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Results of an expedition survey on population of rare, aboriginal, local and endangered Brown Carpathian cows

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Abstract

From the expedition survey of the cow's population, it appears that 7 breeds and genotypes of cattle are bred in Transcarpathia, part of the Ukrainian Carpathians. The materials presented in the work and their analysis show that during the years 1911-2023 there were changes in the breed composition and numbers. The state of distribution, the number of breeding stock of one of them - a rare, aboriginal, local and disappearing brown Carpathian breed is currently insufficiently studied. From a scientific point of view it represents a valuable object of preserving the biological diversity of cattle and establishing the history of the development of cattle breeding. From a practical point of view - with low-cost production technologies, it provides high-quality milk and meat to the local population, the stability of ecosystems and the biosphere as a whole. It provides also the sustainable development of the regional communities and international cooperation. In the current and future global warming and energy crisis, this breed is suitable for operation under the conditions of application of new "Green Architecture" technologies recommended by the European Commission, which fundamentally change traditional approaches in dairy farming. The results of our research will help clarify the status of the brown Carpathian breed, the number of cows and the breeding area as well as draw attention to the problems of implementation of the provided protection and conservation measures, their financing mechanisms.

Keywords: aboriginal breed, closed population, preservation of biodiversity, gene pool

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Introduction

Cattle is bred in 144 countries of the world. Unfortunately, progressive erosion of genetic diversity is observed in the vast majority of them. Therefore, the strategy of balanced economic development adopted by the conference of the international agricultural and food organization of the United Nations in 1992 gives decisive importance to the inventory, protection and reproduction of breeds of agricultural animals. It is cattle that provide the biological basis on which milk and beef production systems are built, the development of the livestock industry and rural areas of the world (FAO, 2011). To the greatest extent, in the microregion of the Upper Potyssia of the Carpathians, this applies to the brown Carpathian breed, a component of the economy and ecosystem of the Transcarpathian region of Ukraine with a population of 1250.1 thousand people, an area of 12.8 thousand km² with a specific relief structure. Natural factors in terms of hydrological, climatological parameters, soil and grass complexes are also very different here. In these conditions, animals of the brown Carpathian breed, occupying a wide amplitude of significant differences in altitude, from floodplain meadows to high-altitude meadows, feel comfortable and produce high-quality milk and beef. Thanks to their strong legs and hoofs, they can move through wetlands and climb stony paths in the mountains, the lowest grazing mark is 101 m above sea level, the highest is 1880 m above sea level. However, the breed is limited in its distribution area, localized within the borders of the region, bred in a closed population. According to the United Nations (FAO) assessment methodology, it is endangered (FAO, 2010). It is known that the main indicator of the protection and preservation of the breed of the first level in situ is the mother stock. But literary and other sources, inventory materials indicate that during the period of reforming the agrarian sector in the state, breeding farms were liquidated, the population of cows of the brown Carpathian breed is undergoing negative changes, especially in recent years it has been sharply reduced. For various reasons, negative trends do not stop, its protection and preservation are insufficient. Taking into account the multifaceted scientific and practical importance of the breed, the problem of increasing research attention, establishing territorial and numerical representation of cows arises. The task of our work was to clarify the status of the brown Carpathian breed, to obtain new data by clarifying the number of breeding stock and to assess changes and geography of distribution. In the following, these materials will provide an opportunity to correctly understand its current state, determine the optimal quantity of cows for the creation of a database and the development of a management strategy for the genetic resources of the brown Carpathian breed. The purpose of this - sustainable use, discovery of potential opportunities for protection, preservation and development in the purity of the genotype of animals in situ and ex situ, as well as establishing a tireless system of natural food production at the local and regional level in the situation of climate change and energy crisis using the technologies of "Green Architecture"

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recommended by the European Commission. The priority is climate neutrality, preservation of valuable natural complexes, landscapes and biodiversity, production of organic products (KRAVCHIK, 2021). Especially now and in the future, the industry must also be competitive, so the relative value of the brown Carpathian breed changes rapidly with the progress of knowledge and technology. In our opinion, it is necessary in the near future to find and apply tools that will avert regression and support the existing mother stock of the brown Carpathian breed and even give an incentive for its growth.

Material and methods

The object of research was the brown Carpathian breed of cattle. In the first part of the work, its status was clarified according to the new internationally recognized system of approaches in the classification of gene pool objects, "State of the world genetic resources of animals in the field of Food and Agriculture Organization" (FAO) of the United Nations (FAO, 2011) and "Program for the conservation of the gene pool of the main species of agricultural animals in Ukraine for the period until 2015" (GUZEV, 2009). Organized and conducted an expedition on the specified topic according to the developed model in three stages: preparatory, field stage and processing of collected materials, drawing up a report. At the first stage, literature, archival documents, materials of the Agency for Identification and Registration of Animals, veterinary institutions were worked out, routes were planned. During the second stage, animal owners, veterinary workers, artificial insemination technicians, shepherds were interviewed. The expedition survey covered all 3 ecological zones and 13 administrative districts of the Transcarpathian region according to the division of territories before consolidation. The inventory and dynamics of the herd of cows, quantitative ratio of breeds, geographical location in the studied territory were carried out during 2023 using the route method with the determination of the belonging of animals to the corresponding breed by phenotype (according to the standardized description of the phenotype and the protocol recommended by the FAO outlined in the publication "Phenotypic characteristics of genetic of animal resources", 2012) and recorded the number with an entry in a field diary. In conclusion stage, a comparative-analytical generalization of the obtained data was made on the background of a number of materials, including retrospective ones, statistical processing was carried out, and a report was drawn up.

Results and discussion

A comprehensive assessment of the status of gene pool objects of cattle in Transcarpathian region established that the brown Carpathian breed counts two gene

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pool objects – lowland and mountain. In terms of threats to existence, it belongs to category 1 [1], which is already on the verge of extinction, local [M] – which is bred only in one country, regional [TR] – Is present only in one region. Thus, as of the end of 2023, the brown Carpathian breed belongs to rare, local and endangered species. Counts two gene pool objects. Since ancient times, pastoralists lived in the current territory of Transcarpathia and had a lot of oxen, cows and other livestock, as evidenced by the registers of the 16th century, and they were good experts in their field. Animals gave them clothes and food, served as traction force. A cow was considered a measure of wealth. The family craft was passed down from generation to generation and this affected the mentality of the local people, their culture and socio-economic organization. Undoubtedly, one-person farming has become the most widespread. The facts confirm that, according to official documents, back in 1895 there were 250.8 thousand heads of cattle. In the calculation, there were 51 heads per 100 people. Improvement of imported animals begins, breeding work is carried out. In 1903, on the basis of the estate of Count SCHÖNBORN, a state breeding farm for Carpathian grey (in the future Carpathian brown) cattle was organized and mating stations were established in the villages. These initiatives carried out had a positive effect on the growth of the productivity of cows. It became profitable to engage in dairy farming, and already since 1911 there has been a positive trend in the growth of farms that kept cows, including animals of a new genotype, which is indicated by data per 100 farms (IRENEY et al., 1925), Table 1.

Table 1. Growth dynamics of farms that kept cattle in the years 1911-1933 per 100 farms (%)

Sex-age groups	**Years**		
	1911	**1925**	**1933**
Cows	43.7	48.4	53.6
Oxen and bulls	30.5	24.9	19.5
Growers	25.8	26.7	26.9

Over the course of 22 years, the number of farms that kept cows (per 100 farms) increased by 22.7%. But there were also unfavourable periods. For example, the World War I led to the decline of the industry. By the end of 1916, only in the Uzhan Committee, the number of cattle decreased by 32% compared to 1914. In the post-war years, the polonynska economy developed widely, which gave a new impetus to development. Thus, in 1933, 23,300 heads of mainly grey Carpathian cattle, including 4,130 cows, were grazed on the subalpine and alpine meadows from May 15 to June 1 and until September 21, depending on the polonyna and weather. On pastures located along the Teresva River, 14 cows were grazed for every 100 head of cattle, 61 on the Tysa. One shepherd served 14 cows or 28 oxen. A total of 137 large oxen farms operated. The herding of animals for grazing was accompanied by celebrations and ceremonies. V. GOSNEDL (1936) reported on the breeding of 68.7% Carpathian grey cattle, 15% Grey steppe cattle, 12.2% Pinzgau and 4.1%

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Simmental cattle. During the World War II, population degradation took place again. 78,300 heads of grey Carpathian, Simmental, Grey steppe and Pinzgau cattle were exported to Germany alone. After the end of the war, the situation gradually stabilized and acquired positive dynamics. The herd increased sharply, taking into account purebred brown Carpathian animals. Statistical data on the quantitative and breed composition are given in Table 2. It should be added that in 1948 the State Breeding Book of Brown Carpathian Cattle was published.

Table 2. Changes in the number of brown Carpathian cattle and their specific weight to all breeding cattle in the Transcarpathian region for the years 1950-1968

Genotypes	**Years**		
	1950	**1959**	**1968**
Total brown Carpathian cattle, heads x1000	17.6	89.5	136.3
Specific weight of all breeding cattle, %	81.0	86.0	99.0

In the specified period (Table 2) the number of animals increased rapidly (7.7 times) and the specific weight of purebred brown Carpathian cattle increased by 18% to all available purebred cattle. This phenomenal breed is a genotype on which scientists and practitioners worked in the last century and many years of breeding "in itself" formed the original gene pool. Let's dwell on the most characteristic features. A mature cow is entered in the 8th volume of the State studbook of brown Carpathian cattle, dark and light brown colour, nose mirror dark with a mandatory light ring, live weight 485 kg, and height at the withers 133 cm. It presents milk-meat type with strongly emphasized indicators: weight 5680 kg, fat 3.72%, average daily fattening gain 800 g. It has a harmonious body structure, a well-developed udder, strong limbs and hoof horn, the possibility of increasing the milk yield of high-quality, improves the feedlots (Gosplemkniga, Vol. 8, 1992). Resistant to diseases and parasites. Maintains live weight for a certain time when faced with seasonal stresses caused by interruptions in feeding, has a high reproductive capacity, a long period of productive use. Milk and beef have high nutritional and technological properties. The breed is an important element of local farming culture, a historical heritage, adapted to local soil and climatic conditions, etc. The best specimens of the breed were presented at state and regional exhibitions. It should be noted that in the 90s of the last century, the largest share of income in the agriculture of the Transcarpathia region came from animal husbandry, including the sale of live breeding and improved young animals within the local and national markets. In the studied territory, the specific weight of animal husbandry in the produced gross agricultural products was 51.3% in monetary terms, while cattle breeding accounted for 89.1% in the structure of the industry's gross products. A favourable factor for keeping cattle is the abundance of types of grass cover on an area of more than 200,000 hectares of natural meadows and pastures. However, during the time that has passed since the radical reformation

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of property and land ownership relations, in accordance with the laws of Ukraine "On Business Societies", "On Rural (Farm) Economy", "On Entrepreneurship", a price disparity has arisen for industrial, crop and livestock products and shift occurred to the development of crop production. The collapse of the livestock industry caused a decline in milk production with a shortage of milk and milk products, covering the region's need by 63.8% (TERPAY, 2021). In addition, the low interest of investors in the agrarian sector for development of cattle breeding was found out. As a result, the number of farms of various forms of ownership and the total number of cows decreased significantly from 141,500 to 42,034 in 2023, or by 3.4 times, Table 3.

Table 3. Dynamics of the cow population in Transcarpathia oblast for 1990 and 2023, farms of all forms of ownership

Eco zones	Districts	Quantity, headsx1000, years			Per 100 ha of agric. land		
		1990	2023	fold	1990	2023	fold
Moun-tains	Volovetskyi	6.8	2.0	3.4	40.0	11.8	3,4
	V.Bereznyansk.	7.0	1.8	3.9	38.9	10.0	3,9
	Mizhhirskyi	10.2	6.6	1.5	32.5	21.0	1,5
	Perechynskyi	5.3	1.3	4.1	31.2	7.6	4,1
	Rakhivskyi	9.8	5.9	1.7	29.5	17.8	1,7
	Svaliavskyi	5.8	1.4	4.1	37.4	9.0	4,2
In the mountainous area		44.9	19.0	2.4	34.0	14.4	2.4
Pre-moun-tains	Irshavskyi	12.0	2.6	4.6	33.5	7.3	4,6
	Tiachivskyi	18.6	5.4	3.4	35.1	10.2	3,4
	Khustskyi	13.8	6.0	2.3	36.4	15.8	2,3
In the foothill zone		44.4	14.0	3.2	35.0	11.0	3.2
Low-lands	Berehivskyi	10.7	1.5	7.1	23.0	3.2	7,2
	Vynogradivsk.	13.0	2.6	5.0	28.3	5.7	5,0
	Mukachivskyi	16.4	3.3	5.0	28.8	5.8	5,0
	Uzhhorodskyi	12.1	1.6	7.6	24.5	3.2	7,7
In the lowland zone		52.2	9.0	5.8	26.3	4.5	5.8
In the region		141.5	42.0	3.4	30.9	9.2	3.4

The reduction applies to all three ecological zones, 13 administrative districts and 561 rural settlements. The changes did not take place evenly. As for the ecological zones, the greatest decline occurred in the lowland – by 43.2 thousand cows or 5.8 times, the lowest in the mountain – 2.4 times. Both in absolute values and in percentage calculation, in particular, Tiachivskyi, Mukachivskyi, Uzhhorodskyi, Irshavskyi and Berehivskyi districts decreased by 13.2 – 9.2 thousand heads, in percentage Uzhhorodskyi by 7.6, Berehivskyi by 7.1 times. It should be noted that the lowest number of cows is kept in the lowland ecological zone – 9,000 heads, Perechynskyi – 1130, Berehivskyi – 1136, Svalyavskyi – 1167 heads, separate settlements. Thus, the author found that in the village of Runia and Dibrova of

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Tiachivskyi district, with a population of 678 and 440 men, there are 5 and 3 cows, respectively, in the village of Glyniany, where 301 people live, none. It is also necessary to assess the low volume of livestock per 100 hectares of agricultural land. With average indicators in the region of 9.2 cows, again, there is only 4.5 heads in the lowland ecological zone, 3.2 each in the Berehivskyi and Uzhhorodskyi districts. The situation is a little better in Vynogradivskyi – 5.7, Mukachivskyi district – 5.8 cows. Dispersion is observed, on average there are 23.4 heads for one farm, and 1.01 heads for individual farms, in which dairy farming is not the main source of income. Although the specific weight of cows kept in the latter, as of January 1, 2023, is 96.8% and in enterprises of various forms of ownership 3.2%. As a result of a sharp reduction in the number of cows and young cattle of different sex and age groups, many owners of hayfields have nowhere to put the hay harvested from them and burn it en masse, harming the microbiota and the environment, Figure 1.

Figure 1. Burns after burning mowed, dried and collected grass in natural hayfields and even areas of sown perennial grasses.

At the same time, first of all, it should be noted that the region is rich in natural hay meadows, and this industry affects the level of employment of the population, food supply, ecological and social criteria, and is a source of organic matter. Farms of all organizational forms use a mixed system of maintenance: on self-grown forage and pastures, the purchase of concentrates outside the region; manual milking, in a small part of individual farms – machine milking, controlled manual pairing and artificial insemination. Repairs instead of lost cows are carried out at the expense of raised own heifers. The production of milk and meat is only partially oriented to the local

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market. Summarizing the above indicators, we note that cattle have played an important role in the life of the local population since ancient times. Since the reform of the agrarian sector of the economy in the 1990s, the total number of cows in Transcarpathia region has decreased by 3.4 times. The vast majority of cows are kept in individual farms to provide livestock products for their own needs and for small sales to neighbours and local markets. Geographical distribution of brown Carpathian and other breeds, quantitative ratio, were studied on the territory of Transcarpathia. We recorded quite high breed heterogeneity and diversity, breeding of 7 different specialized and combined breeds and genotypes of cattle. It should be noted that they underwent constant changes in the place of distribution, ratio and number, which can be traced in the statistical indicators of occurrence. The presence and predominance of individuals of the brown Carpathian breed with different levels of variation in all ecological zones and over the region is shown in Table 4.

Table 4. Representation of breeds and genotypes by ecological zones and by region

Breeds and genotypes	**Ecological zones**			
	Mountains	**Foothills**	**Lowland**	**Presence in region, %**
Brown Carpathian	+	+	+	86
Simmental	+	+	+	2.8
Ukrainian brown/dairy	few animals	crossed	+	8.3
Ukrainian red/dairy	few animals	crossed	+	1.3
Holstein	-	-	+	0.4
Aberdeen Angus	-	-	+	0.3
Hungarian Grey	-	-	+	0.9

The heterogeneity of the breeds varies depending on the location of the zone relative to the height above sea level. Indicatively, the high saturation of local cattle cows with a small proportion of Simmental cattle is characteristic of the mountainous area. This is explained by the harsher environmental conditions to which it has adapted well due to its endurance, optimal size and weight of adult animals, short legs, the ability to overcome long distances on a rocky surface, resistance and strength constitution The criterion of functional characteristics is that it can withstand heat, which is very important in times of global warming. To understand the problem, in Holstein animals heat stress begins at an air temperature of +22 C°, at +28 C° it becomes critical, while the brown Carpathian feels only minor discomfort. In addition, according to the Federation of Brown Breeds of Europe, brown cattle cause less emissions of greenhouse gases per unit of produced protein.

The allelic frequency of the kappa casein B variant obtained by genotyping (63.8% BB and 32.6 AB). Beta casein is 30% of milk protein. The difference in the yield of

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hard cheese brown French – Holstein + 13% in favour of the first. The fat/protein ratio is between 1.15 and 1.23 (Brown Swiss News, 2020, 2021, 2022, and 2023). Although brown Carpathian cattle predominate on the plain, the percentage is no more than 67.7% with the presence of all available breeds and genotypes in the region. The foothills occupy intermediate positions. Despite the fact that the regions have a similar breed composition in our day, they are distinguished by their specificity and difference in the percentage ratio between them. Specialized factory breeds and types imported in different ways turned out to be biologically unstable. The ecological conditions of breeding differ sharply from their needs, accordingly, health, productivity, quality of products are deteriorated and the population is insignificant, accordingly, the specific weight in the total share is 11.2 percent. The negative influence of this factor is observed. Thus, the brown Carpathian breed of cattle is one full-fledged representative in the studied territory and corresponds to the main regularity, which consists in the differentiation of relationships in the system of cattle breeding – ecology – climate – plant – animal breed. The assessment of the presence of breeds and the population of cows of the brown Carpathian breed, which has been well adapted to the conditions of Transcarpathia for over 100 years, reflects the degree of threats to it. In particular, the introduction of new diseases, uncontrolled crossbreeding of imported breeds with local livestock violates its genetic purity and stability. Anticipating such a situation, far-sighted Carpathian scientists and breeders in the 70s and 80s of the last century performed exclusively breeding the Carpathian brown, which, starting from the 90s of the specified century, has been destroyed under the influence of various factors, Table 5.

Table 5. Dynamics of the breed composition of cows in the Transcarpathian region since the official existence of the grey bay Carpathian (GC) in the subsequent brown Carpathian (BC) breed, thousands of heads, %

Breeds	**1911**	**1937**	**1980**	**1990**	**2023**
	Heads (%)	**Heads (%)**	**Heads (%)**	**Heads (%)**	**Heads (%)**
GC and BC	45.0 (22.5)	76.8 (70.5)	138.5 (97.6)	110.8 (78.3)	36.1 (86.0)
Others	155.0 (77.5)	32.1 (29.5)	3.4 (2.4)	30.7 (21.7)	5.9 (14.0)
Total	200.0 (100)	108.9 (100)	141.9 (100)	141.5 (100)	42.0 (100)

In particular, in 1992 alone, 16,200 cows and 12,000 beef cows and heifers were inseminated with the semen of Holstein bulls. Through barter operations, more than 4,000 different Holstein genotypes, mainly commercial heifers, were purchased directly by farms from Hungary. Inbred depression acquires special relevance in a territorially and numerically limited breed. The real pressure of which can be avoided by rethinking traditional approaches to breeding, maintaining the optimal number of breeding stock of the brown Carpathian breed, today classified as a breed that is preserved and protected by various international and state documents of Ukraine. At the same time, it should be noted that the research of the last decade has changed the above representations. Using various sources of information and the results of own

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research, in 2023 it was established that the structural share in the spectrum of breeds by specific gravity increased significantly in favour of the local one, which is not found anywhere else in the state. For example, if in 2013 the specific weight of cows of the brown Carpathian breed was 78.6 percent, then in 2023 it was 86.0 percent. Summarizing the above, we note that the indicators for 2023 characterize Transcarpathia as the main centre of breeding and distribution of genetic resources of the brown Carpathian breed, which indicates the significant importance of the region in the development and preservation of its gene pool, and the determining importance of the breed in its sustainable development. Due to its biological characteristics, the brown Carpathian breed has occupied and still occupies dominant positions in terms of number and specific weight, almost since the time of breeding. However, the processing of research results, the total assessment by all methods revealed the process of a rather significant narrowing of brown Carpathian cows in 2023 to 36,100 heads. At the same time, accelerating the pace of livestock limitation may lead to a change in the evolutionarily formed ecological balance, especially in the highlands, and the loss of alpine and subalpine meadows, unique for Ukraine, where these animals were grazed. STOYKO et al. (1982) emphasize that there is already a gradual change of grassy vegetation to tree-shrub vegetation, which leads to a reduction in their area. This can be prevented by stabilization of the population of the Carpathian brown breed, which is tolerant to the extreme conditions of the Carpathians, accurate information about the current condition, constant monitoring, deepening of research and restoration of traditional management of polonyna farming. In addition, brown Carpathian cattle adapt to various systems of production and maintenance, are an important resource that determines the possibilities of further socio-economic and ecological development of the region using modern technologies of "Green Architecture" recommended by the European Commission. At the same time, valuable organic fertilizer is obtained from the animals, which is so necessary for the poor soils of Transcarpathia. Below we present the absolute values, the specific area of territorial distribution and the specific weight of the herd of cows of the brown Carpathian breed in the section of ecological zones, administrative districts and individual settlements according to the results of the expedition survey in 2023, Table 6.

The results presented in the paper and the comparative quantitative analysis, as can be seen from Table 6, show that the distribution of ecological zones, administrative districts by the number and specific weight of the breed is significantly different, and distinguished by a significant uneven distribution of livestock territorially. At the time of the study, the mountainous zone was noted to have the largest number of brown Carpathian cows - 18,200 cows. Among the districts Mizhhirskyi – 6.4, Khustskyi – 5.9 and Rakhivskyi – 5.8 thousand heads, where the maximum number is. Instead, the opposite trend, the presence of a noticeable negative impact, which is expressed in the intensive reduction of the number of cows, breeding of other breeds,

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Table 6. The total number of cows and the brown Carpathian (BC) breed and its specific weight in the section of ecological zones and administrative districts of the Transcarpathian region as of the end of 2023

Eco zones	Districts	Quantity, thousands of heads		
		Total	BC	% BC
Moun-tains	Volovetskyi	2.0	1.8	90.0
	V.Bereznianskyi	1.8	1.7	94.4
	Mizhhirskyi	6.6	6.4	96.9
	Perechynskyi	1.3	1.2	92.3
	Rakhivskyi	5.9	5.8	98.3
	Svaliavskyi	1.4	1.3	92.9
In the mountainous zone		19,0	18.2	95.8
Pre-moun-tains	Irshavskyi	2.6	2.5	96.2
	Tiachivskyi	5.4	3.4	63.0
	Khustskyi	6.0	5.9	98.3
In the foothill zone		14,0	11.8	84.3
Low-lands	Berehivskyi	1.5	1.1	73.3
	Vynogradivsk.	2.6	1.7	65.4
	Mukachivskyi	3.3	2.3	69.7
	Uzhhorodskyi	1.6	1.0	62.5
In the lowland zone		9.0	6.1	67.7
In the region		42.0	36.1	86.0

absorption crossbreeding with Holstein, unsystematic use in the reproduction of home-bred bulls (TERPAY, 2013) caused a critical situation in the lowland areas, since here there are 6.1 thousand of cows. The lowest number of cows here is also connected with the high ploughing of the land. Going back to the data and comparing the results in other districts we see close values. A small number of cows were noted in the Perechynskyi, Berehivskyi and Uzhgorodskyi districts, 1.2 – 1.0 thousand each, while in Mizhhirskyi it was almost 6 times more, as many as 6.4 thousand heads. Uzhgorodskyi district has about half the population of neighbouring Mukachivskyi district. Tyachivskyi, the largest in terms of population, keeps 3,400 cows. In terms of saturation, again, the primacy is in the mountainous ecological zone – 95.8%, Rakhivskyi – 98.3% and Mizhhirskyi districts – 96.9%. Diametrically opposite indicators are in the lowland ecological zone – 67.7%, in the Uzhgorodskyi district – 62.5%. The average level of specific weight is characteristic of the foothill zone with a slight fluctuation of the indicator. Its almost exclusive presence is observed in the examined settlements of Rakhiv district: Vyshka – 90, Kniahynia – 39, Velyko-Bereznianskyi, Luhy – 138, Trostianets – 12, Strymba – 129 cows. Unique centers of breeding are villages Bohdan – 281, Yasinia – 547 of the Rakhivskyi district. The same number of cows are in the villages of Ruske Pole – 92, Vilkhivtsi – 96, Lazy – 147, Bedevlia – 133 of the Tyachivskyi district. Similar values are found in the villages of Horinchevo – 103, Berezovo – 155, Dragovo –

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87, Nankovo – 104 cows in Khustskyi district. Strengthens its position in terms of the number of cows in the herds of the villages of Tyshiv – 59, Bilasovytsia – 65 of Volovetskyi district; Klynovets – 40, Velyka Vyznytsia – 49 of Mukachivskyi district; Lysychevo – 88, Lukovo – 91 cows in Irshavskyi district. The average level of specific weight is characteristic of Izok (Mizhhirskyi district), Poroshkovo (Perechynskyi district), Trosnyk (Vynogradivskyi district), Hat (Berehivskyi district), Serednie of Uzhgorodskyi districts with a slight fluctuation of the indicator. The mentioned parameters refer to the villages of Guklyvyi (Volovetskyi district), Haydosh (Uzhhorodskyi district), which indicates the similarity of the data. It is sporadically distributed in Andriivka and Chervone settlements of the Uzhhorod district. This breed is rare in the villages of Palad and Komarivtsi of the mentioned district and Perekhrestia of Vynogradivskyi district. The situation is even worse in the village of Zabrid (Velyko-Bereznianskyi district), where 8 cows are kept with a population of 1,250 people. In village Mala Roztoka of Irshavskyi district with a population of 510 people there are only 4 cows. In village Mala Kopany of Vynogradivskyi district with a population of 1,380 people - 5 cows. Single animals are visually found in Pidvynohradiv (Vynogradivskyi district), Zhniatyno (Mukachivskyi district), V. Dobron (Uzhhorodskyi district), which is a negative signal for the safety of the brown Carpathian breed. It follows from the above that the decrease in the population of the brown Carpathian breed occurs, firstly, due to a general decline in the number of cows, and secondly, due to the introduction of other breeds and the crossing of the brown Carpathian breed with them. A very negative impact on the population is caused by the wrong breeding strategy and methods. The recent introduction of non-native breeds, limited access to natural resources of hayfields and pastures, especially in nature conservation areas, large population migration, and lack of economic measures aimed at the development of the cattle industry as a whole and the protection of the herd of Carpathian brown animals. It is known that in order to preserve the species, it is necessary to have a certain number of breed stock, a genealogical structure, zootechnical and breeding records, that is, sources of information in this regard. It should be emphasized that at the time of the expedition survey, we cannot represent the genealogical structure in the form of lines and families, because in modern times there are no subjects of the breed affairs, bearers of legal rights and obligations of the organizational form regarding the preservation of the relevant gene pool of rare, aboriginal, local and endangered brown Carpathian breed of cattle. Therefore, the next step after the expedition survey is to select animals typical for the breed, their linear evaluation and determine the optimal (from the biological, selection and economic point of view) sizes of the closed gene pool population of limited volume for its preservation, to establish performance control and milk quality control, zootechnical and breeding records. It was found that only a small part of cows of the brown Carpathian breed comes from purebred bulls and a sharp reduction, especially in recent years, means that the population needs protection, preservation and constant control of the number

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of livestock and its use. We believe that the main method of preserving the brown Carpathian breed should be purebred breeding with the use of correct selection, rotation of breeder bulls and line breeding, which will ensure the accumulation and consolidation of the necessary hereditary qualities in the offspring in subsequent generations, a constant increase in the viability of the offspring and the strength of their constitution. Support of consolidation and genetic variability while maintaining the available number of breed stock. For the practical implementation of purebred breeding by the method of artificial insemination, 190,000 doses of sperm from 17 brown Carpathian bulls are available at the regional breeding enterprise. On the basis of the concept of preservation of the local brown Carpathian breed and the development of dairy cattle breeding in Transcarpathia region until 2025, developed by the Brown Carpathian Breed Association (Chairman of the Board Vasyl TERPAI), which is part of the European Brown Breed Federation, we, together with the specialists of the breeding enterprise, have created a scheme for fixing bulls-breeders for 2023-2024 (Table 7).

Table 7. The scheme for fixing bulls-breeders of the brown Carpathian breed for 2023-2024, districts of the Transcarpathian region

Districts	**Bull's name**	**Inv. №**	**№, brand DPK**	**Date of birth**	**LW**	**Line, related group**
Berehivskyi	Bublyk	7886	ЗКЗ-629	21/101990	775	Concentrat
Vynogradivskyi	Romb	8829	ЗКЗ-489	7/6. 1983	743	Ranet
Volovetskyi	Reps	1567	ЗКЗ-610	27/7.1989	740	Eleymuni
Irshavskyi	Tsvirkun	5076	ЗКЗ-509	18/5.1984	890	Elegant
Mizhhirskyi	Reps	1567	ЗКЗ-610	27/7.1989	740	Eleymuni
Mukachivskyi	Romb	8829	ЗКЗ-489	7/6.1983	743	Ranet
Perechynskyi	Reps	1567	ЗКЗ-610	27/7.1989	740	Eleymuni
Rakhivskyi	Buton	7586	ЗКЗ-627	17/2.1990	634	Concentrat
Svaliavskyi	Romb	8829	ЗКЗ-489	7/6.1983	743	Ranet
Tiachivskyi	Buton	7586	ЗКЗ-627	17/2.1990	634	Concentrat
Uzhhorodskyi	Buton	7586	ЗКЗ-627	17/2.1990	634	Concentrat
Khustskyi	Buton	7586	ЗКЗ-627	17/2.1990	634	Concentrat

Note: There is no artificial insemination in the Velyko-Berezhnianskyi district;
LW – live weight

A gene pool sperm bank has been formed, which provides ex situ protection. A number of genetic studies are being carried out with the financial support of FAO, the Scientific Research Institute of Zootechnics in Krakow, Poland, in particular, on identifying cows that produce A_2/A_2 milk.

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Conclusion and recommendation

The results of the study made it possible to clarify the status, outline the specifics of the distribution of cows of the rare, aboriginal, local and endangered brown Carpathian breed and their number in Transcarpathia as well as changes in the breed composition. The multifaceted importance of the breed was clearly shown – it is a natural model for the restoration of a transformed ecosystem and livestock farming, plays and will play a major role in the future in providing food, improving people's nutrition, sustainable development of local communities, preserving biodiversity and mountain ecosystems of the Carpathian region. It will make it possible to adapt one of the branches of animal husbandry to climate change and apply the technologies of "Green Architecture" in the aspect of environmental and nature protection recommended by the European Commission. The urgency of measures for the protection, preservation, reproduction and more qualified use of the genetic resources of the brown Carpathian breed of cattle is to include a special provision in the Law of Ukraine "On breeding matters in livestock breeding" on rare, aboriginal, local and endangered breeds. The need to create a system and conduct constant monitoring of the breed, which include studies of changes in the genetic structure, biological features, dynamic population trends, etc., development of new approaches to financing these activities. On the basis of many years of research, develop practical recommendations and action plans for protection and preservation. Create an electronic database. Ensure popularization of this genetic object in mass media, official websites of the Ministry of Agriculture, regional state administration, scientific institutions, and publication of booklets. It is necessary to continue comprehensive research of animals and their products, to determine the specific optimal sizes of native gene pool micro populations of the brown Carpathian breed, to conduct a linear assessment of animals for the long-term preservation of genetic resources, which must continue to be protected by the legislation of Ukraine.

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