve other breeds in our own breed. Because of this it is important for all breeders to know how you take care of and preserve the variation there is in the breed. The number of individuals, the size of the breed, does not necessarily tell us how much genetic variation that is left. If you wish to know exactly how much diversity there is in a breed, you will need to use computer programs or go to a laboratory and make DNA analyses.

Pedigree data

Pieter Oliehoek's interest in genetic diversity started when he was a student of biology and began his exam assignment. Since he was an owner of a Icelandic Sheepdog it was natural for him to study this breed more closely. Through extensive analyses of pedigree data, he managed to show how the breeding was concentrated to a few families or bloodlines. He also showed that these lines were overrepresented in many European countries and his work has been referred to several times in the Icelandic Sheepdog magazines in different countries. The results of this study can not be found through ordinary studies of pedigrees, such as many breeders of course already do. Because what you need is to have access to data that goes all the way back to the beginning of the breed as such. Nevertheless, his result has had a great impact on what you expect if you for instance decide to bring “new blood” into your breeding. Pieter told that he once brought from Iceland a potential bitch for breeding, believing that she represented “something new” only to find that this was not so at all. He could just as well have brought a bitch from Denmark or Germany because she represented almost exactly one of the lines that was already overrepresented in the rest of Europe.

Founders- the first of the breed

When Pieter wrote his master thesis, he identified a long line of problems connected to loss of genetic diversity, but he had no solutions. It was, according to him, quite unsatisfactory when he held lectures to breeders or breed clubs. So, he decided to continue his work on the subject for his Ph.D. and he also started his firm “Dogs Global”. Now, when Pieter gives his lectures, he has three solutions to offer, but more of this later. To be able to understand Pieter's work, you must first understand the concept “founders”. The word “founder” is used for individuals that started a certain

breed. Founders are defined as being mutually unrelated and all individuals in a breed can in principal be traced back to one of these first dogs. Pieter Oliehoek stated that a breed never has more diversity than that which existed with the founders. If you have pedigree facts that goes back long enough you can calculate how much of the founders' original genome that is still to be found in the present dog population. Pieter calls this FGS (Founder genome Surviving) or FGE (Founder Genome Equivalent) and to make it easier to understand he recalculates the concepts into individuals.

Overrepresented ancestors

The concept "genome" is used for an individual's total amount of DNA. If for instance a breed is started from four dogs, then there were principally four founder genomes to start with. If all four original dogs have contributed lively to the breeding in the following new generations all the hereditary material – that is all four founder genomes- will still be there. FGS will be four. But that is very rare. In a lot more of the breeds some founders will be overrepresented and the genome of others has almost disappeared. This is what Pieter Oliehoek has specialised in calculating, in order to better understand the breeds genetic diversity. When he calculates a breed's FGE (Fonder Genome Equivalent) that tells us the number of founders that could have produced the present population if they had been used equally. A breed could for example start out with ten original founders, but if four of them have no progeny in the present population then their lines are "extinct" and their genetic contribution is lost. A bit simplified you can then say that the breed's FGE is reduced to six individuals.

Reasons for worrying

In almost all breeds we should probably worry more about the loss of diversity than we do. The tricky thing is that many of the actions that has led to that only a small part of the breed's original genetic material still is available happened a long time ago. That is why breeders now can not act as they did before when they make decisions about mating two individuals. They may think that a planned mating will not lead to inbreeding because there are no common ancestors within three to five generations. But according to Pieter Oliehoek not even ten generations is enough to evaluate inbreeding. If a few of the breeds founders are overrepresented in a large part of the breed, nearly every mating will result in inbreeding with the problems and risk that follows. It is usually said that inbreeding leads to loss of genetic diversity. At is not wrong- but the opposite is actually also a fact: that is, low genetic variation can contribute to an increase of a breeds inbreeding. The problem is of course that most of us is very far from having access to pedigree data that goes all the way back to the beginning of the breed.

Three solutions – Pieter Oliehoek

During the seminar Pieter Oliehoek presented three solutions to the participants. One solution assumes extensive pedigree data knowledge, the two others do not. Absolutely basic is to use as many animals as possible for breeding. In doing so you can secure that there will be enough variation also in the future for our breeds. Every single breeder can do a lot when choosing animals to breed,

but the strategic responsibility when it comes to secure the genetic variation in the breed must be up to the breed club. The Icelandic Sheepdog club (*Denmark and other countries as well within the ISIC cooperation. I added this as translator*) has worked with Pieters first data for nearly 20 years and the club has even looked for dogs with “rare genes” in adds in the club magazine. That is, they looked for potential breeding animals who represented those lines that were near extinction. The club is continuously working with this subject and the day after the seminar, the club had invited Pieter to hold a workshop with focus on their own breed.

Mean Kinship or average relationship

This method demands access to pedigree data for the breed all the way back to the founders and if possible, on a global scale. With the help of a special computer program you can calculate an individual dog's average relationship to all other individuals in the breed. Based on the size of this relationship Pieter Oliehoek gives them a colour code like green, yellow or orange. Green dogs have very low relationship to the rest of the breed. They represent thus “rare genes” that are important to preserve by using the dog for breeding. Yellow dogs are middle high in relationship to the rest of the breed and they are also fine to use. In order not to indicate a “full stop” Pieter uses the colour orange in stead of red on those dogs that have a high degree of relationship to the rest. There may well be other characteristics with such a dog that makes it a positive contributor to the breed. But basically, the orange dogs are so much related to the rest of the breed that many breedings will produce a higher degree of inbreeding.

One-time litters

Many breeds have different breeding restrictions that decides what dogs may be used for breeding. The most important reason why a dog is not used in breeding is as a rule a dog that lives with a family that has not considered breeding. This is something that national kennel clubs or special clubs must try to change by encouraging to what Pieter calls one-time litters. It is better for the genetic variation of the breed that many different dogs have one litter instead of litters being concentrated to some few breeder dogs. This goes for both male dogs and bitches and breeders can help to make sure that family dogs can contribute to the breed. Here Pieter also warned against the tendency, in many countries, to routinely neuter dogs at an early age.

Crossbreeding

Pieters last solution is crossbreeding with another breed. In that way you can introduce a new founder, and thus new genetic variation to the breed. But it is important to think carefully before starting such a project. If a crossbreeding project is not carefully planned or if you do nothing in the following generations to keep the new variation that has been added the effect will quickly be lost.