

3. Introduction, basics, history and present of livestock breeding

The topic of today's lecture is Introduction, basics, history and present of livestock breeding. The lecture is part of Module 2: Conservation and Sustainable Use of Animal Genetic Resources, that is a part of the ISAGREED project. This presentation was supported by Erasmus+ KA2 Cooperation Partnerships Grant "Innovation of the content and structure of study programmes in the field of management of animal genetic and food resources using digitalization".

As part of the lecture, we will first talk about domestication, which was at the beginning of livestock breeding. Then we will explain the term breed and the possibilities of classifying breeds. Next, we will briefly explain the basic principles of animal breeding, and in conclusion, we will look at the current state of farm animals in the world.

Domestication is a complex and long-term process that can be defined in different ways. One possible definition says that domestication is the process of hereditary reorganization of wild animals into domestic forms according to people's interests.

Domestication is an exciting phenomenon not only from the perspective of biology but also from the perspective of the development of human society. Hundreds of studies have been published on the topic of domestication, and as technical possibilities are improved (here, I am mainly referring to methods using DNA analysis), new findings are constantly emerging, or existing ones are being refined.

The beginnings of domestication are dated to a relatively broad period of 15 to 5 thousand years before Christ and are associated with the change in the way of life of people from a nomadic to a more settled one and the emergence of agriculture when man was already able to close animals and keep them in secured areas and provide them with food. The first domesticated species was the dog, followed by sheep and goats.

Domestication centers are found almost all over the world, except for Australia and the polar regions. Most of them have been reported in Asia and Europe. As for the domestication of individual species, most of them were independently domesticated in several areas.

Three essential pathways of domestication are mentioned in the literature. On the one hand, this is the so-called prey route, when domestication was preceded by hunting and extensive breeding in captivity. The second form was the so-called commensalism when animals approached humans voluntarily and took the resulting advantages, such as the possibility of obtaining food. Gradually, there was habituation to the presence of humans and mutually beneficial cooperation. The direct route is an accelerated form of the first mentioned route and was considered for species that were domesticated later, i.e., when people already had some experience with animal keeping.

Why did humans start breeding animals in the first place? First of all, of course, it is an inquiry of providing food in the form of meat, milk, or eggs, then animals are a source of various raw materials, such as leather, fur, or wool, and last but not least, humans can use their energy, for example, to transport goods and themselves, work in agriculture, forestry etc.

Here is a Tibetan yak pictured, which is just an excellent example of a multi-purpose species.

The reasons for domestication were not only material but, for example, various religious rituals using animals as sacrifices are relatively well documented. Animals already served man as companions in ancient history. In certain cultures, animal breeding was a prestigious matter that brought and demonstrated a better position in society, and last but not least, it is necessary to mention the use of animals for defense. It is clear from history that wars were won with horses.

So now we know what animal husbandry brings to humans, but let's look at it from the other side... if it also has any advantages for domestic individuals. The answer to this question is not entirely clear-cut; it will mainly depend on what and how intensive the use is.

In any case, life in captivity is much easier for an animal because it is provided with food, protected from adverse climatic conditions and predators, and there is no need to look for a reproduction partner.

This is connected to the fact that the genetic makeup of individuals changes over time, as humans preferentially reproduce animals that suit their ideas. Sometimes these decisions can partially go against natural selection and allow genes to be passed on to the next generation, even for individuals who cannot do so in the wild. These interventions affect the gene pool of the species. Genetic modifications are created and spread as a prerequisite for further development and the basis of the so-called domestication changes, distinguishing domesticated animals from their wild ancestors.

We can divide domestication changes into several groups. Morphological changes are visible at first glance, which include, for example, changes in body size in the sense of giant or dwarf growth, changes in body proportions, changes in the ratio of individual parts of the body to each other, for example, lengthening of the body and shortening of the limbs or changes in the shape of the skull. Domesticated animals have also been reported to significantly reduce brain capacity, specifically in pigs, with a reduced brain size of up to 30%.

Other significant exterior modifications are changes in the type of coat or plumage and changes in coloration, where domestic animals generally show many more color variants than their wild ancestors. This is because in wild animals, the coloring is often rather inconspicuous, which allows them to hide from predators. Domestication is generally associated with the appearance of a white color, whether in full coat or the form of spots. There are, of course, exceptions, for example, in animals living in polar regions.

Another important group is physiological changes, which are related to the internal functions of the organism and the regulation of some basic physiological processes. From this group, the most significant changes are those related to reproduction. This is especially true in the more frequent repetition of estrus in domestic animals compared to wild ones. Domestic animals are often polyestrous, meaning that heat repeats at regular intervals throughout the year, while wild females tend to be monoestrous with heat only once a year.

The last group is behavioral changes, where we can include, for example, the loss of the migratory instinct or the reduction of the stress response to the presence of humans.

Now let's move on to animal breeding. As the beginning of modern animal breeding, the first breeds emerged in England in the second half of the 18th century, when the period was referred to as the Industrial and agricultural revolution. In this context, I want to mention especially Mr.

Robert Bakewell, whose name is associated with creating the Leicester sheep and Leicestershire longhorn breeds, and the Colling brothers, responsible for creating the shorthorn breed.

Another example of a well-documented breed originating in England is the Thoroughbred. In the pictures, you can see three breeding stallions at this breed's origin. Breeds are designated as thoroughbred, for which historically only purebred breeding has been used for a long time without the possibility of admixture of blood, respectively genes of other breeds. These breeds have a so-called closed stud book, which means that only an individual can be entered in the studbook, which has both parents already registered there. There is also no artificial insemination allowed used in this breed. The main selection criterion is speed, respectively racing performance.

In the previous talk, the term breed was mentioned several times, so it would be good to characterize it more precisely, as it is one of the basic terms used in animal science.

The breed is a basic taxonomic unit of animal breeding.

The breed is a specific group of domestic animals having a homogeneous appearance (phenotype), homogeneous behavior, and/or other characteristics that distinguish them from other organisms of the same species. These characteristics are genetically determined; therefore, they are passed to the progeny.

These typical (requested) traits are given by BREED STANDARD.

The formation of breeds can be done by selection and/or crossing.

Humans are usually at least minimally involved in the creation of a breed. A breed exists if people are interested in its breeding.

There are approximately 8,800 breeds of 38 different animal species worldwide. The picture shows that many breeds are currently endangered in some way, which you will hear about in more detail in the following lectures of this module.

We can classify breeds according to various criteria. Given that this module is primarily focused on genetic resources, I would like to mention the division of breeds according to the degree of breeding or, let's say, according to the influence of the conditions of the environment on the formation of a breed and how intensively a person interferes with his breeding work.

While the so-called primitive breeds arise mainly due to the adaptation of animals to certain local conditions, intensive breeding activity is necessary to obtain the characteristics of so-called cultural breeds. Thanks to intensive breeding, there is an increase in productivity and performance. However, on the contrary, the ability to adapt can decrease, and such animals are then much more demanding in breeding conditions. For economic reasons, interest in breeding high-performance breeds prevails worldwide, and less efficient breeds often become endangered. It is, therefore, true that the breeds included in the genetic resources usually belong to the breeds with less degree of breeding, the most often referred also as autochthonous, native, or local.

Currently, we have so-called intensive specialized breeds with high productivity and performance. The main tools of up-to-date breeding, which are supposed to help ensure high productivity while maintaining a good level of functional traits, are estimates of genetic parameters, breeding values and selection indices, genomic selection, or methods enabling the

shortening of the generation interval and the faster achievement of genetic gain. You will learn more about these procedures in further lectures.

On the other side are native breeds, where the goal of breeding should be to maintain their original typical traits. We can talk about conservative breeding. In the case of these breeds, high productivity is not a priority, but genetic diversity monitoring is crucial. Interest in breeding these breeds can be supported, for example, by promoting local products or subsidizing their breeders.

The table shows the status of the main species of farm animals in the world, in the European Union and in the Czech Republic. Note the different ratios of the representation of individual species in the world and Europe due to their different requirements for breeding conditions, as well as cultural traditions and possibly different religions in these regions.

Perhaps more interesting than a table with these numbers is the graph, showing a continuous decline in farm animals (especially ruminants) in the European Union. This reduction is partially compensated by the increase in productivity, which mainly concerns milk production.

Currently, the negative effects of animal production on the environment are also intensively discussed, but that would be beyond the scope of this lecture.

At this moment I would like to thank you for your attention. If you have any questions, you can use the email listed here.