

9.1 Effect of inbreeding on individual and on population level

In section 4.4 on individual inbreeding, it was shown that inbreeding increases the chance of homozygosity in each locus. This is also true for homozygosity in general. Inbreeding causes an increase in the level of homozygosity, and a decrease in the level of heterozygosity. At 100 % inbreeding no heterozygosity is left.

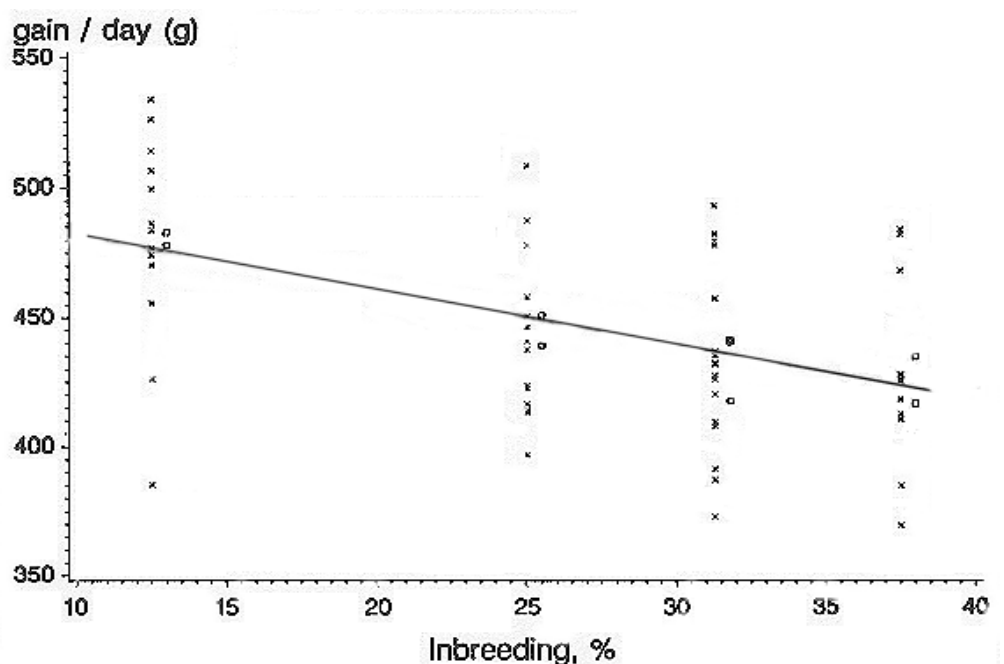
What concerns an individual also concerns the entire population. Again we refer to the albumin example of dogs which, was given in section 2.4. By examining the total number of heterozygotes in all dog populations it becomes clear that 16 % units are missing, compared to the expected in a H-W population if we regard all examined dogs as one breed. The joint overall lack of heterozygotes makes it possible to estimate the inbreeding, within the individual population, to 33%, using the formula from section 4.4. The measurement of inbreeding in the various breeds can also be regarded as a measurement of differentiation between breeds. Inbreeding in a breed is caused by random loss of variation, whereby the breed loses parts of its original variation. Inbreeding drives the evolution, which is competition between populations on a higher level. Each population, if it is large enough, will acquire new mutations to compensate for the loss of original common variation.

It is known that one of the consequence of strong inbreeding is loss of vitality. A linear negative relationship between production traits and the degree of inbreeding can be predicted. Therefore it is important to ensure that the inbreeding is kept at the lowest level possible among the production animals. This can be done using pedigree information before mating, or by use of more robust systems, such as subdividing the animals into herds, keeping the females in the herd while adding new males from other herds. This system can ensure a low level of inbreeding, see Figure in section 9.3 for circular full sib mating giving minimal inbreeding. On the population level a herd can be regarded as a pair of full sibs.

The decrease in the level of the production traits is called **inbreeding depression**. It is at a magnitude of 0.4 units for an increase in the inbreeding of one unit. For reproduction traits or fitness traits the decrease is much higher, at about one unit. This cause the fact that it is extremely difficult to produce 100 % inbred domestic animals.

Figure 9.1 shows a linear decrease in average daily slaughter gain in swine. The slope of the line is 2.1 grams decrease for one unit increase in the degree of inbreeding (data from et al. Anim Prod. 58:298-300, 1994).

Figure 9.1.
Decrease in the average daily
slaughter gain in relation to
inbreeding in swine



The linear decrease in production ability can be directly related to the linear decrease in the degree of heterozygosity, which is proportional to the increase in the degree of inbreeding. Correspondingly there is an

increase in the degree of homozygosity, which is equal for both homozygote types. For every locus the decrease is proportional to $2Fpq$, and the corresponding increase is Fpq for each type, see table in section 4.4. The magnitude of the inbreeding depression depends on the magnitude of the dominance deviation, which is constant for a given trait. The inbreeding depression is generally largest in traits with low heritability.