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## **Difficulties in maintaining small horse breed populations, possible ways of decreasing the growth rate of inbreeding**

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### **Abstract**

Nowadays, the need for the survival and preservation of endangered breeds, including strains, genealogical lines, female families, has gained social acceptance. The primary objective within breeding conversation is to prevent genetic loss of the breed and to maintain genetic and phenotypic diversity. In simple terms: to avoid inbreeding. One of the conditions for the long-term maintenance of small breeds is to increase the population. The protection of mare families and genealogical lines is also an extremely important professional starting point. . The possibility of extending the persistence of the breed over time is helped by increasing the generation interval. In the case of endangered breeds, it is usually justified to deviate from the species-specific sex ratio when maintaining the breed, because a narrow sex ratio is beneficial for maintaining genetic diversity.

Keywords: gene preservation, livestock animals, endangered breeds

Nowadays, the need for the survival and preservation of endangered breeds, including strains, genealogical lines, female families, has gained social acceptance. A particular turning point in this respect was the Convention on Biological Diversity (CBD), adopted in Rio de Janeiro in 1992, which also emphasised the universal protection of domestic animal breeds having small populations within living systems.

The European Union has now established a financial support scheme for endangered breeds in two funding cycles (the third funding cycle is under preparation). The

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support for gene conservation in the Member States of the European Union can be seen as an integral continuation of the "Rio Convention".

Moral and financial support is a very important part of the conservation of endangered breeds, but it is not in itself the solution to saving them. The biggest challenge in maintaining a breed is to meet the professional requirements for breeding according to the rules of genetic conservation. In short, it is the preservation of genetic diversity, the genetic stock of a breed that has been left to us.

The primary objective within breeding conversation is to prevent genetic loss of the breed and to maintain genetic and phenotypic diversity. In simple terms: to avoid inbreeding. Though, avoiding inbreeding is impossible for breeds with a closed pedigree and low population, such as the Gidran, the Shagya Arabian, the Hucul, the Nonius or the Mezohegyes Half-breed, due to the very limited possibilities for immigration. However, various breeding techniques can be used to delay or slow down the increasing of inbreeding, to preserve diversity, i.e. to reduce genetic variation to an acceptable level.

There is no doubt that maintaining small breeds requires a completely different mindset and action than performance-based breeding with large numbers. This is very hard to understand and even harder to accept.

One of the conditions for the long-term maintenance of small breeds is ***to increase the population***. This makes sense, because a larger number of individuals increases the chances of selecting breeding stock candidates that are desirable in terms of utility, type and genetic value. Greater selection pressure makes real sense if selection is based on the need to meet the original use and to protect diversity at the same time. Selection should be made for all the traits that were once characteristic of the breed. In situ gene conservation, on the other hand, is about saving and preserving the existing population of the breed, which has been (partially) abandoned by the old use, while integrating the breed into the changed value system. The great challenge of gene conservation and the key issue for its survival is to find a rational use. In today's Hungarian equestrian society, the majority of people measure usefulness only in terms of success in equestrian sports, while the validity of such recognition of success for any breed under genetic conservation is questionable.

Gene conservation and new uses are professionally successful if they help to maintain the original gene combinations. In the case of the Hucul breed, the 'Hucul-path' can certainly be included, in the case of the Gidran, military can be brought into line with hunter riding, the endurance of the Shagya is certainly helped by its suitability for long-distance riding, but these cannot be exclusive.

By increasing the population, there is even some chance of increasing the essential genetic diversity. This can be explained by the fact that each offspring receives only

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half of the genetic base of the parent. If more than one offspring of an individual (or parent pair) is bred, together they may pass on all the genetic material of the ancestor who is not bred to the next generation. Offspring from the same mating may have a distant genetic make-up, thus increasing genetic diversity. However, this cannot be detected by ordinary methods, but can be detected by molecular genetic methods (e.g. by assessing allele frequencies of DNA microsatellite loci).

Accepting the truth of the above, it makes sense to increase the number of small breeds if it is possible to attract as many breeders as possible to breed the breed. There is a limit to the size of the herd that can be bred by a single breeding farm or state stud. It is not possible to keep more breeding stock than a given number (usually not very large). There is not enough stable capacity, feed resources, service staff and the financial resources available to maintain the stud are limited.

For all in situ gene bank herds (almost regardless of the number of herds), the measurement of genetic diversity is the number and strict protection of the number of *mare families and stallion genealogical lines* (in the case of the Hucul, the Shagya Arabian, the number of strains, including the genealogical lines), and the balance among them. The availability and protection of all remaining mare families and genealogical lines is an extremely important professional starting point. (Causes of gene loss include war damage, anti-horse policies, lack of professional knowledge (e.g. the export of some Shagya mare families and stallions to the West), changes in the way they are used) It is considered a professional crime if the mare families and/or the stallion genealogical lines in any gene bank herd has been eroded. In this way the identity of the breed will be lost. The protection and maintenance of every available mare families is a much more important professional task than simply increasing the number of mares. The mare families are genetic merits that carry diversity. The number of mare families is a measure of the breed's potential for genetic renewal. Breeding should not be done with the offspring of the better-producing mare families, but all possible mare families should be maintained in balanced populations (approx. with the same numbers) in a gene bank flock. Of course, this is theoretical, because even under the most careful professional supervision, the numbers of mares in a family will vary, but we must strive to maintain a balance. The size of a mare family also affects the selection pressure, because a mare family with many individuals can allow more intensive selection than a family with few broodmares.

The situation is similar with stallion genealogical lines. There are genealogical lines 'A', 'B' and 'C' in the Gidran breed, while 'A', 'B"', 'C' and 'D' in the Nonius breed. In the Hucul and in the Shagya Arabian stallion strains are distinguished, and the maintenance of several separate lines of descendants from each is justified. In other words, the genetic diversity of the stallion park is also important for protecting

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the diversity of the next generation. There is no reason, for example, to establish paternal half-siblings from a given genealogical line, unless they are surrounded by a line of other stallions belonging to the same genealogical line but not closely related to them. Otherwise, the genetic diversity of the population will decrease through their offspring. It is also not typical for breeding herds to be one-sided, with having 3-4-5 individuals from a genealogical line, whereas only one or none at all from other lines. The balanced use of stallions from different genealogical lines and strains is very important during the breeding work.

The inevitable increase in inbreeding from one generation to the next means that it is important to manage this threat over time. The possibility of extending the persistence of the breed over time is helped by *increasing the generation interval*. It cannot influence the generation-to-generation change in genetic structure, but it can push out the same genetic loss over time. In the long run, it makes a difference whether age of breeding animals is between 15-20 years when they are the parents of the next generation or it is between 5-10 years. In gene conservation, the expected breeding progress from generation to generation is not a constraint, but the preservation of diversity is. Increasing the generation interval can help to successfully maintain a breed.

The lengthening of the generation interval is particularly useful in the case of large mare families, but it is preferable to shorten it in the case of small families (to take advantage of the small but still noticeable effect of the increase in numbers on the increase in diversity, and to protect the rare mare family from disappearing by increasing the number of mares).

In all but exceptional cases, increasing the generation interval of endangered horse breeds (livestock breeds) increasing the generation interval is in the breeders' best interest.

In the case of endangered breeds, it is usually justified to deviate from the species-specific sex ratio when maintaining the breed, because a narrow sex ratio is beneficial for maintaining genetic diversity, assuming that the stallions are not related to each other and to the mated mare population. In other words, the emphasis is on diversity in the case of stallions as well. Of course, it is very difficult to resolve the contradiction between the low number of offspring per stallion and the determination of its breeding value. (This is why the former national stud farm practice was genius, where young stallions were provided for the public breeding to prove their breeding value. This is no longer a reality for small breeds.)

*Immigration* is the most important factor in delaying the growth rate of related breeding. This is possible and most fortunate with intra-breed immigration, i.e. bloodlines, but the possibility of this is very limited. In the case of the Shagya Arabian, the "bringing back" of Shagya stallions and mares from Germany, Sweden

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and Switzerland by Rombauer-Papócsi-Hecker after the foundation of the association is of great importance to this day. To a lesser extent, the Bábolna stud still does this today. The Nonius breed was also greatly helped by some breeding stock from the Ószény stud farm. Private breeders have also managed to obtain representatives of the mare families of the Mezőhegyes half-breed and Gidran, which are already extinct in our country. For many reasons, this is becoming more and more difficult for many endangered native breeds.

In the case of the Gidran (to a less extent in the case of the Mezőhegyes half-breed and the Nonius breeds), the possibility of other type of immigration is given or voluntarily offered by the type of the breed. The breed, in the first six decades of its development, was influenced by Arabic character and genetic background. Then, up to the turn of the 1900s, the English racehorse, later known as the English Thoroughbred, became increasingly important during the breeding. This is how the Gidran became an Anglo-Arabian breed, perhaps closer to the English half-breed character at the breed's peak and still is today. There is no professional misconception that the English Thoroughbred and the Arabian horse (including the Shagya Arabian, the Anglo-Arabian, and occasionally the Arabian Thoroughbred) are not considered to be strangers to the pedigree of the Gidran breed. For the other two, the English Thoroughbred can be taken into account.

It is characteristic of the half-breed horse that if from time to time there is no crossbreeding with the English Thoroughbred or the Arabian horse, signs of roughening will appear in the breed.

English Thoroughbreds were originally used to improve nobility, appearance defects and some (intrinsic) valuable traits (such as increased lung capacity and heart capacity, brighter blood temperament, better canter). Arabic was used to maintain the Anglo-Arabic character. It is no coincidence that both were regarded as improving breeds for Gidran.

Today the situation has changed. It is easy to see that both genotypes are increasingly losing their original breeding character, but their role has increased and they have become indispensable in maintenance of inbreeding. Not usually the breed, but the appropriate individual for this purpose!

All these small populations have mating difficulties. Maybe it is higher for Hucul and Gidran and maybe lower for other breeds. It is hardly possible to find mating partners that do not have common ancestors within the first three, often the first two generations. This raises not only questions of viability and reproductive biology, but above all it brings with it a major loss of diversity. As the rate of related breeding increases, so does the loss of diversity, which is the greatest obstacle to the effective maintenance of breeds that have declined to small numbers.

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If, in addition to decreasing inbreeding, an English Thoroughbred or Arab half-breed can be used for crossbreeding that not only fits the breed type but also improves performance, this will be another "benefit".

In the last decades, there are many examples of English thoroughbreds or Arabian half-breeds in traditional Hungarian breeds that have not only maintained diversity but also improved performance. It is enough to mention the names of Direktor xx, Déva xx, Királyrét xx, Kegyúr xx, Hadik xx, Razbeg xx, Naum xx, Bob Herceg xx, The Bart xx, Masetta xx, Akitos xx, Francia xx and Délibáb. The Arabians were also excellent. In Hungary earlier Gazal III, Siglavy XII, O "Bajan, Mersuch XXII, Pap ox, Visbaden ox.

In addition to the importance of the English Thoroughbred and the Arabian for the maintenance of small horse populations, it should be emphasised that their immigration does not mean that the pedigree and phenotypic individuality of the breed is abandoned. Neither of them can be used unlimitedly, because that would mean adulterating the breed. Their use should follow the old Mezőhegyes breeding philosophy, according to which after English Thoroughbreds or Arabian stallions, first of all mare offspring should be bred, and the F<sub>1</sub> stallion that can be considered as a stud stallion must be of exceptional ability.

Even this is not the end of the principle of using English Thoroughbreds and Arabian half-breeds to reduce the growth rate of inbreeding, because F<sub>1</sub> mares must be mated with sires that can be traced back to the founder stallion. It is advisable to keep the proportion of English Thoroughbreds and/or Arabian half-breeds in the gene bank herds in accordance with the principle of crosses for breeding. Constantly present, consistent target matings must be made.

It is also important to take into account that phenotype evaluation should never be carried out on F<sub>1</sub> mares. These individuals should be considered as transitional types of breeding, which are inevitable in the process of professionally correct breeding.

By breeding according to the rules of genetic conservation, by considering the possible variations, by managing the breed as a whole in a uniform way, the situation that is actually threatening can be overcome.