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MANAGEMENT OF GENETIC RESOURCES IN LIPIZZANER BREED NUCLEI AT SÂMBĂTA DE JOS AND BECLEAN STATE STUDS

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Abstract

The conservation of the Lipizzaner horse in Romania depends on breeding systems that maintain genetic variability while respecting established selection traditions. This paper analyzes the management of genetic resources in two Romanian state-owned Lipizzaner breeding nuclei, Sâmbăta de Jos and Beclean, by comparing current practices with those applied in earlier periods. The study is based on a critical synthesis of scientific literature and the examination of stud farm documentation, breeding regulations, and technological norms. Emphasis is placed on reproductive organization, the use of pedigree records, and practical measures aimed at maintaining genetic diversity. A comparative approach highlights continuities and changes in breeding objectives and management strategies over time. The findings identify strengths and operational constraints influencing population structure and long-term viability within the Romanian state stud farm system.

Key words*: breeding nuclei, conservation genetics, genetic resources management, Lipizzaner horse, state stud farms.*

INTRODUCTION

The Lipizzaner horse is one of the most emblematic European horse breeds, closely associated with cultural heritage, classical horsemanship, primarily managed within state-run breeding systems.

In Romania, Lipizzaner breeding has traditionally been concentrated in state-owned stud farms, at Sâmbăta de Jos and Beclean, where structured selection and reproduction practices have played a decisive role in shaping population structure.

The Lipizzan horse, considered a 'Baroque horse' (Zechner et al., 2002), today represents a cultural heritage.

The *Tradition of breeding Lipizzaner horses in Romania* has been included in the *National Inventory of Living Elements of Intangible Cultural Heritage.* (CIMEC, National Institute of Heritage, 2020)

The candidacy file was submitted by Romania for the Representative List of the Intangible Cultural Heritage of Humanity of UNESCO as part of a multinational file for the March 2020 session (Dell, 2020)

On December 1, 2022, Romania's National Commission for UNESCO welcomed the decision of the Intergovernmental Committee for the Safeguarding of the Intangible Cultural Heritage of Humanity, meeting in Rabat, Morocco, regarding the inscription on the Representative List of the Intangible Cultural Heritage of Humanity of the 'Traditions of breeding Lipizzaner horses' from 7 countries (Austria, Bosnia and Herzegovina, Croatia, Italy, Romania, Slovakia, Slovenia, and Hungary), where this heritage is actively and uninterruptedly preserved. (Romania's National Commission for UNESCO, 2022).

Like any other population of domestic animals, it can become endangered by acquiring a status of risk, under the influence of multiple factors, among which the most important and likely to manifest in the current period is economic inefficiency, compared to other populations under the same conditions (Drăgănescu, 1979; Grosu, 2003). Therefore, the Lipizzaner breed nuclei zootechnically managed by the National Forest Administration - Romsilva at the State Stud Farms of Sâmbăta de Jos and Beclean provide, in addition to their cultural significance, numerous other genetic, zootechnical, and scientific arguments, and necessarily constitute an object of genetic resource management.

MATERIALS AND METHODS

The study is based on an integrated methodological approach combining bibliographic analysis and documentary research. International scientific publications addressing genetic resource management and conservation genetics were reviewed, along with institutional documentation from the state stud farms of Sâmbăta de Jos and Beclean.
The period analysed in this study was 1920-2025.

RESULTS AND DISCUSSIONS

Across European state-managed Lipizzaner breeding nuclei, the relatively small and structurally controlled reproductive populations, typically comprising limited numbers of breeding stallions and broodmares, reflect a historical decline in horse populations followed by stabilization under conservation-oriented management, with current trends indicating the maintenance of moderate herd sizes and carefully balanced breeding structures to limit inbreeding while preserving genetic variability, and future expectations pointing towards continued reliance on controlled nucleus systems and coordinated international breeding strategies to sustain genetic resources (Zechner et al., 2002; FAO, 2007; FAO, 2015) (Table 1).

Table 1. European State Studs Lipizzan population statistics for 2025 (heads) (Lipizzan International Federation, 2026)

National Stud Farms	Stallions for breeding	Mares
Beclean, Romania	15	51
Djakovo, Croatia	25	69
Karadjeordjevo, Serbia	4	8
Lipica, Slovenia	29	142
Lipik, Croatia	6	37
Monterotondo, Italy	6	48
Piber, Austria	97	96
Sâmbăta de Jos, Romania	14	83
Szilvasvarad, Hungary	16	78
Topolcianky, Slovakia	10	57
Vucijak, Bosnia and Herzegovina	10	36
Total	232	705

The Romanian State Studs are managed since 2002 by the National Forestry Administration - Romsilva, and since 2019 through the National Forestry Administration - Romsilva - Horse Breeding Direction S.O.C.

Currently, the system is structured in 14 studs and 4 stallions depots, which are technically subordinate to the Horse Breeding Direction of the National Forestry Administration - Romsilva. The State Studs/Studfarms in Romania are elite farms whose role is to provide an optimal management of the genetic equine patrimony, by continuous genetic improvement of the cultural breeds, and the conservation of the vulnerable or endangered breeds of horses. The Stallion Depots are also elite farms positioned on the next lower level of the genetic improvement pyramid (Figure 1). These units are intended to multiply and transfer genetic progress achieved in the stud farms. An important aspect is that most state studs are in charge to manage the breeding stock of pure breeds with high risk status e.g. endangered (Hutsul, Gidran, Furioso North Star, Nonius) (Drăgănescu, 2003). In some cases they represent almost the entire livestock herd of pure bred in Romania. Romanian State Studs are also abiding by the breeding regulations applied at the moment of the breeds foundation, a true cultural vestige that conserves not only valuable genes but also a living old traditional breeding system. Experimental breeding practices were avoided in the State Studs. In the spirit to maintain the population close to the original gene pool, the old traditional breeding methods were also maintained (preserving the sire 'sire bloodlines' and 'mare families').
The national genetic patrimony breeding stock numbered then 1505 heads [733 breeding stallions used in public breeding system/ private horse breeders/owners, 94 breeding stallions (sires) and 678 broodmares (dams)]. The strategic policy for genetic improvement and conservation was maintained.

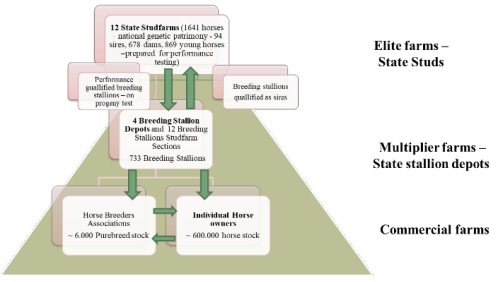

Figure 1. Horse breeding system in Romania - Genetic improvement pyramid

'Sire Bloodlines'

The small herds in the stud farms, typically comprising a maximum of 40-150 mares but with between 4 and 12 stallions, necessitated a specific breeding principle-breeding in 'bloodlines' (Drăgănescu, 1979). Thus, given the limited possibilities for exchanging breeding stock between stud farms, breeders were forced to deliberately avoid the drawbacks of inbreeding through selective breeding. Inbreeding can thus be controlled in closed populations through intra-family selection ('bloodlines'), namely by replacing each breeding animal, or at least the males, with one of their descendants (reducing the family size variance to zero) and through rotational inter-family crossbreeding, namely directing matings in such a way as to avoid close-relative matings (Drăgănescu, 1979; Drăgănescu & Grosu, 2003). The Sâmbăta de Jos and Beclean Stud Farms are not an exception to this breeding principle.

Currently, at Sâmbăta de Jos Stud Farm, seven male bloodlines are maintained at the stud farm: *Conversano*, *Favory*, *Maestoso*, *Neapolitano*, *Pluto*, *Siglavy-Capriola*, and *Tulipan*. The Pluto line was founded by the stallion Pluto I, acquired in 1936 from Atta Constantinescu's Răcăciuni estate. Another branch belonging to the same classic bloodline was imported in 1955 from Czechoslovakia through the purchase of the stallion Pluto V, born in Topolcianky.

The Siglavy-Capriola line descends from the stallion Siglavy-Capriola I, also imported from Czechoslovakia in 1930. The Conversano, Favory, Maestoso, Neapolitano, and Tulipan lines were reconstituted from the material gathered during the establishment of the State Stud at Sâmbata de Jos in 1920. The Maestoso line also has a Czechoslovak branch at Sâmbata de Jos through the stallion Maestoso XXVII, imported in 1955 (Suciu & Moldoveanu, 1975). At the same time, three broodmare daughters. At Beclean Stud Farm, eight male bloodlines are maintained farm: *Conversano*, *Favory*, *Incitato, Maestoso*, *Neapolitano*, *Pluto*, *Siglavy-Capriola*, and *Tulipan*.

Copernicus Project IC15CT96-0904

For maintaining genetic diversity within the Lipizzan breed on February 1, 1997, the International Lipizzan Federation initiated a large-scale research project at the European level - Copernicus Project IC15CT96-0904, DG 12 - CDPE, with the aim of presenting a scientific description of the phenotypic characteristics and genetic structure of the Lipizzan breed (Brem et al., 2011). In detail, the initiators of this project aimed to describe the genetic structure of the breed using DNA markers, blood group systems, polymorphic systems, morphological parameters, measurements, photographs, information regarding ancestry using pedigree records, health status, disease resistance traits, performance information, and reproductive traits (Brem et al., 2011).

The participants in this project were: the Institute for Genetics and Animal Breeding at the University of Veterinary Medicine in Vienna, the Department of Animal Husbandry at the University of Veterinary Sciences in Budapest, the Department of Animal Science at the Faculty of Biotechnology of the University of Ljubljana, the Institute for Animal Breeding at the University of Veterinary Medicine in Vienna, and the International Lipizzaner Breeders Federation (LIF). The subject of this study was the traditional breeding studs of Lipizzaner horses at Djakovo - Croatia, Lipica - Slovenia, Monterotondo - Italy, Piber - Austria, Sâmbăta de Jos and Beclean - Romania, Silvasvarad - Hungary, Topolcianky - Slovakia (Brem et al., 2011).

The arguments for the protection of the breed at the level of the European Union were as follows: the Lipizzaner breed is a pan-European breed, it also represents a cultural heritage of the continent, the scientific quality of the project, and the possibility of obtaining support from the governments of the states that manage reproduction centers of this breed (Brem et al., 2011).

The role of LIF in carrying out the project involved participation in the execution and implementation of the project: collecting information from genealogical registers on bloodlines and families, detailing the history of the breed, publishing and disseminating the results (Brem G. et al., 2011).

Among the practical aspects of this project, the following can be mentioned: describing the breed on a scientific basis and developing a target standard for this breed, developing a system to reduce inbreeding, creating a

genealogical register of the breed at the European level in a computerized system, demonstrating the genetic independence of the breed, and publishing the results (Brem et al., 2011). The study identified the existence of a 'Romanian pole' and a 'Classic pole' within the Lipizzan breed (Figure 2).

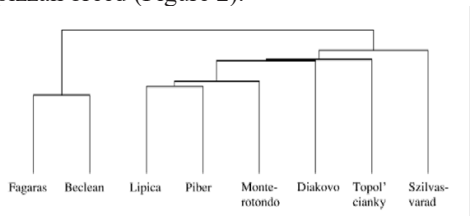

Figure 2. Dendrogram of the genetic relationships among Lipizzaner studs in Europe (Zechner et al., 2002)

The observation is based on the result of the study of the genetic relationships between the 8 important European studs in which this breed is improved. They used the algorithm, which allows the calculation of inbreeding coefficients between very large groups of individuals and obtained the matrix of the average relatedness between studs. Stud relatedness coefficients provide information about reducing the level of inbreeding by mating horses from different studs (Zechner et al., 2002).

In Romanian studs, the system of purebred breeding is applied (T. Suciu et al., 1975). The main component of a purebred improvement program is the selection plan. Since studs are actually small elite farms, consisting of 40-100 mares and 5-12 stallions, the main practical strategy for limiting inbreeding is intrafamilial selection, followed necessarily by inter-familial rotational crossing (Drăgănescu, 1979).

The application of intrafamilial selection involves going through mandatory technological stages: individualization of animals (marking by iron branding), mating control (matching of pairs), monitoring of births, recording of origin (through the genealogical register of the improved breed within the stud farm), production control (the grading operation), and expression of performance as a deviation from the family average (Drăgănescu, 1979).

The complexity and specificity of traits in the selection of purebred horses may require progressive directional selection, stabilizing selection, and regressive directional selection.

For populations whose variability and effective size are sufficiently large, progressive directional selection is most frequently applied. In stud farms that hold such populations, selection is carried out based on multiple traits simultaneously, even though the large number of traits leads to a decrease in overall selection efficiency (Drăgănescu, 1979).

Decisions regarding promotion or removal from breeding are made annually during the classification work of horses. In Romania, between 1975-2006, this was carried out based on the Instructions for the Evaluation of Breeding Horses, issued by the Ministry of Food and Agriculture, and from 2006 to the present, based on the Evaluation Criteria regarding the assessment of breeding horses, no. 894/02.11.2006 and no. 571/29.07.2008, issued by the Ministry of Agriculture and Rural Development. The main effect of selection is the change in gene and genotype frequencies in the population that is the subject of selection. This change occurs in a controlled manner and is directed in the useful direction defined within the objectives of breeding.

Marking

The individualization system accompanied by the iron branding was developed and applied according to a unitary concept after the end of the First World War, respecting the usual traditional codes established for each breed (Mărginean, 1997).

The marking tools are made of iron and reproduce in an official standard form all the specific insignia of the breed. These include letters, numbers and conventional signs.

The marking code used for the Lipizzaner breed bred at the Sâmbăta de Jos Stud Farm continued the traditional system of individualization that remains valid today: It is composed of the father's mark, the mother's mark, the stud mark, the foal number and the mare's registration number (Suciu et al., 1975) (Figure 3).

Horses must be marked only once, at weaning with the father's mark, mother's mark, stud mark, foal number. The mare registration number is applied to mares when they are promoted to the category of broodmares and receive, in the order of their entry in the herd register, the registration number (Suciu et al., 1975).

The father's mark is represented by the initial of the name of the genealogical line to which the father belongs, followed by the chronological nursery number, in Arabic numerals (Suciu et al., 1975).
The mother's mark is made up of conventional signs that represent the paternal line to which the mare belongs (Suciu et al., 1975).
The mark of the stud is represented by the initial of the name of the stud where the foal was born, regardless of the breed.
The number of foals is the order number for each offspring of a nursery stallion. It is attributed in chronological order of the date of birth to the foals, but in an uninterrupted series until the end of the father's breeding career (Suciu et al., 1975).
For the Lipizzaner breed bred in Romanian State Studs, the place of application for individualization marks in juveniles is on both sides of the body, at the place of the saddle, in the middle of an angle formed by the horizontal line that passes at a distance of 3 cm, below the spinal line and the vertical line that passes behind the thoracic angle of the back. The mother mare's matriculation number is applied to the left side of the neck, on a midline in the upper third. The father's mark and the mother's mark are applied on the left side, and the stud mark and foal number are applied on the right side (Suciu et al., 1975).

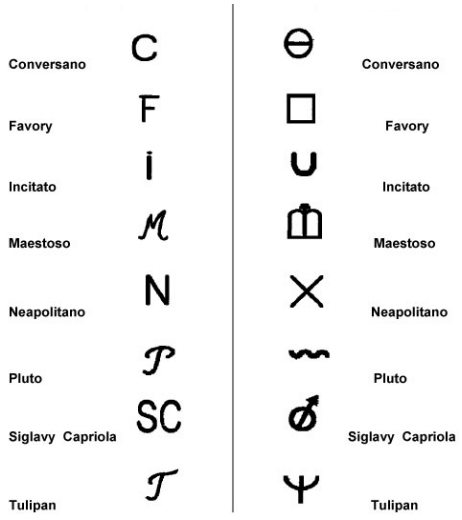

Figure 3. Conventional signs used for individualizing the Lipizzan breed by iron branding in Romania (Suciu et al., 1975)

The comparative analysis indicates continuity in fundamental breeding principles, particularly regarding line preservation and controlled mating. Differences were identified in the formalization of technological procedures across historical periods.
Parameters of genetic analysis in the population of Lipizzaner horses in Romania.
In the population of Lipizzaner horses from Sâmbăta de Jos state stud farms, in the 6.6 generations known and studied, they showed a total inbreeding of 7.12%. This resulted in an increase in homozygosity per generation of approx. 1%, a value similar to those found in other breeds of horses in Romania at that time. There were no cases of inbreeding, the observed level of inbreeding resulted primarily from the relatively high kinship itself (15% overall) of the herd (Drăgănescu & Zeneci, 1977/1978).
In two periods analyzed (1944-1953 and 1954-1963) the moderate inbreeding practiced was somewhat higher than the random one. The authors assumed possible the existence of a tendency to practice inbreeding to consolidate the existing lines and a slight tendency to subdivide the population. The actual population size, deduced from the annual increase in homozygosity, was approximative 50 individuals or 11 effective males (Drăgănescu & Zeneci, 1977/1978).
The authors concluded that the Lipizzaner bred at the Sâmbăta de Jos - Făgăraș stud farm represented a Mendelian population that has evolved relatively isolated reproductively in the last four generations and thus the name of the Romanian Lipizzaner breed is correct, reflects a reality, and the population evolves independently of other populations of Lipizzaners (Drăgănescu & Zeneci, 1977/1978).

Coat colour selection Beclean vs. Sâmbăta de Jos State Stud

From a conservation genetics perspective, the coexistence of differentiated European breeding nuclei represents a strategic advantage for long-term preservation, allowing both intra-population stability and inter-population diversity (FAO, 2007; FAO, 2015).
The identification of a distinct Romanian genetic pole supports the hypothesis of independent evolution under controlled breeding conditions and limited external influence (Zechner et al., 2002; Brem, 2011).

The Romanian Lipizzaner breeding nuclei occupy an intermediate position, combining reproductive isolation with the preservation of multiple sire lines and mare families, ensuring both genetic stability and adaptive potential (Drăgănescu, 1979; Grosu, 2003; FAO, 2013).

In Hungary (Szilvásvárad) and Slovakia (Topolčianky), breeding systems have historically allowed a higher degree of controlled genetic exchange, contributing to increased variability while preserving breed integrity (Zechner et al., 2002; Brem, 2011).

In Austria (Piber), the breeding system is characterized by a centralized structure with strong emphasis on classical sire lines and genealogical continuity (Brem, 2011). In Slovenia (Lipica), the breeding strategy remains highly conservative, focusing on maintaining the original type and genetic identity of the breed (Zechner et al., 2002).

The structure and management of Lipizzaner breeding nuclei in Romania can be better understood in the context of the broader European network of state-managed studs, including those from Austria, Slovenia, Hungary, and Slovakia, where similar conservation-oriented breeding systems have been historically maintained (Zechner et al., 2002; Brem, 2011; FAO, 2015).

Pedigree analysis remains a cornerstone of genetic management in Lipizzaner populations, providing a robust framework for tracking lineage and managing genetic relationships (Zechner et al., 2002; Brem, 2011). Despite advances in molecular tools, pedigree-based systems continue to be effective in historically structured populations (FAO, 2013; FAO, 2015).

The balance between selection and genetic diversity is a central challenge in small populations, where the effective population size is inherently limited (FAO, 2010; FAO, 2013). In Romanian Lipizzaner nuclei, this balance is achieved through rotational mating strategies and the avoidance of close-relative pairings (Drăgănescu, 1979; Grosu, 2003).

Closed breeding systems, such as those implemented at Sâmbăta de Jos and Beclean, rely on the preservation of sire lines and mare families as fundamental genetic units, ensuring both continuity and controlled variability (Suciu et al., 1975; Brem, 2011). This dual objective is critical for maintaining breed identity while preventing excessive inbreeding (Drăgănescu & Zeneci, 1977/1978; FAO, 2010).

The management of genetic resources within Lipizzaner breeding nuclei is aligned with internationally recognized principles of in situ conservation, which emphasize the maintenance of adaptive genetic variation within traditional production systems (FAO, 2007; FAO, 2015). In the Romanian context, this approach is operationalized through structured mating systems and strict pedigree control (Drăgănescu, 1979; Grosu, 2003).

From a conservation perspective, the coexistence of colour-selected and non-restricted populations enhances genetic resilience, preserving both phenotypic diversity and adaptive potential within the breed (FAO, 2010; FAO, 2015).

A comparable model is observed in the Kladruber breed, where black and grey populations are maintained in separate nuclei under strict genealogical control (Kladruby nad Labem; UNESCO Czech Heritage, 2019). This dual structure demonstrates that colour-based selection can generate stable subpopulations without compromising breed identity (FAO, 2015).

In contrast, the Sâmbăta de Jos nucleus maintains a non-restrictive selection regarding coat colour, allowing the natural predominance of grey phenotypes while conserving broader genetic variability (Nürnberg, 1993; Brem, 2011).

In the Romanian breeding system, the Beclean nucleus applies directional selection for dark coat colour, particularly black, resulting in a phenotypically uniform subpopulation. This implies controlled mating strategies that reduce the frequency of the grey allele while preserving lineage continuity (Nürnberg, 1993; Dovč et al., 2006).

Coat colour selection in Lipizzaner breeding represents a historically conditioned objective, linked to both cultural preferences and genetic mechanisms. Lipizzaners are typically born dark (black or bay), with progressive greying due to the dominant grey gene (Zechner et al., 2002; Brem, 2011).

The two breeding nuclei display complementary management approaches. Sâmbăta de Jos maintains broader phenotypic variability and a

less restrictive selection framework, while Beclean applies directional selection, particularly for coat colour, resulting in a more uniform phenotype. This dual system contributes to both stability and adaptability of the overall population.

The conservation of animal genetic resources in structured breeding systems is defined by the Food and Agriculture Organization as the management of population variability within and between populations to ensure long-term adaptability (FAO, 2007). In the case of Lipizzaner breeding nuclei from Sâmbăta de Jos and Beclean, this objective is achieved through the maintenance of closed populations combined with controlled mating strategies (Drăgănescu, 1979).

Closed breeding systems, although potentially vulnerable to inbreeding, can maintain genetic stability when supported by structured pedigree analysis and rotational mating between families (Grosu, 2003). The Romanian Lipizzaner population reflects such a model, where sire lines and mare families are preserved as fundamental genetic units (Suciu et al., 1975).

The concept of effective management of small populations emphasizes the importance of balancing selection intensity and genetic variability, particularly in elite breeding units (FAO, 2010). In Romanian state studs, the relatively small number of breeding animals necessitates strict control of mating plans to avoid the accumulation of inbreeding coefficients (Drăgănescu & Zeneci, 1977/1978).

Pedigree-based selection remains the central tool for genetic management in Lipizzaner populations, allowing breeders to trace lineage continuity and avoid close-relative matings (Zechner et al., 2002). This approach, although traditional, is still recognized as a reliable method in conservation breeding programs (FAO, 2013).

The preservation of sire lines such as *Conversano*, *Favory*, *Incitato, Maestoso*, *Neapolitano, Siglavy-Capriola, Pluto and Tulipan* ensures the continuity of historically valuable genetic traits while contributing to population structure stability (Brem, 2011). The Romanian breeding system maintains these lines in parallel, thus reducing the risk of genetic erosion.

The Copernicus Project demonstrated that European Lipizzaner populations exhibit structured genetic differentiation, with identifiable clusters such as the Romanian pole (Zechner et al., 2002). This supports the hypothesis that the Romanian population has evolved under relative reproductive isolation, maintaining distinct genetic characteristics.

The conservation of traditional breeding practices is increasingly recognized as a complementary strategy to modern genetic management, particularly in culturally significant breeds (FAO, 2015). In this context, the Romanian system represents a model of in situ conservation, where genetic resources are preserved within their historical production environment.

The integration of genealogical records, performance evaluation, and controlled reproduction ensures that selection decisions are both scientifically grounded and consistent with long-term conservation goals (R.N.P. Romsilva D.C.E.A.C. R.A.). This integrated approach is essential for maintaining both adaptive variability and breed identity.

In the context of small and historically managed populations, maintaining genetic structure stability requires the integration of both classical pedigree approaches and modern analytical frameworks, ensuring the control of inbreeding and long-term population viability (Leroy et al., 2016).

Recent pedigree-based analyses in Lipizzaner populations confirm the persistence of structured genetic clusters and support the efficiency of traditional breeding schemes in maintaining population stability (Mancin et al., 2020).

The conservation value of local breeds is not only genetic but also cultural, with traditional breeding systems representing a key component in sustaining both identity and functional diversity (Gandini & Villa, 2003).

The integration of molecular tools in conservation programs provides complementary insights to pedigree analysis, allowing a more precise characterization of genetic variability and relationships within populations (FAO, 2010).

Molecular marker studies conducted on Romanian animal populations further confirm the necessity of integrating classical and modern

approaches in genetic resource management (Socol C. T. et al., 2015).

Recent advances in molecular genetics and genomic characterization provide new perspectives for the conservation and management of small and historically valuable horse populations. Studies performed on endangered and closed populations demonstrated that pedigree analysis continues to represent an effective tool for monitoring genetic variability, founder representation and inbreeding trends, while molecular tools significantly improve the precision of population characterization and breeding management (Ablondi et al., 2018; Dell et al., 2020; Vostrá-Vydrová et al., 2016).

Current FAO recommendations emphasize that genomic characterization and cryoconservation strategies should complement traditional pedigree-based approaches in order to ensure sustainable management of animal genetic resources and preservation of long-term genetic diversity (Boettcher et al., 2022). In this context, the integration of molecular markers and genomic technologies into breeding programmes may provide valuable additional information for the conservation of structured horse populations and for optimizing mating strategies.

Emerging evidence highlighted the value of genetic markers and advanced genomic technologies in improving selection accuracy and providing a more precise assessment of genetic variability within livestock populations (Foksha et al., 2023; Davidescu et al., 2024). In conservation-oriented breeding systems, these approaches may offer important complementary support to traditional pedigree-based management of Lipizzaner breeding nuclei.

CONCLUSIONS

The management of genetic resources in Romanian Lipizzaner breeding nuclei reflects a balance between tradition and modern conservation principles.

The study confirms the existence of a distinct Romanian genetic pole within the European population.

The complementary breeding strategies applied in Sâmbăta de Jos and Beclean enhance both genetic stability and adaptive potential.

Maintaining structured breeding systems remains essential for the sustainable conservation of the breed.

The future integration of molecular genetic tools alongside pedigree-based selection may enhance the accuracy of genetic resource management and support the long-term sustainability of Lipizzaner breeding nuclei.

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