DAGENE

International Association for the Conservation of Animal Breeds
in the Danubian Region

BOOK OF ABSTRACTS

"The role of pastures and rangelands in the conservation of local breeds"

35th Annual Meeting and International Conference

of the International Association for the Conservation of
Animal Breeds in the Danube Region

Organized by

University of Zagreb Faculty of Agriculture

co-organized by

Balkan Environmental Association (B.EN.A)

Zagreb, Croatia

19–20 June 2026

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INTERNATIONAL ASSOCIATION FOR THE CONSERVATION OF ANIMAL BREEDS IN THE DANUBIAN REGION (DAGENE)

and

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Balkan Environmental Association (B.EN.A)

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35th Annual Meeting and International Conference of the International Association for the Conservation of Animal Breeds in the Danube Region

at the University of Zagreb Faculty of Agriculture in Zagreb, Croatia,
on 19–20 June 2026

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Location venue:

VI pavilion; Great Hall

University of Zagreb Faculty of Agriculture in Zagreb
Svetošimunska cesta 25, Croatia
45.8276152659585, 16.030893108152696

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Scientific programme — Friday 19 June 2026

08:45 Registration & Networking (VI pavilion; Great Hall)

09:15 Opening of Symposium

- Welcome speech (Prof. Aleksandar Mešić, dean of University of Zagreb Faculty of Agriculture)
- Welcome speech (Prof. András Gáspárdy, president of the DAGENE association)

ORAL PRESENTATION

Section 1. Chair: Jelena Ramljak

09:30 Conservation of Animal Genetic Resources in Croatia: Status, Trends and Challenges
**Ivanković A., Čačić M., Korabi N.*

09:45 The Gidran Horse as a Bridge between Genetic Value and Cultural Heritage
**Ramljak J., Kovačić B., Horvath I., Trogrlić J., Jakrlin S., Ivanković A.*

10:00 Genetic Analysis of Selected Body Measurements of Hungarian Hucul Horse Mares
*Barsi B., *Posta J.*

10:15 *In Vivo Ex Situ* and *In Situ* Gene Conservation of Indigenous Sheep and Cattle Breeds
**Hudák P., Mátyás E., Pócz D., Balázs R., Edviné Meleg E., Pálinkás-Bodzsár N.*

10:30 Meat Quality of Istrian Cattle — Physicochemical Characterization
*Šubara G., *Pećina M., Kelava Ugarković N., Šuran E., Ivanković A.*

10:45 From Tradition to Productivity: Breeding and Performance of the Native Tsigai Sheep
**Becskei Z., Gáspárdy A., Dimitrijević V., Tarić E., Kovačević S., Dominiković N., Paskaš S., Rašeta M., Bjedov S., Cekić B.*

11:00 Coffee Break

Section 2. Chair: Janos Posta

11:30 New Aspects of The History and Current Status of the Dairy Tsigai Sheep Breed in Hungary
**Vásárhelyi A.M., Lévai A., Becskei Z., Gáspárdy A.*

11:45 Lambing Distribution and Lambing Intervals in Romanov Ewes Under a Continuous Mating System
**Vlahek I., Maurić Maljković M., Piplic A., Popović N.*

12:00 Growth potential of whether lambs under extensive grazing regime
*Teyssieres J., Vásárhelyi A.M., Lévai A., *Gáspárdy A.*

12:15 Production and functional traits of the Pag sheep: An indigenous Croatian dairy breed
**Prpić Z., Kelava Ugarković N., Konjačić M., Jurković D.*

12:30 Reaffirmation of the Istrian Goat: From Historical Symbolism to Pastures
**Šubara G., Kapurlain J., Kostelić A., Ivanković A., Šuran E.*

12:45 Molecular Tools for Strengthening Breeding Programs in the Istrian Goat
**Kasap A., Ramljak J., Držaić V., Špehar M., Šubara G., Šuran E.*

13:00 Lunch time – *Faculty lobby, pavilion VI*

Section 3. Chair: Peter Chrenek

14:00 Effect of Two Factors on Goat Sperm Cryopreservation
*Bercik J., Vozaf J., Balazi A. Vasicek J., *Chrenek P.*

14:15 The Banija Spotted Pig: Current Population Status, Genetic Diversity and Prospects for Sustainable Conservation
**Škorput D., Kaić A., Karolyi D.*, Salajpal K., Luković Z., Djurkin Kušec I., Mercat M.-J., Poklukar K., Škrlep M., Čandek-Potokar M.*

14:30 Native Poultry Breeds in Croatia
**Janječić Z., Bedeković, D.*

14:45 Conservation and Management of the Carniolan Honeybee (*Apis mellifera carnica*) in Slovenia
**Žan M., Bojkovski D., Flisar T.*

15:00 Traditional Meat Products as a Tool for Valorisation and Conservation of Indigenous Livestock Breeds
**Kos I., Vnučec I.*

POSTERS Section 4. Chair: Mateja Pećina – (3 minute pitch, single slide presentation)

15:15 – 15:45

Comparative Growth Performance of Four Indigenous Bulgarian Chicken Breeds
Pavlova I., Lukanov H.

In Vivo Gene Conservation of the Hungarian Giant Rabbit
Liptói K., Váradi É., Drobnyák Á., Pálinkás-Bodzsár N., Molnár T., Benedek I., Csobán M., Eiben Cs., Végi B.

Frequency and Characteristics of Keel Bone Damage in Laying Hens of the Red Rhode Island and White Jilling Breeds
**Lazarov L., Gadzhakov D., Hristova H., Nikolov P.*

Genetic Variability of Canine Nr3c1 Gene and its Role in Glucocorticoid Signaling
Piplica A., Sušić V., Menčik S., Popović N., Ostović M., Šperanda M., Klišmanić M., Ekert Kabalin A.

Cross-Border Collaboration Research on the Migratory Behavior of Russian Sturgeon (*Acipenser gueldenstaedtii*)
Atanasoff A., Gül B., Galaţchi M., Nikolov G., Zapryanova D., Ürkü Ç.

Edible Dormouse - ´The Food of the Gods´ (*Deorum Cibus*)
Kelava Ugarković N., Konjačić M., Prpić Z.

Donkey Welfare (*Equus Asinus*) in Contemporary Husbandry Systems
Kučinac M., Baban M., Mijić P., Prlić P., Ristić T.

15:45 – 16:00 **DAGENE Board Meeting** (for DAGENE presidial members)

City tour	**18:00 – 20:00,** guided by hosts; meeting point – Ban Jelačić Square, at the equestrian statue
Social dinner	**20:00 – 22:00,** Restaurant Pivnica Medvedgrad, Ilica 49, Zagreb

Field trip programme — Saturday 20 June 2026

1) Visit to the Terezijana Exhibition in Bjelovar – Visit to the Croatian Hussar Regiment

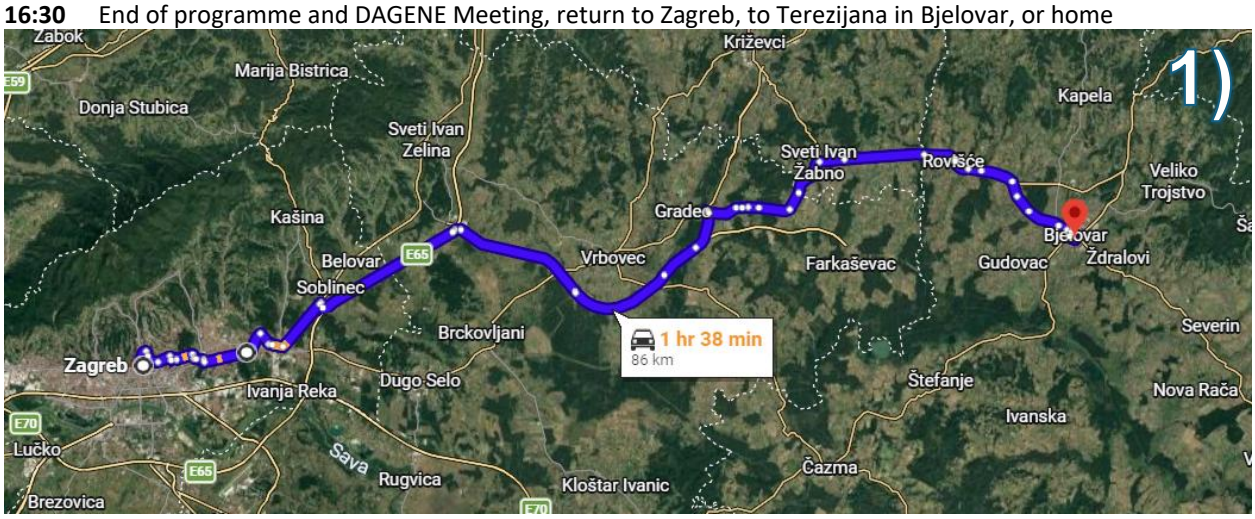
8:15 Departure from Zagreb by private cars (travel time: 1 hour 40 minutes; 86 km)
Address: City centre - Bjelovar, 43 270 Bjelovar
(45.746698235032994, 17.071795117387996)
9:45 Arrival in Bjelovar (gathering at the agreed location)
10:00 Tour of the Croatian Hussar Regiment fair with Gidran breed horses
12:00 End of the Croatian Hussar Regiment tour with Gidran breed horses

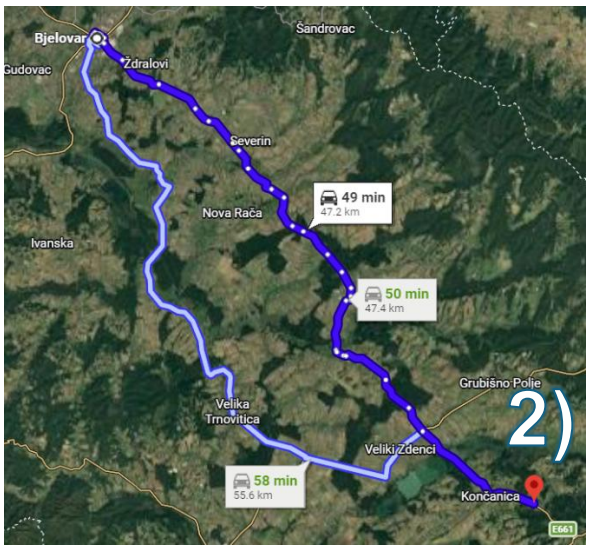
2) Visit to Buša and Croatian Posavac Breeder

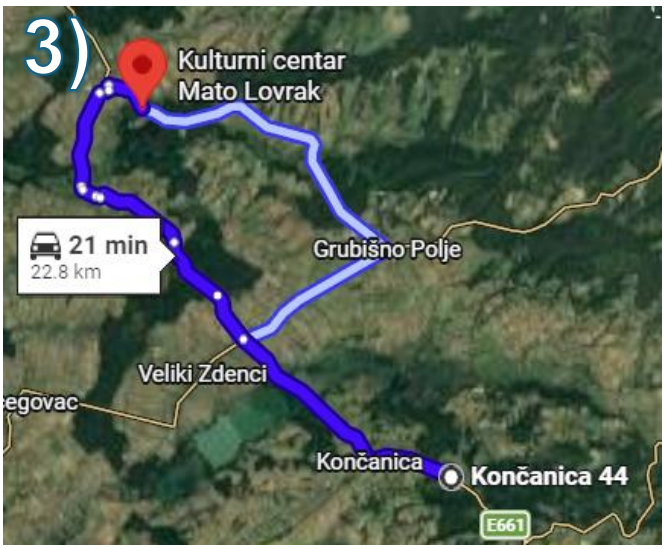
12:00 Departure by car to visit Buša and Croatian Posavac horse breeder (travel time: 50 minutes; 47 km)
Farm address: Končanica 404, 43 505 Končanica
(45.64933567083007, 17.15087005490756)
13:00 Arrival at the farm, breed presentation and conversation with the breeder
13:40 End of farm visit

3) Visit to the Mato Lovrak Museum – Lunch

13:40 Departure by car to visit the Mato Lovrak Museum (travel time: 20 minutes; 22 km)
Address: Lovrak Centre, 43 270 Veliki Grđevac
(45.746698235032994, 17.071795117387996)
14:00 Museum tour with a professional guide
15:00 Lunch at the restaurant
16:30 End of programme and DAGENE Meeting, return to Zagreb, to Terezijana in Bjelovar, or home







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CONSERVATION OF ANIMAL GENETIC RESOURCES IN CROATIA: STATUS, TRENDS AND CHALLENGES

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ABSTRACT

Croatia maintains a national programme for the conservation of indigenous and endangered domestic animal breeds, currently encompassing 37 breeds across eight species: cattle (3), pigs (3), horses (4), donkeys (3), sheep (9), goats (3), poultry (4), and dogs (7), with one native bee subspecies (*Apis mellifera carnica*). Conservation status ranges from vulnerable (buša cattle, Zagorje turkey) to endangered (Slavonian-Syrmian Podolian cattle, Turopolje pig) to critical (Međimurje horse, Northern Adriatic donkey, White Croatian goat, Dalmatian dog, and others). Population trends vary considerably by species. Positive growth has been recorded for horses (+94% for the Croatian Coldblood horse since 2016, +110% for the Croatian Posavina horse) and buša cattle (+571% since 2016), driven by consistent agri-environment subsidy schemes paying approximately 200–500 €/livestock unit. By contrast, several breeds show declining trends: the Turopolje pig (−43% since its 2021 peak), Black Slavonian pig (−49% since its 2020 peak), Hrvatica hen (−58% since 2016), and most island sheep breeds (Pag, Rab, Krk). Dog breeds monitored by the Croatian Kennel Club have shown marked population contractions since 2022–2023, particularly among hunting breeds (Istrian hounds, Posavian hound). *Ex situ* conservation is coordinated through the Gene Bank of Domestic Animals of the Republic of Croatia, which since 2013 has accumulated over 50,000 biological samples — hair (42%), tissue (32%), semen (25%), and blood (0.3%) — covering all major indigenous breeds. A National Gene Bank Network of four recognised partner institutions further supports decentralised collection and storage. DNA parentage verification is fully implemented for horses and partially for cattle, while most sheep, goat, and swine breeds still lack systematic molecular control. Key challenges include the continued decline of breeds dependent on traditional extensive farming systems, insufficient integration of DNA traceability tools across all species, and the need to translate gene bank holdings into active conservation management rather than passive archival storage. Targeted interventions — including higher subsidy rates for critically endangered breeds, mandatory parentage testing, and stronger linkage between conservation and protected designation of origin products — will be essential to secure the long-term viability of Croatia's animal genetic heritage.

Keywords: local breeds, *in situ* conservation, gene bank, trends, genetic diversity

Acknowledgement: This paper was supported by: a) the National Programme for the Conservation of Autochthonous and Endangered Breeds of Domestic Animals in the Republic of Croatia, and b) the EU PASTINNOVA project 'Innovative models for sustainable future of Mediterranean pastoral systems', financed by the Partnership for Research and Innovation in the Mediterranean Area (PRIMA) programme supported by the European Union [grant agreement number 2113].

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THE GIDRAN HORSE AS A BRIDGE BETWEEN GENETIC VALUE AND CULTURAL HERITAGE

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ABSTRACT

The population size of the Gidran horse breed is an important breeding indicator, but it is also a measure of the preservation of cultural and historical heritage. Gidran was developed as a military horse, selectively bred for endurance, obedience, and agility, which made it an integral part of military units. With the decline of the traditional military use of horses, the demand for their breeding decreased, resulting in a reduction of the population size. At the same time, the breed's role shifted from a functional to a symbolic one, while retaining its significance through cultural heritage and historical tradition. Today, the participation of Gidran horses in cultural and historical events represents a form of living heritage that enhances the breed's visibility, strengthens its social relevance, and promotes interest in breeding. However, cultural value alone is not sufficient to ensure the long-term conservation of the breed. According to FAO guidelines, population sustainability is assessed based on the number of breeding animals and the effective population size (*Ne*). Over the last decade, the *Ne* of the Gidran breed has ranged between 19 and 35, which is below the recommended threshold of 50 required for maintaining genetic diversity. Such values indicate an increased risk of genetic variability loss and rising inbreeding levels, highlighting the need for continuous monitoring and careful breeding management. The sustainability of the Gidran breed can only be ensured through the integration of traditional values, controlled breeding practices, international cooperation, and modern genetic technologies. As a breed of both biological and historical significance, the Gidran illustrates how the conservation of genetic diversity and the preservation of cultural heritage must be addressed as complementary objectives, since the loss of either would diminish its overall value and long-term sustainability.

Keywords: Gidran horse, cultural heritage, genetic resources, conservation.

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GENETIC ANALYSIS OF SELECTED BODY MEASUREMENTS OF HUNGARIAN HUCUL HORSE MARES

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ABSTRACT

In our research, the body measurement traits of Hungarian Hucul mares were evaluated. Conformation scoring of mares, along with body measurement, is carried out from the age of three. Data from 719 individuals, collected between 2002 and 2025, were included in our study, including height at withers (measured by stick and by tape), heart girth, and cannon bone circumference. The age at entry into the studbook, the year of conformation scoring, the stallion line and mare family were included as fixed effects in the analysis. Genetic parameters (heritability, genetic and phenotypic correlations) were estimated using VCE6 software. Heritability (h^2) values were above 0.7 for height at withers measured by stick and tape, as well as for heart girth size, while a lower value (0.455) was found for cannon bone circumference. The genetic correlation (r_G) between height at withers measured by stick and heart girth was 0.447, and, as expected, the highest (0.969) was observed between height at withers measured by stick and tape. The lowest phenotypic correlation (r_P) was 0.393, observed between height at withers measured by stick and cannon bone circumference, while the highest value (0.899) was also found between the two withers height measurements.

Keywords: Hucul horses, conformation, genetic parameters

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IN VIVO EX SITU AND *IN SITU* GENE CONSERVATION OF INDIGENOUS SHEEP AND CATTLE BREEDS

Péter Hudák, Enikő Mátyás, Dániel Pócz, Réka Balázs, Erika Edviné Meleg, Nóra Pálinkás-Bodzsár

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ABSTRACT

In the mid-2010s, the National Centre for Biodiversity and Gene Conservation – Institute for Farm Animal Gene Conservation initiated *in vivo* gene conservation programs in several ruminant breeds and types. These efforts were implemented through both *in situ* and *ex situ* conservation. In addition to collecting genetic samples, phenotypic data were also recorded. Population genetic analyses were applied not only to support breeding (e.g. monitoring inbreeding and genetic diversity), but also for breed classification. Among cattle breeds, the Mountain Spotted cattle, also found in Transylvania (Romania), were selected and compared with the Hungarian Spotted breed in Hungary within a population genetic framework. Another breed studied was the Carpathian Brown (Bruna de Maramureș), well established in the Carpathian region. This analysis included individuals from *in situ* populations in Székelyföld (Harghita County, Romania) as well as stocks developed in Hungary over the past two decades. Regarding sheep, we maintain the red variant of Cigaya (Red Berke) and various colour types of the Gyimesi Racka (Curkán) under both *in situ* and *ex situ* conditions. A Suta Racka population was also established for conservation purposes. Comparative genetic analysis of the Red Berke and the Kecskemét Yellow-headed sheep helped to distinguish these types. Phenotypic recording (body measurements, condition scoring, photographic documentation) and behavioural observations supported the evaluation of both external and functional traits. The resulting dataset is used not only for research, but also for education and knowledge dissemination.

Keywords: in situ, *ex situ*, behavioural characteristics

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MEAT QUALITY OF ISTRIAN CATTLE — PHYSICOCHEMICAL CHARACTERIZATION

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ABSTRACT

The Istrian cattle (*boškarin*) is one of the autochthonous cattle breeds of Croatia. Following a significant population decline during the second half of the 20th century, positive population trends have been recorded over the past three decades. The current breeding population in 2025 comprised approximately 1,700 registered cows and bulls, and including young stock, the total population reaches nearly 3,000 individuals. Over the past two decades, efforts have been made to redefine the economic programme for Istrian cattle, primarily through meat production, but also through other benefits such as breed identity, ecosystem service functions, and related values. The ongoing reaffirmation programme centres on the gastronomic positioning of Istrian beef as a premium, terroir-linked product. Understanding the physicochemical properties of Istrian beef is therefore a prerequisite for the full valorisation of this initiative. The study was conducted on 30 young bulls maintained in a traditional pasture-based cow-calf system, and from the 8th month, housed in group boxes at the cattle farm in Pazin. Diet consisted of high-quality hay supplemented with a grain mixture. At slaughter, mean live weight was 590 kg, with an average daily gain of 820 g and a net daily gain of 416 g. The dressing percentage and carcass conformation assessed by EUROP classification indicated lean, moderately muscled carcasses consistent with the morphological characteristics of the breed. Physicochemical analysis of the longissimus thoracis muscle revealed favourable meat quality parameters. The ultimate pH averaged 5.5, indicative of normal post-mortem acidification and good technological quality. Protein content averaged 23.7%, confirming the high nutritional value of boškarin beef. The findings confirm that boškarin beef is a high-quality, distinctive food product with strong potential for gastronomic repositioning as a premium, terroir-specific commodity.

Keywords: Istrian cattle, meat quality, physicochemical properties, meat terroir

Acknowledgement: This research has been fully supported by Croatian Science Foundation (Genetic, Economic and Social Interactions of Local Breed Conservation Programs, GGD LocBreed), grant number IP-2020-02-4860.

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FROM TRADITION TO PRODUCTIVITY: BREEDING AND PERFORMANCE OF THE NATIVE TSIGAI SHEEP

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ABSTRACT

Tsigai sheep, comprising two types, represent one of the 14 officially recognized native sheep breeds in the Republic of Serbia, accounting for approximately 0.3% of the total national flock of nearly 1.7 million sheep. As one of the oldest breeds in the region, Tsigai sheep are predominantly reared in the northern parts of the country. Both types—Tsigai and Chokan Tsigai—are triple-purpose breeds belonging to the long-tailed group, with a transboundary distribution across Romania, Hungary, Serbia, Slovakia, Croatia, and Bosnia and Herzegovina, etc. The aim of this study was to assess the population status and production traits of Tsigai and Chokan Tsigai sheep over a 15-year period. Data were obtained from the Annual Reports on Sheep Breeding of the two main livestock breeding organizations for the period 2010–2024. Population status and dynamics were analysed based on the number of breeding animals recorded in herd books and assessed on annual selection evaluation events. The tested production traits included fertility, adult body weight, lamb birth weight, lamb weight at 90 days (weaning), and wool yield for both Tsigai types. The results of population dynamics shows a fluctuation in numbers of breeding animals. The population dynamics for the Tsigai sheep was as follows (by years): 1549, 1757, 1304, 1367, 1830, 2054, 1713, 1549, 4302, 5580, 5613, 5161, 4362, 4097, 3786, 3353. The population dynamics of the Chokan Tsigai was as follows: 351, 724, 632, 541, 632, 510, 229, 696, 1098, 1834, 2092, 2505, 2453, 2079, 2295. The assessment of production traits over the observed period showed average fertility rates of 1.29 and 1.21, adult body weights of 75.66 kg and 66.54 kg, lamb birth weights of 4.23 kg and 3.54 kg, and weaning weights (at 90 days) of 30.26 kg and 25.17 kg for Tsigai and Chokan Tsigai, respectively. Average wool yield was 3.42 kg for Tsigai and 3.54 kg for Chokan Tsigai. Production traits were generally stable, with the greatest variability observed in body weight and the highest stability in fertility and wool yield. It can be discussed thath over the tested 15 years, the Tsigai population in Serbia ranged from approximately 1,500 to 5,000 animals recorded in the herd book, whereas the Chokan Tsigai population was more limited, varying between 200 and 2,500 registered animals. By 2024, the population comprised approximately 3,300 Tsigai and 2,300 Chokan Tsigai breeding animals under pedigree control. The results indicate that the population status of Tsigai sheep in Serbia is currently stable, largely due to

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organized breeding programs and national selection measures, supported by governmental subsidies. The governmental subsidies are as follows: 85 Euros per sheep with full pedigree, and plus 38 Euros per sheep with a full pedigree if the breed has a status of autochthonous genetic resource, 2024. Conservation programs implemented over the past two decades have contributed to the recovery of the Tsigai population, which is no longer considered at risk and financially is not treated as a genetic resource. In contrast, the Chokan Tsigai remains a vulnerable autochthonous genetic resource, requiring continued conservation efforts and targeted additional financial support measures. From the aspect of production traits, in comparison with other breeds, both Tsigai types exhibited production traits most similar to the autochthonous Sjenica sheep (the biggest population of sheep in Serbia), but lower productivity than the main imported breeds such as Württemberg and Île-de-France (the two main exotic breeds of sheep in Serbia). Overall, Tsigai sheep demonstrated moderate but stable production performance. Further improvement of both Tsigai types requires clearly defined long-term breeding objectives, continued conservation programs, and sustained governmental support.

Keywords: native sheep, Tsigai sheep, production traits.

Acknowledgement: The study was supported by the: a) Ministry of Science, Technological Development and Innovation of the Republic of Serbia (Contract number 451-03-34/2026-03/200143), and b) European Regional Development Fund (ERDF) (Grant Contract No: VEKOP-2.3.2.-16-2016-00012: 'Scientific foundation and development of the 21st century gene banking strategy of indigenous farm animal species, breeds and ecotypes in the Carpathian Basin'.

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NEW ASPECTS OF THE HISTORY AND CURRENT STATUS OF THE DAIRY TSIGAI SHEEP BREED IN HUNGARY

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ABSTRACT

The dairy-type Tsigai represents a breed variant of the Tsigai sheep indigenous to Hungary and Serbia. The origins of the dairy Tsigai can be traced back to the 19th century, when selection for milk production was emphasized in certain flocks of the historical Vojvodina region (primarily in southern Bácska and Sirmium). Breeding efforts aimed to improve dairy performance while maintaining adaptation to local environmental conditions. In Hungary, the contemporary dairy Tsigai population emerged during the final decades of the 20th century through modern breeding programs and the importation of Serbian animals. Compared to the native Tsigai, this breed is larger in body size and demonstrates a typical dairy phenotype characterized by well-developed udders and an average milk production of 150–200 litres per lactation under semi-intensive conditions. In terms of reproductive performance, the breed is characterized by relatively late sexual maturity and seasonal polyoestrous activity, while traits such as twinning ability and longevity contribute to efficient lamb production. With a breeding population of fewer than 300 ewes, the dairy Tsigai is regarded as critically endangered in Hungary. Ongoing conservation and genetic management initiatives aim to preserve the breed, while future opportunities may include applications in organic dairy farming and landscape management, thereby supporting its long-term survival and sustainable utilization. Current conservation strategies emphasize genetic surveillance and planned mating schemes. Prospective applications also involve exploiting the breed's favourable milk quality for niche dairy products and its suitability for sustainable, low-input agricultural systems. Earlier assessments of genetic diversity were based on analyses of blood groups and protein polymorphisms, which indicated moderate variability within the population; however, the restricted genetic background of the breed remains a significant issue. Subsequent molecular investigations have incorporated the analysis of STR polymorphisms. At present, research efforts are focused on characterizing the maternal lineage through the analysis of mtDNA.

Keywords: breed preservation, milking variant, genetic diversity

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LAMBING DISTRIBUTION AND LAMBING INTERVALS IN ROMANOV EWES UNDER A CONTINUOUS MATING SYSTEM

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ABSTRACT

Romanov sheep is one of the most popular meat breeds in the Danube region and the most numerous imported sheep breed in Croatia. It is considered early-maturing, prolific (producing large litters) and with reduced reproductive seasonality. While early sexual maturity and litter size are easy to measure, the extent of reproductive seasonality is not, largely because of constraints imposed by breeding schemes. The aim of this research was to assess the degree of aseasonality in Romanov sheep in a semi-intensive, accelerated lambing system with continuous matings. A dataset from one farm, comprising 267 Romanov ewes and 892 lambings, was obtained. Monthly lambing distribution was evaluated for the full dataset and after sequential exclusion of first and second lambings to account for management effects. Lambing intervals between consecutive lambings were calculated. The effects of first litter size (LS) and age at first lambing (AFL) on first lambing interval (LI) were assessed using linear models. Lambings occurred throughout the year, with a clear concentration in the winter months. Overall, 65.0% of all lambings occurred between December and March. 10.3% of lambings were recorded between August and November. This distribution was partly influenced by management practices, as all ewe lambs were first exposed to rams in early August, resulting in 82.2% of first lambings occurring during winter. After excluding first lambings, 61.3% of lambings still occurred during winter, and 54.2% after excluding both first and second lambings. Ewes that first lambed in February and March (64%) had subsequent lambings throughout all months of the year. The average LI was 239 ± 60 days. First LI was the longest (275 days), while the second was the shortest (208 days). Litter size had no significant effect ($p = 0.434$) on first LI, while AFL showed a statistically significant ($p = 0.030$) but negligible association with first LI (first LI shortens by 0.11 days for a one-day increment in AFL). Romanov ewes showed moderate aseasonality under continuous mating. Lambing intervals were shorter than one year, but a persistent winter peak indicates partial seasonal influence. LS and AFL had no meaningful influence on the first LI.

Keywords: Romanov sheep, reproductive seasonality, lambing interval, continuous mating

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GROWTH POTENTIAL OF WHETHER LAMBS UNDER EXTENSIVE GRAZING REGIME

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ABSTRACT

The year 2026 has been declared the International Year of Rangelands and Pastoralists by the FAO. To understand the exact capabilities, this study examines the growing and fattening ability of sheep under extensive conditions during the primary plant-growing season (between mid-May and mid-October). The investigation included whether lambs of Hungarian native sheep breeds with German Mutton Merino (GM) control individuals (5 per breed). After a short acclimatization, the lambs lived in a natural environment, grazing freely during the day and spending the night in a sheep barn in the area of the Körös-Maros National Park. They were not given any feed supplements. Lick salt and drinking water were always available to them. In addition to the initial and final weights of the lambs, their monthly live weights were also determined. The average daily gain was calculated by knowing the age and the weight gained per month and during the entire fattening period. To ensure reliable comparison, the values of live weight and daily gain were corrected for the assigned days of life using a linear model where the breed was considered as a fixed, and the age as a continuous variable. Data preparation and processing were done with the software Statistica (version 14, TIBCO). The effect of the age of the individuals was not significant, which means that lambs of similar age participated in the fattening period. However, differences between breeds were already evident in the initial weight (as a result of the growth during pre-weaning period and the weight at maturity): the Tsigai, Merino, White Racka and GM started the study with a significantly higher weight than the Black Racka and the Dairy Tsigai. The lambs gained weight in the first and last fattening months, but lost weight overall during the intervening three months. The extensive, pasture-based fattening showed that the acclimatization and mid-summer weight losses were regained in accordance with the compensatory capacity of the young animals. The initial difference between breeds remained in the final weight, and this is also reflected in the average daily gain during fattening.

Keywords: native sheep breeds, whether fattening, pasture-based feeding system, compensatory growth.

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PRODUCTION AND FUNCTIONAL TRAITS OF THE PAG SHEEP: AN INDIGENOUS CROATIAN DAIRY BREED

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ABSTRACT

The Pag sheep is one of the most important indigenous sheep breeds in Croatia, primarily reared for milk production intended for processing into the renowned Pag cheese. This paper aims to analyse the key production and functional traits of the breed, with particular emphasis on udder morphology and health. During an average lactation period of 152 days, Pag sheep produce on average 132.5 kg of milk, with a high milk fat content (7%, or 6.7 kg of milk fat produced per lactation) and protein content (5.9%, or 5.7 kg of proteins). In the Pag sheep, four udder types have been identified with respect to suitability for machine milking, with the majority of ewes exhibiting udder conformation suitable for machine milking. The most common is a rounded udder shape with slightly laterally positioned teats (average teat angle of 49°) that are relatively small in size. In comparison with some high-yield dairy breeds, only a small portion of the udder lies below the level of the teat base (low cistern height), which is associated with reduced milk retention at the bottom of the cistern after machine milking, and a lower need for additional hand-stripping (potentially reduced risk of mastitis). The prevalence of infected mammary glands in the studied flocks of Pag sheep was only 8.1%. An increase in udder circumference and width was associated with higher milk yield and a lower somatic cell count. In Pag sheep found to have udders with low and vertically positioned teats at the beginning of lactation, no occurrence of mastitis was recorded during lactation. Furthermore, Pag sheep that exhibited a larger udder circumference at early lactation had a lower incidence of subclinical mastitis during lactation compared to sheep with less developed udders.

Keywords: milk yield, udder morphology, machine milking, udder health, somatic cells

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REAFFIRMATION OF THE ISTRIAN GOAT: FROM HISTORICAL SYMBOLISM TO PASTURES

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ABSTRACT

The Istrian goat is one of the oldest and most culturally embedded livestock breeds of the Istrian Peninsula. Archaeological evidence points to goat husbandry as the dominant livestock activity in Istria even before the Roman period, while during the medieval period the goat served as an indispensable companion to the Istrian peasant, providing milk, meat, and hide under conditions of war, disease, and chronic food insecurity. So deeply rooted was the goat in regional identity that it has served as a heraldic symbol in the coat of arms of Istria and the Republic of Croatia to this day. Despite this historical significance, the breed was subjected to centuries of legislative suppression. The Austro-Hungarian authorities issued a decree in 1883 effectively banning goat keeping in Istria and requiring individual permits for each animal, while post-war Yugoslavia enacted laws prohibiting free-range goat rearing in 1947, reducing the practice to marginal levels for the following half-century. The cumulative effect was dramatic. Accordingly, the 2011 Green Book of Indigenous Croatian Breeds classified the Istrian goat as extinct or insufficiently known. The turning point came with the cross-border APRO project (IPA Slovenia–Croatia 2007–2013, led by the Agency for Rural Development of Istria), which confirmed the breed's continued existence and defined its morphological and genetic characteristics. The sustainable safeguard action plan was launched in 2020 by the Istrian Region. The programme combines genetic consolidation of the existing population, elimination of introgression from related breeds, continuous help and advice to protect and improve the health of the goat herd, purchase of quality breeding stock and creation of new herds and formation of new breeders, and a novel public engagement model through which individuals can symbolically adopt a goat and financially support registered breeders. The Istrian goat is today recognised not only as a living genetic reserve but also as a cultural monument — a tangible link to centuries of Istrian rural tradition, landscape management, and biodiversity conservation. The programme currently counts eleven registered breeders of the Istrian goat (average age 37 years), with the total population having grown to approximately 320 animals. This positive demographic trend demonstrates that with a well-structured and adequately supported conservation framework, the successful revitalisation of a critically endangered autochthonous breed is achievable. The Istrian goat stands as a compelling example that timely intervention, institutional commitment, and community engagement can reverse even the most acute trajectories of breed decline.

Keywords: genetic resources, Istrian goat, breed revitalisation, programme

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MOLECULAR TOOLS FOR STRENGTHENING BREEDING PROGRAMS IN THE ISTRIAN GOAT

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ABSTRACT

This study demonstrates the application of advanced molecular-genetic methods to strengthen breeding programs and ensure the long-term conservation of genetic diversity in the Istrian goat breed. A total of 214 individuals were genotyped using Illumina 60K and 84K SNP chips. Pedigree accuracy was assessed by detecting Mendelian conflicts, which revealed a 16% error rate. These were successfully corrected using *SeekParentF90* software, resulting in a verified, reconstructed pedigree. To evaluate the impact of current mating practices, the genomic inbreeding coefficient (F_{ROH}) was estimated based on runs of homozygosity (ROH). The prevalence of long ROH segments indicates a significant level of recent inbreeding, primarily attributed to the overrepresentation of specific buck lines within the population. To mitigate these trends, genetic distances between individuals were calculated using the genomic relationship matrix (GRM) as proposed by VanRaden. These results provide a robust scientific framework for optimizing mating plans by selecting the most genetically distant bucks for the female population, thereby minimizing further inbreeding and ensuring the long-term sustainability and genetic vitality of the Istrian goat population within the national breeding programme. Furthermore, these results will serve as a foundation for establishing a systematic selection program once the population size has sufficiently increased.

Keywords: Istrian goat, SNP, genomic tools, inbreeding, conservation

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EFFECT OF TWO FACTORS ON GOAT SPERM CRYOPRESERVATION

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ABSTRACT

The aim of this preliminary study was to compare the effect of two freezing techniques (programmable and manual) and two types of seminal extenders (Triladyl® and OptiXcell®) on the quality of cryopreserved goat sperm after thawing. The experiment included ejaculates from goats of the Slovak White Shorthair Goat (n = 3) and Slovak Brown Shorthair Goat (n = 2), collected during the natural reproductive period of goats. After collection, the sperm were diluted, equilibrated for two hours at 4 °C and then frozen using a programmable or manual technique. After thawing, the progressive sperm motility was mainly evaluated. The results showed that the cryopreservation process led to a decrease in sperm motility compared to fresh samples. However, the use of the OptiXcell® extender ensured significantly higher progressive sperm motility after thawing compared to the Triladyl® extender (65.38% vs. 40.06%; $p < 0.05$), for both freezing techniques. On the contrary, no statistically significant differences were found between programmable and manual freezing, indicating their comparable effectiveness (36.85% vs. 40.06%, and 57.13% vs. 65.38%). Based on the results obtained, it can be concluded that the type of extender used has a more significant impact on sperm quality after thawing than the freezing technique itself. Manual freezing has proven to be a suitable alternative to programmable freezing, especially in conditions without access to automated equipment, which may have significant practical benefits for the preservation of goat genetic resources in gene banks.

Keywords: cryopreservation, goat sperm, freezing technique, sperm motility, gene bank

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THE BANIJA SPOTTED PIG: CURRENT POPULATION STATUS, GENETIC DIVERSITY AND PROSPECTS FOR SUSTAINABLE CONSERVATION

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ABSTRACT

The Banija Spotted Pig is a Croatian indigenous breed with origins dating back to the 19th century. After a long period of decline, the population has recovered as a result of dedicated conservation efforts, culminating in the breed's official recognition in 2018. Currently, the population comprises 204 sows and 39 boars. Conservation measures have successfully stabilized the population size. Several studies have analysed the genetic diversity parameters and selection potential of the Banija Spotted Pig. Pedigree-based analyses indicate the reduced genetic diversity, classifying the breed as endangered ($Ne < 50$; $\Delta F > 1\%$). However, recent genomic analyses present a more optimistic picture, revealing a relatively favourable level of genetic diversity compared to some other local pig breeds. The breed shows high proportions of polymorphic loci, moderate to high heterozygosity, and relatively low levels of ROH-based inbreeding. Nevertheless, the shallow pedigree structure and the presence of genomic inbreeding (estimated from runs of homozygosity) highlight the need for continuous monitoring, carefully controlled mating, and greater integration of molecular information into future conservation strategies. In addition, favourable polymorphisms in genes associated with meat quality, growth, and fatness have recently been identified, opening up possibilities for selection. The available results support the development of balanced breeding goals that combine the conservation of genetic diversity with selective improvement of economically important traits, particularly meat quality.

Keywords: Banija Spotted Pig, sustainability, genetic diversity, selection

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NATIVE POULTRY BREEDS IN CROATIA

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ABSTRACT

Native poultry breeds in Croatia represent a significant genetic resource and are an important element of sustainable poultry farming. The aim of this paper to analyse available data on the breeding of Croatian native poultry breeds, from their recognition to the present day, with a special emphasis on an overview of their distribution by counties and the representation of individual breeds. The paper analyses data on breeding numbers, spatial distribution, and changes in populations for the Zagorje turkey, the Hrvatica hen, the Križevci crested hen and the Posavina crested hen. The analysis allows comparison of native breed representation across counties and the identification of areas with the greatest potential for their conservation and further development. The results obtained indicate an uneven spatial distribution of native breed breeding and highlight the need for targeted breeding and support measures at the county level. The paper contributes to a better understanding of the state of native poultry breeds in Croatia and provides a basis for future research and planning of effective conservation programmes.

Keywords: native poultry breeds, Hrvatica hen, Križevci crested hen, Posavina crested hen, Zagorje turkey

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CONSERVATION AND MANAGEMENT OF THE CARNIOLAN HONEYBEE (*Apis mellifera carnica*) IN SLOVENIA

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ABSTRACT

The Carniolan honeybee (*Apis mellifera carnica*) is an indigenous Slovenian subspecies with a long tradition and significant importance for agriculture and ecosystems. In Slovenia, it is legally protected, as only this subspecies may be bred, ensuring the preservation of its genetic integrity. It is characterised by gentleness, high productivity and adaptability, which have contributed to its global spread. Beekeeping represents a significant agricultural activity in Slovenia; more than 11,000 beekeepers manage approximately 210,000 bee colonies, evenly distributed across the country. The number of colonies and queens has increased in recent years, reflecting effective management and conservation practices. However, honey production shows considerable interannual variability, largely influenced by weather conditions, which also affect self-sufficiency. In addition to honey and other products, the primary contribution of honeybees lies in pollination, a key ecosystem service on which much of food production depends. Therefore, conservation of the Carniolan honeybee is essential for sustainable agriculture, biodiversity, and food security. This article provides an overview and analysis of the status, population trends, and conservation of the Carniolan honeybee (*Apis mellifera carnica*) in Slovenia, based on national statistical data and registry records. Particular attention is given to its spatial distribution, breeding practices, and honey production dynamics between 2010 and 2025.

Keywords: Carniolan honeybee (*Apis mellifera carnica*), beekeeping in Slovenia, honey production, pollination, ecosystem services.

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TRADITIONAL MEAT PRODUCTS AS A TOOL FOR VALORISATION AND CONSERVATION OF INDIGENOUS LIVESTOCK BREEDS

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ABSTRACT

Indigenous livestock breeds represent an important component of animal genetic resources, particularly in regions with a long tradition of pastoral and small-scale production systems. However, the sustainability of local breeds increasingly depends on their economic valorisation and integration into contemporary food markets. Traditional meat products may provide an effective pathway for preserving indigenous breeds by connecting local production systems, cultural heritage, sensory distinctiveness, and rural development. This review discusses the role of traditional dry-cured and fermented meat products in the valorisation of indigenous breeds in Croatia. Particular emphasis is placed on the relationship between breed-specific raw material characteristics, traditional processing practices and the resulting sensory identity of the final products. Indigenous breeds are often associated with specific fat composition, muscle structure, flavour intensity, and technological suitability for traditional processing methods, which may contribute to product differentiation and perceived authenticity. The paper also highlights current challenges related to standardisation, market positioning, sustainability of small-scale production and the preservation of traditional knowledge. In addition, the importance of linking scientific evidence with sensory quality, geographical identity and consumer perception is discussed as a basis for strengthening the long-term conservation of indigenous breeds through value-added meat products.

Keywords: indigenous breeds, traditional meat products, sensory quality, valorisation, animal genetic resources.

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COMPARATIVE GROWTH PERFORMANCE OF FOUR INDIGENOUS BULGARIAN CHICKEN BREEDS

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ABSTRACT

This study provides the first comparative evaluation of growth performance in four indigenous Bulgarian chicken breeds: Rhodope Painted Chicken (RPCh), Southwest Bulgarian Chicken (SWBCh), Bulgarian Longcrower (BL), and Struma Chicken (SCh). The aim of the research was to monitor and compare growth characteristics of these breeds during a 154-day rearing period. A total of 285 chicks were reared in three replicates per group and sex-separated after day 42. Body weight (BW), average daily gain, feed intake, feed conversion ratio (FCR), and European Broiler Index (EBI) were evaluated. RPCh exhibited the most intensive early growth, reaching the highest BW at 84 days (males: 1388.4 ± 117.0 g; females: 1069.8 ± 95.5 g; $p < 0.01$), with a similar tendency at 126 days. At 154 days, male BW ranged from 2256.3 g (BL) to 2637.5 g (SCh), while females showed comparable final weights from 1406.3 g (SWBCh) to 1696.7 g (SCh). Total feed intake ranged from 9150.0 g (SWBCh) to 10,427.0 g (RPCh) in males and from 7623.0 g (BL) to 8950.0 g (RPCh) in females. SCh demonstrated the most efficient feed utilization ($p < 0.01$), whereas BL and SWBCh showed the least efficiency. Observed FCR values were typical for slow-growing indigenous breeds and are not directly comparable to commercial broilers. Males exhibited higher EBI values than females across all periods. Overall, SCh and RPCh showed superior growth efficiency. These findings provide a basis for the conservation and sustainable utilization of indigenous Bulgarian chicken breeds in niche poultry production.

Keywords: Rhodope Painted Chicken, Southwest Bulgarian Chicken, Bulgarian Longcrower, Struma Chicken, feed conversion ratio

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IN VIVO GENE CONSERVATION OF THE HUNGARIAN GIANT RABBIT

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ABSTRACT

The population of the Hungarian Giant Rabbit has declined below the critical threshold, threatening the survival of the only protected native rabbit breed in Hungary. Currently, only 80 breeding does are registered in the Hungarian Giant Rabbit Breeders' Association, of which 22 are maintained at our institute. The aim of our work is the conservation of this breed through the establishment of a nucleus population and the development of *in vivo* and *in vitro* gene banks. Within the in vivo gene bank, four breeding lines have been established using eight bucks, and additional animals (25 does and 10 bucks) are kept for research purposes. Within the framework of the INTERREG HUSK/2302/1.2/018 project, the entire domestic population was surveyed. Hair samples were collected from phenotypically suitable individuals and subjected to genetic analysis. Following the optimization of DNA extraction and genetic marker analysis, 20 bucks from independent breeding stocks were selected for inclusion in the conservation program. Spermatological evaluation of the population has been initiated, alongside the adaptation of semen cryopreservation and artificial insemination techniques to support the establishment of an *in vitro* gene bank. As only limited breeding data are available for this breed, these are being continuously collected. Infrastructure improvements were needed, which included the renovation of residential buildings and an expansion of capacity by 60 cages.

Keywords: Hungarian Giant Rabbit, *in vivo* gene conservation, biodiversity

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FREQUENCY AND CHARACTERISTICS OF KEEL BONE DAMAGE IN LAYING HENS OF THE RED RHODE ISLAND AND WHITE JILLING BREEDS

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ABSTRACT

Musculoskeletal disorders are one of the major problems in industrial poultry farming. The high incidence of keel bone damage (KBD) in laying hens in industrial complexes is one of the biggest animal welfare problems facing the industry. It leads to a violation of animal welfare, causing pain, limiting their ability to move and perform species-specific behaviours. This in turn leads to a decrease in productivity and unacceptably high losses not only for the individual producer but also for the entire sector. In general, the etiological factors are reduced to three main groups: genetic predisposition, unbalanced nutrition and imperfections in the breeding systems. In our study, we compared the bone health of laying hens in their early egg-laying period, using the sternum as an indicator. For this purpose, 33-week-old Red Rhode Island (n = 126) and White Jilling (n = 78) hens were palpated. The results showed a higher percentage of sternum damage in the Red Rhode Island breed 26.19% (n = 33) compared to the White Jilling breed with 19.23% damage (n = 15). There was also a significant difference in the percentage of detected sternum fractures. In the Red Rhode Island, this was 15.07% of the birds studied, while in the White Jilling, this percentage was almost twice as low - 7.69%. In conclusion, despite the relatively young age, the birds show significant bone pathologies. However, we could conclude that the White Jilling breed is significantly more resistant to keel bone damage compared to the Red Rhode Island.

Keywords: laying hens, keel bone damage, breed predisposition.

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GENETIC VARIABILITY OF CANINE *NR3C1* GENE AND ITS ROLE IN GLUCOCORTICOID SIGNALING

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ABSTRACT

The glucocorticoid receptor is a ligand-activated transcription factor that mediates the actions of glucocorticoids and regulates genes involved in metabolism, development, inflammation, and the immune response. Glucocorticoids are lipophilic, allowing them to freely cross cell membranes and bind to glucocorticoid receptors, which, upon translocation to the nucleus, enhance or suppress transcription of target genes. The glucocorticoid receptor is encoded by the *NR3C1* gene (also known as *NR3C1α*), which has been identified in both humans and dogs. This gene is located on canine chromosome 2 and contains nine exons. The *NR3C1* gene encodes multiple glucocorticoid receptor isoforms via alternative splicing and translation, leading to diverse cellular and physiological responses. Previous studies of *NR3C1* gene polymorphisms have been conducted in the context of various human diseases, such as rheumatoid arthritis, multiple sclerosis, and an increased risk of major depression. In dogs, identified polymorphisms have been investigated in relation to immune thrombocytopenia and in clinical studies evaluating dogs' responses to steroid medications. Since glucocorticoids such as cortisol are key mediators of the hypothalamic-pituitary-adrenal (HPA) axis and play a central role in the physiological adaptation to stress, variations in the *NR3C1* gene may influence receptor sensitivity, feedback regulation, and overall stress reactivity in dogs. Investigating the occurrence of genetic variants and the relationship between *NR3C1* polymorphisms, cortisol levels, and behavioural indicators of stress may provide valuable insights into canine stress physiology and support the development of more individualized approaches to animal welfare assessment and veterinary treatment. Particular attention should be given to indigenous dog breeds, which represent unique genetic resources shaped by long-term adaptation to specific environmental conditions and management practices, and may therefore harbour distinct genetic variants associated with stress resilience and adaptive capacity.

Keywords: dogs, *NR3C1* gene, stress response, glucocorticoids, polymorphisms.

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CROSS-BORDER COLLABORATION RESEARCH ON THE MIGRATORY BEHAVIOR OF RUSSIAN STURGEON (*Acipenser gueldenstaedtii*)

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ABSTRACT

For coastal communities inhabiting the Danube Delta and the Black Sea, many of the terms such as funds, programmes and strategies related to sturgeon species may appear more abstract. However, these terms represent real projects and activities. The present Interreg NEXT Black Sea Basin Programme project, entitled "Borderless Dinosaur (*Acipenser gueldenstaedtii*) of the Black Sea (DINO-PATH)", is a paradigm of this. The Russian sturgeon conservation, a species classified as critically endangered and endemic to the region in the Black Sea is constrained by gaps in knowledge on migration routes, habitat use, and cross-border population dynamics. The DINO-PATH initiative, which was implemented by Turkey, Romania and Bulgaria, utilised a multifaceted approach that incorporated acoustic and satellite telemetry with environmental and fisheries data to facilitate comprehensive studies on migratory behaviour and habitat utilisation. Individuals who have been tagged are tracked across the Danube Delta and the Black Sea, thus generating high-resolution spatio-temporal datasets. These models have been shown to facilitate a more profound comprehension of species–environment interactions. Beyond the scientific realm, the project fosters cross-border collaboration, enhances institutional capacity, and raises public awareness, thereby promoting the responsible utilisation of marine resources and the harmonisation of conservation strategies with the EU's biodiversity objectives.

Keywords: Black Sea, Danube River, migration routes, sturgeon conservation, telemetry

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EDIBLE DORMOUSE - ´THE FOOD OF THE GODS´ (*DEORUM CIBUS*)

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ABSTRACT

The edible dormouse (*Glis glis* L.) is an indigenous game species in Croatia belonging to the rodent order. In many European countries, it is a protected species due to habitat loss caused by uncontrolled deforestation, whereas its population in Croatia remains stable. The edible dormouse inhabits deciduous and mixed forests, particularly beech and fir woodlands. It feeds on fruit, acorns, seeds, mushrooms, and insects. Dormouse hunting and meat consumption have a long-standing tradition. As far back as Roman times, dormouse meat was considered a delicacy and was referred to as the ´food of the gods´ (*deorum cibus*). The ancient Romans bred them in special enclosures within forests, as well as in purpose-made vessels (glirarium) kept inside their homes. In Croatian tradition, dormouse meat was historically consumed, and this heritage has been preserved through local events such as ´Puhijada´ (dormouse festivals) in Gorski Kotar, Istria, and on the islands of Hvar and Brač. It is prepared as a stew, deep-fried, roasted on a spit, or singed. When prepared by singeing, the fur is burned over an open flame, which imparts a distinct aroma to the meat. In the past, dormice were salted in small barrels—much like sardines are preserved today (a Mediterranean preservation method)—or preserved in lard. Highly valued throughout history as an elite delicacy, dormouse meat carries a rich cultural legacy that stretches from ancient Rome to the present. Today, this unique heritage holds great potential to be developed into an intriguing gastronomic tourism story, offering modern travellers an authentic, deeply localized culinary experience rooted in ancient tradition.

Keywords: edible dormouse (*Glis glis* L.), game meat, gastronomic heritage, culinary tourism

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DONKEY WELFARE (*EQUUS ASINUS*) IN CONTEMPORARY HUSBANDRY SYSTEMS

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ABSTRACT

The welfare of donkeys (*Equus asinus*) in contemporary husbandry systems is shaped by the interaction of biological, behavioural, and environmental factors. Their evolutionary adaptation to arid environments has led to high metabolic efficiency and specific behavioural traits that may become risk factors under modern conditions. Abundant feeding and reduced activity often result in metabolic disorders such as obesity, insulin resistance, and hyperlipemia, increasing the risk of laminitis and compromised welfare. Assessment is complicated by their stoic nature, as donkeys rarely show clear signs of pain. Therefore, traditional evaluation methods are often insufficient, requiring objective approaches based on subtle behavioural changes, body condition, and physiological indicators. Integrated assessment enables early detection and prevention of chronic disorders. Environmental conditions are also critical. Despite their perceived resilience, donkeys are sensitive to moisture and low temperatures, while poor housing increases the risk of respiratory and hoof diseases. The shift from working roles to milk production, tourism, and therapy introduces additional challenges, including reduced activity and increased stress. Improving welfare requires species-specific management and better education of owners. In conclusion, donkey welfare depends on an integrated approach combining scientific knowledge, objective assessment, and management aligned with species-specific needs.

Keywords: welfare, *Equus asinus*, metabolic disorders, husbandry systems, assessment