Topic 1: Analysis of the AnGR biodiversity status using pedigree data
Practical example

Hello, welcome to another topic from the module Conservation and Sustainable Use of Animal Genetic Resources, where we will show the basic operations with pedigree records.
It is important to understand at the beginning the basic difference between the terms: inbreeding coefficient and relationship coefficient. The relationships coefficient represents the probability that two related individuals have inherited an allele of the same locus from a common ancestor (the so-called IBD allele - "identical by descent"). In contrast, the Coefficient of Inbreeding - Fx, represents the probability that two homologous alleles of an individual are identical by descent (IBD - autozygous).
First, we will look at the inbreeding coefficient. Several approaches can be used to estimate the level of the inbreeding coefficient. The two basic approaches are shown here on the slide. One is the Wright's inbreeding coefficient, and the other is the inbreeding coefficient based on the additive relationship matrix. We have already discussed both approaches in the lecture video. The method of constructing the additive relatedness matrix is discussed in detail in the lecture module "Animal Breeding" - the topic "Genetic value of the individual".
Several examples will then be given to illustrate the different approaches.
We want to estimate the level of the coefficient of inbreeding for the individual Rek I. There is one common ancestor in this pedigree, the individual Baronka. This individual is in the second generation of ancestors, which implies that the number of free generations from the father's side (Kazan) is equal to 1 and the number of free generations from the mother's side (Poly) is also equal to 1.
If we put this information into the appropriate formula for estimating the inbreeding coefficient according to Wright, where n1 and n2 is the number of free generations from the sire's and dam's side to the common ancestor, where the number of these free generations from the sire's and dam's side was equal to 1 in both cases, we obtain a value of the inbreeding coefficient corresponding to 0.125, or, as shown here, 12,5 %.
We obtain the same value if we use the additive relatedness matrix to find values of inbreeding coefficients. The inbreeding coefficient is shown here on the diagonal and for the Rek I individual it represents the value 1.125 - 1. This means that the value of the inbreeding coefficient is equal 0.125.
As the additive relationship matrix shows, the coefficient of inbreeding of an individual corresponds to half of the additive relationship between the parents of that individual. The additive relationship of the parents of individual Rek I, which is Kazan and Poly, takes the value of 0.25. Shown here in red.
Here on the slide, we will show a situation when we want to predict the value of the inbreeding coefficient of a future offspring of an individual Rek I and Poly. Note that Poly is the mother of individual Rek I. Therefore, the closest common ancestor in this case is Poly. The number of free generations from the parents to the common ancestor is equal to 1 from the father (Rek I) and equal to 0 from the mother (Poly), because it is the mother (Poly) who is the common ancestor.
Therefore, the value of the expected coefficient of inbreeding for a future offspring between Rek I and Poly is equal to 0.3125, i.e. 31.25%.
Again, if we use the additive relationship matrix to predict the value of the inbreeding coefficient of individual X, resulting from the mating of Rek I and Poly, we obtain a value of 0.3125, similar to the previous slide. The additive relationship matrix further shows that the relationship coefficient between individual Rek I and Poly is equal to 0.625. Again, the inbreeding coefficient corresponds to half of the relationship between the father Rek I and the mother Poly, in this case, as already indicated, to a value of 0.3125.
But because sometimes in breeding more complicated combinations occur in the following examples we will show more complex relationships.

Here we have one of the more complicated pedigrees. This slide shows all possible common ancestors in that pedigree. These are the Dan individual, the Jiskra individual, the Kim individual, and the Orka

individual. If we wanted to select all the inbred individuals in this pedigree, these would be the following individuals: Dan, who has a inbreeding coefficient equal to 0.125 and has a common ancestor in Ziki. Bára, who has a inbreeding coefficient equal to 0,0625 and her common ancestor is the individual Kim. And Alan, who has a inbreeding coefficient of 0.1953, with Dan and Kim as common ancestors.

Slide12 shows an estimate of the inbreeding coefficient according to Wright (1922) for the individual "Alan". The overall value of the inbreeding coefficient for Alan is approximately equal to 20%. Alan has several common ancestors on both his sire's and dam's side. One of them, for example, is Dan, who is even inbred himself and his inbreeding coefficient is equal to 0.125. Dan contributes 14% to the total inbreeding coefficient. Another common ancestor for the individual Alan is the individual Jiskra. Jiskra contributes 3% to the total inbreeding coefficient for Alan. Another common ancestor is the individual Kim, which contributes 1.56% to the total inbreeding coefficient. And the last common ancestor for the individual Alan is Orka. Which contributes 0.78% to the total inbreeding coefficient. If we sum up all these contributions we get approximately the allredy mentioned value of 20%. Which corresponds to the total coefficient of inbreeding for the individual Alan.

The above example begins to be complicated, and therefore it is very easy to overlook any relationship between the two individuals of a given pedigree.

For this reason, it is preferable to use an additive genetic relationship matrix for more complicated relationships. As it follows from the additive relatedness matrix, the estimate of the inbreeding coefficient for the individual Alana has the same values as in the previous calculation. Minor inaccuracies are due to rounding errors. In addition, from the additive relationship matrix it is possible to directly obtain the inbreeding coefficients for all individuals in the pedigree and possible relationships between individuals

Finally, let's take a few cases for consideration. Everyone should try to find the right answer to each question and be able to justify it. There are no exact answers to these questions. The first question, when a breeder resorts to inbreeding, may be answered, for example, that the breeder is trying to establish some breed-specific traits or variables. But there are several other correct answers. To the second question whether inbreeding is bad, there is no clear answer because as the name suggests inbreeding can be neither bad nor good but depends on the context. For example, if the breeder is trying to fix some important breeding traits or variables, as already mentioned, this is a good or positive approach. Conversely, if bad and undesirable traits are being fixed and so-called inbreeding depression is occurring, this is a bad situation or a bad part of breeding.

At the end of this video, I would like to thank you for your attention and I look forward to seeing you again for the next videos.