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Possibility and practice of action against drift in the Lipizzan horse population in Hungary

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Abstract

Modern animal husbandry has drastically changed the genetic structure of some domestic species. Many factors has negative effect on small, preserved populations, but perhaps the intensification of the genetic drift is the biggest challenge for the breeder.

In order to reduce the effects of genetic drift, breeding animal exchanges are of paramount importance, which can maintain the greatest possible genetic variation in the subpopulations of a breed and help to build the required genetic links among them. In the case of the Hungarian population, the mentioned process is exemplary on the paternal side, but cannot be considered satisfactory on the maternal side. Looking to the future, efforts should be made to import as many breeding mares as possible from the original mare families, as well as to rotate the Hungarian, Făgăraș (Fogaras) and original mare families already in Hungary.

Keywords: Lipizzan, mare families, genetic drift

Introduction

The Lipizzan is one of the horse breeds of which special historical past creates a unique situation for the current breeders of the breed. The specimens of the breed can be found in many parts of the world, but no doubt its breeding centre can be found in the territory of the successor states of the former Austro-Hungarian Monarchy. After the end of the Monarchy, breeding continued in all independent countries. The magnitude of gene flow between studs in these countries varied considerably by time and location. Therefore, the subpopulations became more and more isolated. As a result, subpopulations have emerged that are distinct in their phenotype and genotype, but in both senses the fact that they belong to the same breed is unquestionable.

ZECHNER et al. (2001) examined the body measurements of Lipizzan horses in European public studs. They found that in terms of type, the two opposite poles are represented by studs of Szilvásvár and Piber. This result can be explained by different selection aim.

ZECHNER et al. (2002) examined the genetic distance between state studs of the breed. They found,

based on the relationship of the horses of different studs that the studs can be divided into three groups. The first group includes studs of Lipica, Piber and Monterotondo. The second group consists studs of Făgăraș (Fogaras) and Bethlen. Szilvásvár, Đakovo (Diakóvár) and Topolčianky (Kistapolcsány) as representatives of the third group are located between the two extreme ones, but are genetically closer to the first group, due to a continuous gene flow.

The genetic structure of a given population can be influenced by a number of factors. Such as mutation, natural and artificial selection, immigration, emigration and drift. Each of these affects the genetic structure of a herd in different ways, e.g. influencing the frequency of genes responsible for the development of a certain trait (BODÓ, 2011; DOHY, 1999; LACY, 1987).

One of the biggest sources of danger is the genetic drift during maintenance of an endangered breed. In a panmictic population the proportion of the heterozygous allele pairs is quite high, thus ensuring the long-term survival of such a population (SZALAY and KOPPÁNY, 2017).

According to RÉDEI (1987), genetic drift is the change in random allele frequency that results from a sampling error in gametes. This means that some genes become homozygous and others drift out of the gene pool. We can talk about drift not only in the case of genes, but also in the case of individuals and even certain genotypes, which is a serious loss for a variety, so special care must be taken to prevent it (DOHY, 1999).

However, for a breed that is bred with significant numbers of individuals in several countries, its subpopulations may be quite different. Mating between subpopulations serves to prevent the differences. In the absence of such a relationship between countries, the herds become increasingly closed, and the process of drift begins, thereby increasing the genetic distance between the subpopulations (SOMOGYVÁRI, 2019).

In maintaining of endangered populations, high heterozygosity, satisfactorily large population size, narrow sex ratio, reliable artificial selection and a mating of non-related animals are favourable (SZALAY and KOPPÁNY, 2017).

The subject of our research was the study of the genetic diversity in the Hungarian Lipizzan horse population on the basis of studbook data. The aim of the research study was to identify the possible presence of genetic drift and the breeding management practices taken against it.

Evaluation effect of imported stallions and presence of mare families were also aim of the current study.

Material and methods

Several studbooks and studies were available for the processing of pedigree data, such as the Magyar Lipicai Méneskönyv I. (Mezőgazdasági Minősítő Intézet, 1988), a Magyar Lipicai Méneskönyv II. (Magyar Lipicai Lótenyésztők Országos Egyesülete, 1990), Magyar Lipicai Méneskönyv III. (Magyar Lipicai Lótenyésztők Országos Egyesülete, 2008), Magyar Lipicai Méneskönyv IV. (Magyar Lipicai Lótenyésztők Országos Egyesülete, 2013), Lipicai Ménismertető 2021 (Magyar Lipicai Lótenyésztők Országos Egyesülete, 2021). The old studbooks kept in Bábolna, Făgăraș and Szilvásvár, owned by the State Stud Farm of Szil-

vásvárad (Lipicai ménés Fogaras törzskönyv 3., 1882-1896; Lipicai ménés Fogaras törzskönyv 4., 1889-1905; Lipicai ménés Fogaras törzskönyv 5., 1885-1913; Lipicai ménés Bábolna-Szilvásvár, 1950-1975), Stutenprotokoll Volume I 1785-1880 in Mezőhegyes. Romanian studbooks (Cartea Crescatoriei Asiciatie Volomul II (2007); Cartea Crescatoriei Asiciatie Volomul IV (2016)).

Furthermore, data from Croatian stud books (ČAČIĆ and TADIĆ, 2005; ČAČIĆ, 2010; KERESTEŠ, 2008; MANDIĆ and RASTIJA, 1997) were processed.

In addition, we used the pedigree data found in the National Horse Breeding Database and in the database of the Association of Hungarian Lipizzan Horse Breeders.

As the first step of our work, we build the mare families in the Hungarian population. When making the family trees, we traced the origin of the live mares back to the founder mares. As a second step, a pedigree analysis was carried out, which gave us a real picture of the genetic composition of the Hungarian Lipizzan horse. The graphical presentation was created with Microsoft Office 365.

Results and discussion

After a long separation era, on the initiative of Szilvásvár, several foreign stallions were introduced into Hungarian breeding. Their task was to reduce the mating among closely related animals. Its diversity-enhancing effect cannot be ignored either. Stallions 4969 Maestoso Bellamira-37 (XXXIII.) and 5540 Neapolitano Trompeta III-05 (XXVIII.) came to the Hungarian breeding from Austria. From Croatia arrived 5132 Tulipan Toplica XXII-2 (VIII.) and 4574 Conversano Krabbe III-1 (XXVII.). From Slovenia, 4101 Favory Allegra XXVI (XXVIII), 3974 Neapolitano Allegra XXVI (XXV.), Pluto Steaka XVI (XXXII.) and 5450 Siglavy Samira XVIII (XVI.) came. These stallions enriched the genetic material of the domestic population, while at the same time strengthening the breed characteristics. These processes are essential to help maintain the greatest possible genetic variance that ensures the long-term survival of the breed. In addition, due to the historical origin of the breed, breeders in all countries should strive to ensure that the different subpopulations do not become genetically distant from each other and the common gene pool contains as much of the original as possible.

Figure 1 and 2 show the pedigree of domestic stallions of import sire paternity. Individuals from different countries are marked in different colours in the figures (green - Hungary, red - Austria, yellow - Slovenia, blue - Croatia, purple - Făgăraş/Dalnic (Dálnok), brown - Czechoslovakia).

3974 Neapolitano Allegra XXVI (XXV. tm)	358 Neapolitano Primavera-70	185 Neapolitano VI Presciana III 50 Primavera
	527 Allegra XXVI	461 Neapolitano Capriola V 358 Allegra XXII
	Siglavy Capriola X	Siglavy Capriola VIII 48 Pluto XXVI
253 Siglavy Capriola X-70	191 Pluto XXIX-3	Pluto XXIX 107 Neapolitano XX

Figure 1: Pedigree of 4749 Neapolitano XXV-9

5132 Tulipan Toplica XXII-2 (VIII. tm)	498 Tulipan Mara XXXVII-1	Tulipan IX-39
		364 Mara XXXVII
	735 Toplica XXII	206 Maestoso Mahonia
		451 Toplica XXI
257 Conversano XXIV-51	1946 Conversano XXIII-6 (XXIV. tm)	631 Conversano XX-11 (XXIII. tm)
		52 Favory XXI
	200 uto XXIX-18	2027 Pluto VIII Roviga (XXIX. tm)
		145 Maestoso XXIX

Figure 2: Pedigree of 6398 Tulipan VIII-27

It is clear from the figures that the ancestors include individuals from several countries. In the case of the stallion Neapolitano XXV-9, it can be said that both the stallion and its father are truly the result of mating through animal exchanges. From the 358 Neapolitano Primavera-70, which was bred by the stud of Piber and covered in Lipica, descends a son, 3974 Neapolitano Allegra XXVI (XXV.) who entered the Hungarian national stud.

In the case of 6398 Tulipan VIII-27, there are several examples of pairings achieved by animal exchange. The stallion itself is the result of such mating, and three of its four grandparents have been bred in this way. These consciously bred stallions increased the genetic diversity of the Hungarian population with a large number of their offspring, so approaching the genetic substance of the Lipizzaner breed as a whole. With the strengthening of the Hungarian civil breeding organization, in the last decade and a half, dozens of breeding mares have entered into Hungarian breeding, which have riched the genetic structure of the herd. The immigration took place mainly from the stud farm in Făgăraș, and at the same time one of the mare families in Făgăraș came to the country. In addition to the mare families in Făgăraș, original, Croatian and Slovenian mare families also appeared in Hungarian breeding. The relative proportions of these are illustrated in Figure 3.

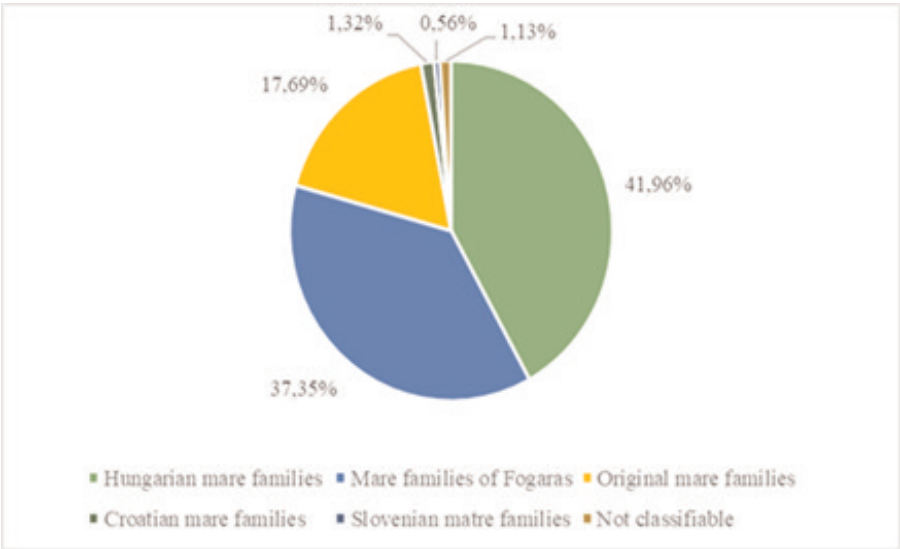


Figure 3: Distribution of mare families by origin

The mare families of Făgăraș and the mares which can be classified into them represent almost the same proportion as the Hungarian mare families. The former participates in the Hungarian population with 41.96% (446 mares) and the latter with 37.35% (397 mares). Approximately one third of the original and Croatian mare families and the only Slovenian mare family are listed in the Hungarian register. The proportion of original mare families is 17.69% (188 mares), of which 172 mares can be classified as one mare family. The proportion of mare families in Croatia and Slovenia is 1.32% (14 mares) and 0.55% (6 mares). The original Croatian and Slovenian mare families, with the exception of the Presciana/Bradamanta family, are present in numbers between 1 and 6 mares, so their numbers have little effect on the Hungarian population. We could not classify 12 individuals into any of the families. Their proportion is 1.13%.

Because of the mare families of Făgăraș's origin goes back to Mezőhegyes, the maintenance of mare families in Făgăraș is the right and obligation of the breeders of Hungary. Apart from gene conservation tasks, the mare families in Făgăraș have given many performance horses to both the World and Hungary. Figure 4 shows the pedigree of Maestoso XXXIX-14 Mithos, who has been declared the best driving horse in the world, and the other horse is, Conversano Szellő, who won first place as a member of the Hungarian team at the World Championship for Pairs in 2021.

Maestoso XXXIX	Maestoso XXXVI	Maestoso XXVIII
		134 Siglavy Capriola IV-10
	373 Conversano XX-31	Conversano XX
454 Maestoso XXXV-19		114 Tulipan VI-5
	Maestoso XXXV	Maestoso XXVII
		70 Siglavy Capriola III-5
	353 Favory XXVI-25	Favory XXVI
		179 Pluto V-1

Figure 4: Pedigree of Maestoso XXXIX-14 Mithos

The research of ZECHNER et al. (2002) is supported by Figure 4, which also illustrates the situation after the First World War. Romania has completely distanced itself from other breeding countries of the breed and has continued the breeding with no emigration and immigration. In Maestoso XXXIX-14 Mithos's pedigree, we don't find any examples of breeding animal changes, but it's worldwide success draws attention to the need for such processes, as they allow not only gene conservation work, but also individuals of outstanding value for sport to enter breeding.

4825 Conversano XXIV-40 Herceg	Conversano XXIII-6 (XXIV. tm)	Conversano XX-11 (XXIII. tm)
		52 Favory XXI
	Favory XXV-13	Favory Dubovina IV (XXV. tm)
Siglavy Capriola XXI-4 Sziszi		164 Favory XXIV-15
	Siglavy (XXI. tm)	Siglavy Capriola XIV
		434 Neapolitano XXI-64 Volga
	Incitato I-36	2056 Incitato X-35 (XII. tm)
		1 Tulipan X-77

Figure 5: Pedigree of Conversano Szellő

In contrast the origin of Maestoso XXXIX-14 Mithos, Figure 5 shows the origin of Conversano Szellő, which provides outstanding sporting performance, and at the same time is a good example of the flow of genetic material between nations. The mare's mother Siglavy Capriola XXI Sissi came to Hungary from Romania, and this mare, which mostly has a genetic background in Făgăraș, has already been fertilized in Hungary with the stallion 4825 Conversano XXIV-40 Herceg. The paternal side contains mostly Hungarian horses, but it also contains Favory Dubovina IV (XXV.), bred in Piber. The mare families No. 2 (Presciana/Bradamanta), No. 30 (502 Mozsgó Perla) and No. 32 (Almerina), which are listed as Hungarian families in many source works, but these are in a special situation in Hungary. The imported specimens of these families entered our country many generations ago, so in the case of the representatives of the families living today, the imported animals “grew” from the 4-5-6 ancestral generations.

In the domestic herd, we can find examples of the import of mares belonging to mare families of non-Hungarian origin bred in foreign countries in recent decades as well. Figure 6 shows the origin of breeding mares from such imports. The mare, 285 Thais XLVI, combining the genetic material of the state studs breeding the breed, moved to Szilvásvár. Her origin is mainly found in the Stud Farm Lipica, but it also includes the Croatian 513 Neapolitano Batosta XXI and the already mentioned Favory Dubovina IV (XXV. in Hungary). The genetic material of the mare was handed over to the foals with the Hungarian Favory XXVII and Siglavy Capriola XIV and the Conversano Krabbe III-1 (XXVII.) from Piber.

973 Neapolitano Capriola XIV	701 Neapolitano Samira XIII	Neapolitano Batosta XXXVII-54
		579 Samira XIII
	670 Capriola XIV	513 Neapolitano Batosta XXI
246 Thais XXXIX		310 Capriola V
	947 Favory Allegra XXVI	Favory Dubovina IV (XXV. in Hungary)
		527 Allegra XXVI
	881 Thais XXXII	Conversano Wera III
		Thais XXIII

Figure 6: Pedigree of 285 Thais XLVI

Conclusions

Because of the breeding animal changes, there is an exemplary gene flow in the Hungarian subpopulation of the Lipizzan breed. Stallion exchanges and purchases has great importance, and this is why many individuals have entered into the country in recent decades. Regarding our stallion park, the increasing proportion of imported stallions and/or sons of imported stallions is very significant. The repeated immigration of stallions has an effect against genetic drift, and another advantage is that the gene pool characteristic of the whole breed is moving towards completeness in the Hungarian population as well. From the mare side, imports can be approached from several perspectives. In addition to the increasing

number of mare families bred in Hungary, the blood refreshment of mares also has a diminishing effect on genetic drift. Most of the foreign-bred mares that came to Hungary can be traced back to mares from Făgăraș, which, due to their original descendancy in Mezőhegyes, they also represent a cultural and historical value in Hungary. The mare families Presciana/Bradamanta, Almerina and 502 Mozsgó Perla can be classified as original Croatian families. However, due to their breeding in Hungary for generations, they do not qualify as imports. Apart from mares classified in these families, only 33 individuals can be classified in any of the original Croatian as well as Slovenian families. This is 3.1% of the domestic mare population, which is unsatisfactory for maintaining the breed's identity. In addition to the current state, the preservation of the fullest possible genetic composition of the breed is not ensured. That is why the importation of foreign-bred breeding mares, especially those belonging to the original mares of the breed, is recommended in the future. The purchase of importing live animals and reproductive material is not typical of domestic breeding, however, in order to avoid the status described above, it should be given a prominent role in the future.

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