Genetic Diversity Platform & Breeder Tool

Genetic Diversity is getting more and more an issue in breeding purebred animals and so it is in dogs. Since 2016 the Austrian Leonberger Club performs DLA typing to monitor and maintain genetic diversity in these genes resulting meanwhile in a representative DLA database of the breed. In addition to DLA typing the Club established a genetic diversity database including stud dogs but also dogs of interest covering nearly 200 individuals. The database was initially set up as online source. Here, improvements were made and since June 2022 a new platform with additional population genetic values was established and released by FERAGEN. All data which are part of genetic diversity are presented on the platform including DLA results, coefficients of inbreeding and the level of heterozygosity. A nice feature is the comparison of its own dog with the tested Leonberger population as well as all other dogs of other breeds represented in the database. This gives the owner/breeder and idea where a dog is genetically located compared to others as shown in Figure 1 and 2.

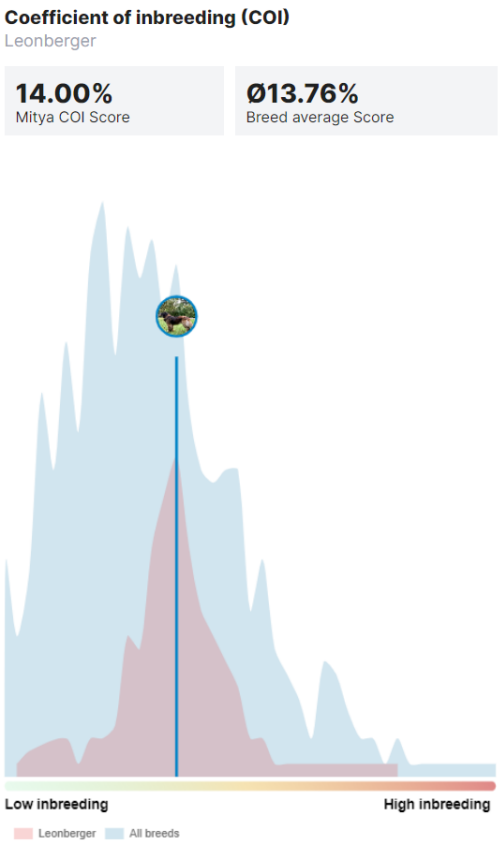

Figure 1: Coefficient of Inbreeding in the Leonberger.

The genomic coefficient of inbreeding is calculated based on genetic markers considering 6 generations. This number of generations was chosen because it correlated best compared to

COI calculations based on pedigrees. The red curve represents the COI of the Leonberger breed, while the blue curve represents the COI of all genotyped dogs of different breeds in the database. The blue line corresponds to the COI value of the dog represented in the profile and indicates its appearance within the breed. The lower the COI, the lower is the level of inbreeding. In comparison to the individual COI value, the mean value for each breed is shown.

As a second value the degree of heterozygosity is calculated and shown in Figure 2. Heterozygosity represents the percentage of different genetic markers inherited from a dog's parents. The higher this value, the more heterozygous marker are present. High values are preferable. The red curve represents the heterozygosity of the Leonberger breed, while the blue curve shows the distribution of heterozygosity from all genotyped dogs in the database. The blue line corresponds to the value of the dog represented in the profile. Also shown is the mean value for the breed.

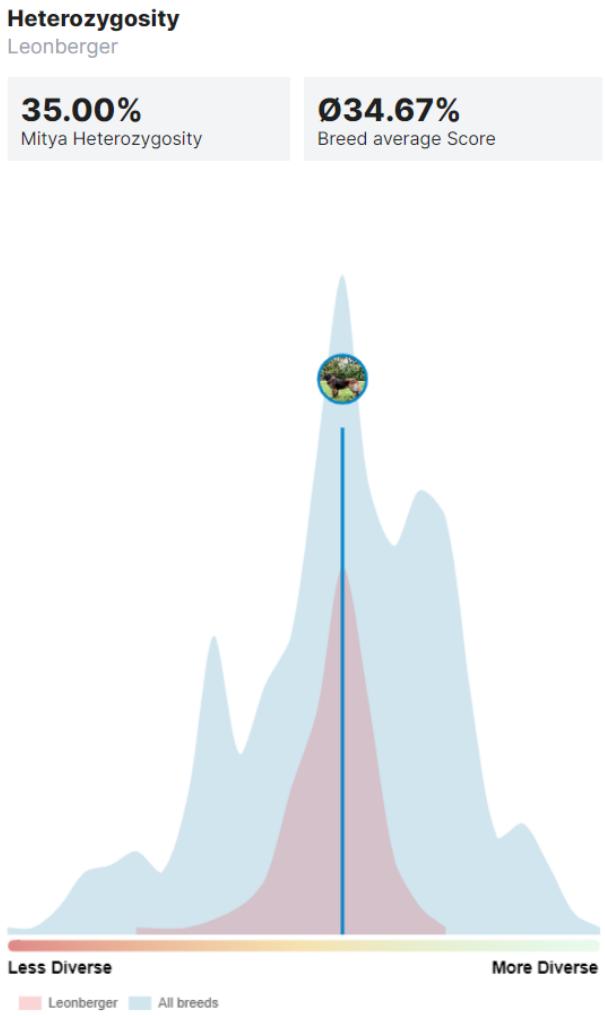

Figure 2: Degree of Heterozygosity in the Leonberger.

DLA haplotypes which are important for a dog's immune system are also included in the database (Figure 3). The numbers represent a dog's haplotypes. Different alleles are uncoloured while identical alleles are coloured in red and gives an indication of homozygosity.

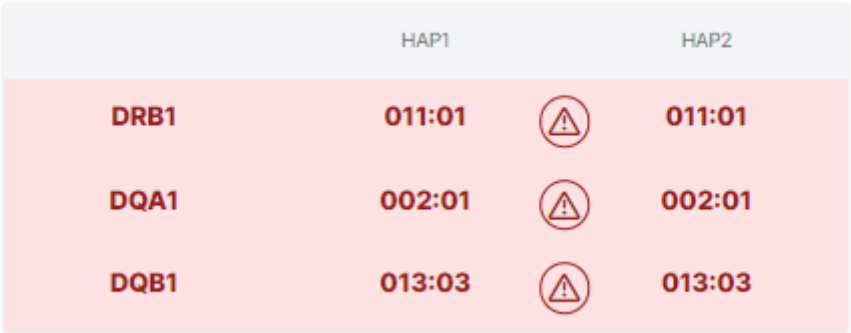

Figure 3: DLA haplotypes of a single dog shown in the database.

Giving breeders the possibility to genetically check a potential mating, a matching tool was included in the platform. This tool allows to find matching partners for single dogs in a very easy way. When using the matching tool, a matching score for each potential mating pair will be calculated and based on that mating partners will be ranked (Figure 4). Also compared are DLA haplotypes with potential outcomes in the offspring.

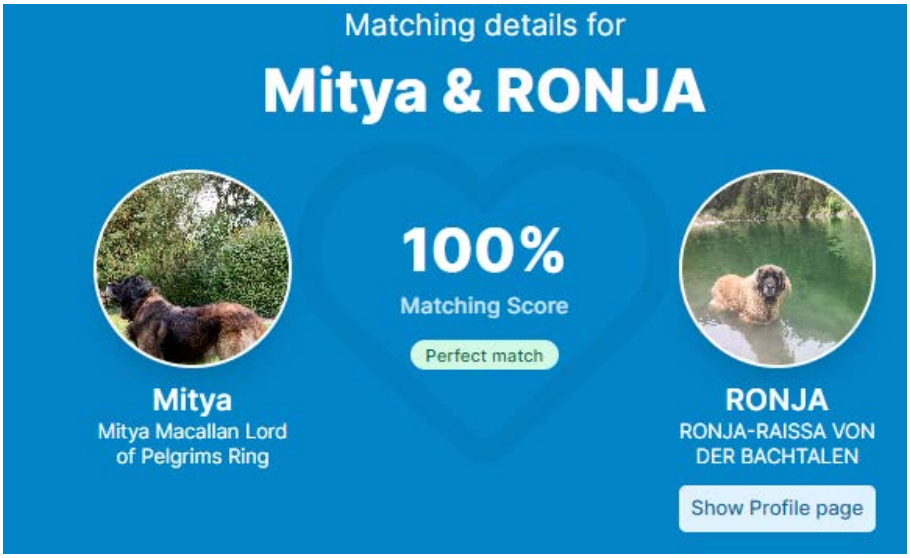

Figure 4: Example of a Matching Score.

The genetic distribution is also part of the matching tool and shows a genetic map of the Leonberger breed (Figure 5). Every dot stands for a dog. The closer the points, the more similar is the genetic make-up of the individuals. Compared dogs are highlighted and connected with a blue line. The blue circle in the middle of the line shows the region where offspring of this mating are expected. Ideally, this circle falls into a genetic diversity space

where no or a low number of dogs is already present. This improves the genetic diversity of a breed and leads to a new combination of the parents' genetic material.

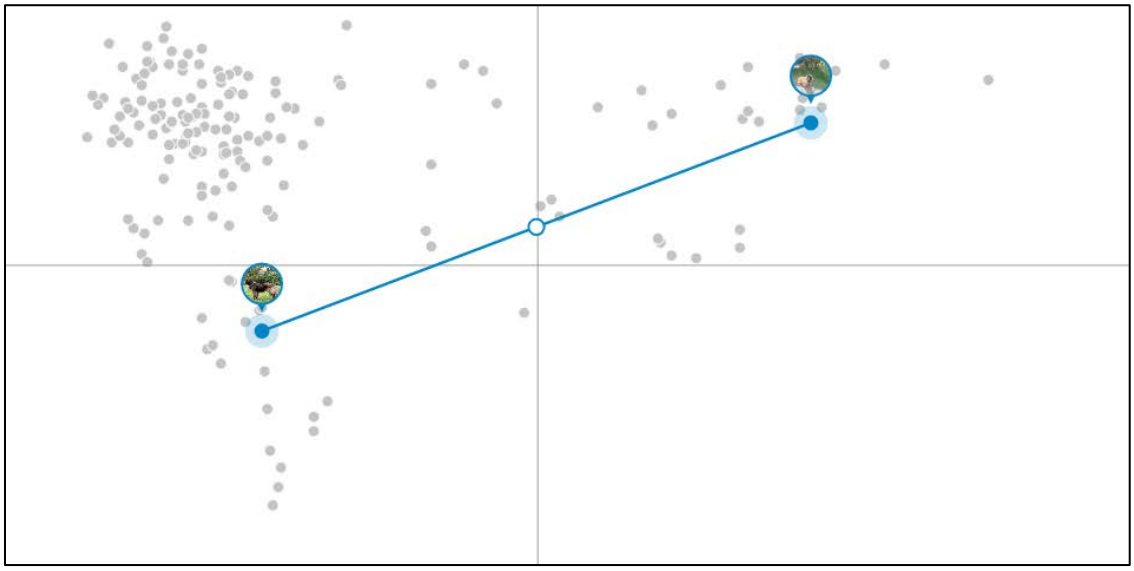

Figure 5: Genetic distribution of genotyped Leonberger.

An additional result obtained with the matching tool is the comparison of the haplotypes from both parents (Figure 6). DLA haplotypes of the two matched pets are listed below and compared. Possible combinations, including a theoretical/statistical distribution of haplotypes in offspring, are shown. Numbers coloured in red indicate identical alleles inherited from both parents. A high diversity in DLA haplotypes is favourable and can be obtained by reducing the amount of red indicated alleles.

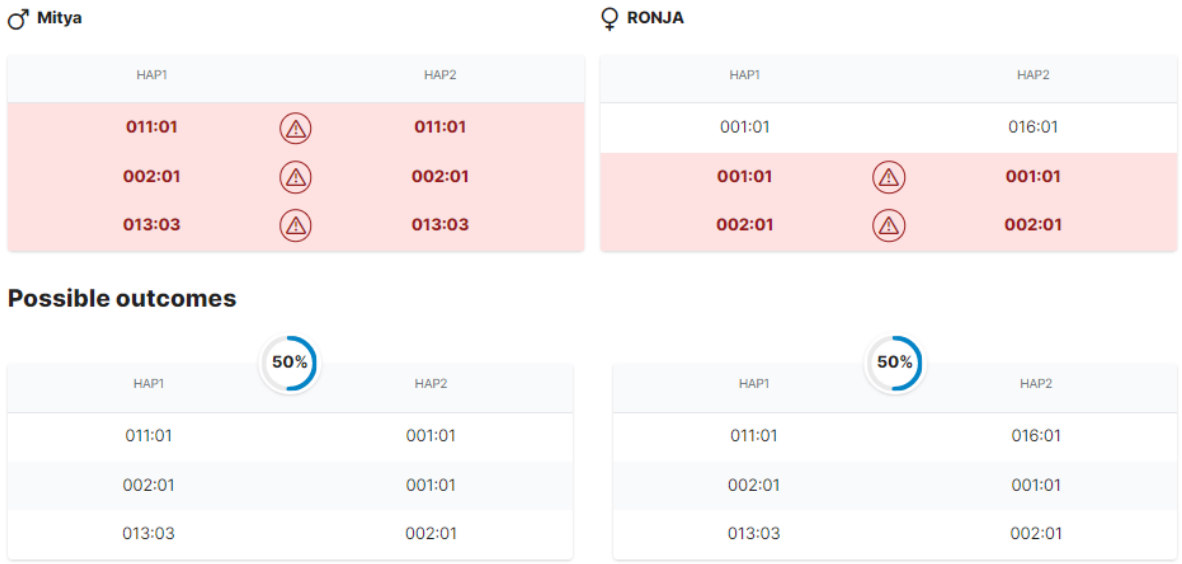

Figure 6: Potential DLA haplotype outcome in offspring based on the DLA results of the parents.

There are additional tools which will be included in the near future with a special focus on breeding clubs. The tools will cover a management function for clubs, the online availability of disorders and traits, and a tool allowing to monitor genetic diversity as well as the effective population size of a whole breed. In other words, a tool to monitor the developments in inbreeding.