Chapter 6: Genetic diversity and inbreeding

Defining a breeding goal and recording of phenotypes and pedigree are important aspects of setting up a breeding program. Accurate pedigree registration is essential for estimating breeding values, as has been indicated in the chapter about collecting information. The pedigree registration can also be used for monitoring the genetic relationship between animals. Knowing the relationship between animals is very useful for managing genetic diversity in a population. Genetic diversity is a measure of genetic differences between animals in a population (i.e. genetic variation). To make sure that the breeding program remains viable in the future it is essential to monitor and maintain genetic diversity. Genetic diversity allows for selection of superior animals for breeding. If there is no genetic diversity, so if all animals would be genetically the same, selection will not result in an improvement in the next generation. In that case it is useless to set up a breeding program. Genetic diversity also has a clear link to inbreeding. Inbreeding results from mating of related individuals, and has a negative effect on health and reproduction.

In this chapter we are still collecting information (step 3), and we will look more into detail at the role of family relationships in genetic diversity. The chapter will be divided into two parts: first an introduction of the theory, and second a toolbox that can be used for evaluation of genetic diversity and for decision making related to selection and mating. Some of the applications of the tools will be subject of later chapters. To introduce the theory of genetic diversity we will take a top-down approach: first consider genetic diversity between populations, then move to within population, and finally look at genetic diversity within an individual. Then we will look at different mechanisms that influence genetic diversity, and discuss their role in animal breeding. We will look at inbreeding and its consequences. The toolbox in the second part of the chapter will include tools to determine the genetic relationship between animals based on their pedigree, to determine the inbreeding coefficient of an individual animal, and to consider (influences on) the level and rate of inbreeding at population level. In the following chapters you will see that these tools are relevant in many of the steps in the breeding program.