Chapter 6.1: What is genetic diversity?

Diversity is another word for variation: the presence of differences among whatever you consider. Related to genetics, most obvious is the genetic diversity between populations. Different breeds, for example, have specific genetically determined characteristics. Think about differences in size, colour, but also in purposes such as beef versus dairy cattle, or hunting versus guarding dogs. Genetic diversity also exists within a population, and is related to the genetic differences between animals in that population. It is possible, but very rare, that there is no genetic variation in a population. This occurs in populations that are fully inbred: animals are genetically completely identical to each other. But like said, this is a very rare situation that may occur in genetic lines of laboratory animals that are especially created for that purpose. The purpose of those populations is to provide animals that are as genetically equal as possible so that genetic differences are not a cause of variation in, for example, testing new medicines. A population of clones would be even better from the point of view of having genetically equal animals.

### Definition

**Clone (animal)** is an individual that is genetically identical to another or a group of individuals that are genetically identical to each other

Such population would have no genetic variation at all. However, in the Netherlands the use of clones is prohibited.

### Definition

**Genetic diversity** represents the presence of genetic differences between animals within species, both between and within populations

The number of alleles that are present in a population is a measure of genetic diversity. The more alleles are present, the larger the genetic diversity is. The frequency at which these alleles occur in the population also have an influence on the size of genetic diversity. The more equal the allele frequencies are, the larger the diversity is. This principle is illustrated in Figure 1 for a gene with two alleles.

![Figure 1. The relation between frequencies of two alleles (blue, straight line), and the consequence for the heterozygosity in the population (curved line). Maximum heterozygosity at p = q = 0.5.](image)

If the frequency of the q-allele is 1, the frequency of the p-allele is 0, and vice versa. A high frequency of one allele always coincides with a low frequency of the other allele. The frequency of heterozygotes, calculated as 2pq, depends on both frequencies. The maximum allele frequency is achieved when both alleles have a frequency that is as high as possible, given the other frequency. And that is when both alleles are at equal frequency. For genes with more alleles the principle is the same: maximum heterozygosity at equal allele frequencies. Genetic diversity depends on the presence of a large number of alleles, but also on the frequency of those alleles in the population. Within an animal you can define genetic diversity as whether an animal is homozygous or heterozygous for a certain gene or parts of the genome.