

Population status and distribution of Bulgarian indigenous chicken breeds

Популационна структура и разпространение на българските породи кокошки

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ABSTRACT

Ten breeds of chickens have been created in the Republic of Bulgaria, two of which are under national control, and the rest are bred only by amateur poultry breeders. The present study aims to determine the population status and regionalization of the local breeds of chickens in the Republic of Bulgaria. The most extensive area of distribution is shown by Struma chicken, Bregovska dzhinka, and Struma bantam breeds, and Stara Zagora red chicken, the Rhodope painted chicken, and Southwest Bulgarian dzhinka - with local distribution. The most numerous breed is the Bregovska dzhinka, occupying 34% of the total number of birds of the studied breeds, and the least numerous is the Southwest Bulgarian dzhinka with only 2% relative share. The predicted rate of inbreeding (ΔF) for the Bulgarian breeds, varies from 0.04% for Bregovska dzhinka to 0.77% for Southwest Bulgarian dzhinka. Population growth rate (r) values vary from 0.93 in the Black Shumen chicken to 1.21 in the Rhodope chicken. Considering various factors influencing the determination of the conservation status, it can be summarized that Bulgarian breeds of chickens, except for Bregovska dzhinka, have an endangered or critical status. Particular attention should be paid to the condition of those breeds where a significant concentration of the main part of their population is observed in an area with a radius of less than 50 km and/or bred in a small number of farms.

Keywords: poultry, genetic diversity, local breed, Bulgaria

РЕЗЮМЕ

В Република България са създадени 10 породи кокошки, като две от тях са под национален контрол, а останалите се отглеждат единствено от любители птицевъди. Целта на настоящото проучване е да се определи популационния статус и направи райониране на местните породи кокошки в Република България. Най-обширен ареал на разпространение показват породите Струмска кокошка, Бреговска джинка и Струмски бантам, а с локално разпространение са Старозагорската червена кокошка, Родопската шарена кокошка и Югозападнобългарската джинка. Най-многочислена е породата Бреговска джинка, заемаща 34% от общия брой птици от изследваните породи, а най-малочислена – Югозападнобългарската джинка с едва 2% относителен дял. The predicted rate of inbreeding (ΔF) за българските породи варира от 0,04% при Бреговската джинка до 0,77% при Югозападната джинка. Стойностите на Population growth rate (r) варират от 0,93 при Черната шуменска кокошка до 1,21 при Родопската кокошка. Взимайки предвид, различните фактори, оказващи влияние върху определяне на консервационния статус, може да се обобщи, че българските породи кокошки, с изключение на Бреговската джинка, са със застрашен или критичен статус. Особено внимание трябва да се обърне върху състоянието на тези породи, при които се наблюдава значителната концентрация на основна част от популацията им в район с радиус под 50 km и/или отглеждани в малък брой ферми.

Ключови думи: домашни птици, генетично разнообразие, местни породи, България

INTRODUCTION

Domestic animal breeds are an important component of the world's biodiversity because of their genes and gene combinations potential to be useful in animal husbandry in the future (Hall and Bradley, 1995). In the scientific literature, the concept of "breed" has various definitions, with perhaps the shortest being "A breed is a group of animals selected by man to have a uniform appearance that distinguishes them from other members of the same species" (Clutton-Brock, 1987). The Food and Agriculture Organization of the United Nations (FAO, 2001) provides a more comprehensive definition of breed "either a sub-specific group of domestic livestock with definable and identifiable external characteristics that enable it to be separated by visual appraisal from other similarly defined groups within the same species, or a group for which geographical and/or cultural separation from phenotypically similar groups has led to acceptance of its separate identity" also perceived by ERFPA (European Regional Focal Point for Animal Genetic Resources). Breed understandings can be far more specific, linking not only unique exterior characteristics, but also productive qualities (MAF, 2000), limiting the genetic resource to breeds with economically significant characteristics. At European level, in addition to individual international and national structures, responsible for the maintenance and recognition of poultry breeds, there are amateur national organizations united in the Entente Européenne d'Aviculture et de Cuniculture (EE), with the Republic of Bulgaria represented by the Union of Fanciers and Small Domestic Animal Breeders in Bulgaria (UFSDABB).

Nowadays, more than 1000 breeds and breed groups of domestic chickens are known (DAD-IS, 2021), only a few of them have been implemented in industrial poultry farming, and breeding and improvement work is carried out with them (Teneva et al., 2015). Between 1989 and 2006, the number of global companies providing genetic material in egg-laying poultry fell from 10 to 2, and for broilers: from 11 to 4 (Gura, 2007), and after 2008, this number, for egg-laying poultry farming, grew to 3, and 5 if some smaller European companies are included. This

concentration of genetic resources and targeted selection work with them leads to a serious reduction of genetic diversity in poultry breeding (Besbes et al., 2007). On the other hand, highly productive hybrids are gradually displacing native breeds and breed groups, further limiting genetic variation in domestic chickens (Lukanov, 2016). Due to the intense competitive relationship between the world's main producers of genetic material for the poultry industry and consumer preferences, which act as a kind of selection engine, there is a serious loss of genetic diversity in industrial flocks as well (Ebegbulem and Ita, 2016). A large-scale genome-based survey of the world's genetic sources in the domestic chicken (The SYNBREED chicken diversity panel) found a reduction in genetic diversity, but chickens from Africa, South America and some native Asian and European breeds still show high heterozygosity in populations (Malomane et al., 2019).

Europe is one of the main centers where a huge number of chicken breeds have been created. Breeds grown on the Old Continent are many more, thanks to highly developed decorative and exhibition poultry farming (Lukanov, 2017). The scientifically based study of local breeds in Bulgaria started with the creation of the Central Poultry Experimental Station near Sofia in 1927, following the world trends for control tests of purebred birds (Tabakov and Hlebarov, 1930). The local breeds Black Shumen chicken, White Sevlievo chicken and Elena buff chicken (Kumanov, 1948) were studied, and later the Stara Zagora red chicken (Nozhchev and Tsonkov, 1969). Subsequently, work was also carried out on the creation of Bulgarian breeds of chickens for general use - Bulgarian black (Cherna edra) chicken and Stara Zagora red chicken (Hlebarov and Totev, 1963; Nozhchev and Tsonkov, 1969). Of all the above, Black Shumen chicken (BS) and Stara Zagora red chicken (SZR), maintained at the Agricultural Institute near the town of Stara Zagora, are still preserved (Lukanov, 2011a,b; Teneva et al., 2015). Scientists and government institutions have not been observing the breeds of chickens raised by amateur poultry farmers for the last 70 years.

In addition to the above-mentioned two breeds created in Bulgaria, there are several more that were created in Bulgaria by amateur poultry farmers, some of them with an interest in organic and free-range production of poultry meat. These are Katunitsa chicken (K), Struma chicken (S), Rhodope painted chicken (RP), Southwest Bulgarian chicken (SWB), Bulgarian longcrower (BL), Bregovska dzhinka (BD), Struma Bantam (SB) and Southwest Bulgarian dzhinka (SWBD) (Lukanov, 2011a,b; 2012; Teneva et al., 2015; Lukanov et al., 2021; Pavlova et al., 2021a).

The present study aims to determine the population status and regionalization of the local breeds of chickens in the Republic of Bulgaria.

MATERIAL AND METHODS

The study covers the period April 2021 - April 2022. Three hundred and twenty-five (325) amateur poultry breeders, mainly breeders of Bulgarian breeds, and two flocks of Black Shumen chicken and Stara Zagora red chicken, raised at the Agricultural Institute, Stara Zagora, were included. The breeders included in the study were identified by the breed organizations and local clubs as permanent owners of parent herds with typical traits of the breeds under consideration. The object of the study was parental flocks of the breeds: K, S, RP, BS, SZR, SWB, BL, BD, SB, and SWBD. Social network (Facebook) groups for Bulgarian chicken breeds and some specialized literary sources were also used as complementary sources to the study (Migineishvili et al., 2021).

The use of social networks is an opportunity to determine indirectly, through the number of registered users in a given breed-specific group, what is the interest in a certain breed and its current popularity. This is not always directly related to population status but indicates future trends in this direction. A total of 14 groups in the most popular social network in Bulgaria are covered, targeting the breeds K (3 groups), S (1 group), RP (1 group), SWB (2 groups), SB (2 groups), BD (4 groups), SWBD (1 group). To avoid repetition of registered users for breeds

with two or more groups (K, SWB and SB), we have taken into account the group with the most registered users. A total of 15838 users are registered in the covered groups. In the same social network, a special group "Bulgarian chicken breeds" was created in 2021 with a survey including questions related to the population status (Which breeds do you raise?; What is the gender ratio?; Since when have you been breeding the given breed?; What town are you from?). The total number of those covered in the survey is 224.

An analysis of the plumage color characteristics of each of the mentioned breeds, gender structure based on breed and plumage color, and several breeding birds was carried out. Using the collected data on the location of the individual breeders, a regionalization of the breeds was made.

With the collected data, calculations were made of:

Effective population size (Ne)

$$N_e = (4 * N_M * N_F) / (N_M + N_F) [1],$$

where N_M = the number of males and N_F = the number of females (Wright, 1931) followed by a 30% reduction of N_e , due to the applied mass selection in ornamental poultry breeding, proposed by Santiago and Caballero (1995). A larger N_e is associated with more genetic variation and less inbreeding.

Prediction rate of inbreeding (ΔF) – measured based on reduction by 30% N_e

$$\Delta F = 1 / (2 * N_e) [2] \text{ (FAO, 2023).}$$

By comparing the current data on the state of the populations of Bulgarian breeds with previous data, a measurement was made of:

Population growth rate (r)

$$r = \text{anti-log} [(\log N_2 - \log N_1) / t] [3],$$

where N_1 and N_2 are, respectively, the number of breeding females from the first and the second census, and t is the time interval in years between the two censuses (FAO, 2013). Data on the number of females from 5 years ago ($t = 5$) were used to determine r .

Predicting population status (N_t)

$$N_t = N_0 * r^t \quad [4],$$

where N_0 represents the actual size of a population of breeding females of a breed and r is the population growth rate, t refers to the predicted period (FAO, 2013). In our case we choose to predict the population status after a 5-year period, i.e. $t = 5$. The choice was dictated by the relatively short period, on the one hand, and on the other for comparability with the data collected 5 years ago.

Generation interval (L)

Calculated based on the approximate economic maturity of the birds as the average age of the parents at the hatch of their offspring that subsequently will produce the next generation of breeding animals.

Based on the data obtained, the status of each breed was determined, according to categorization and evaluation methods proposed by FAO (2013), considering three main parameters: numerical scarcity (number of breeding females); inbreeding rate (ΔF); and presence of active conservation programmes. Breeds can thus be divided into six categories: extinct; cryoconserved only; critical; endangered; vulnerable; and not at risk, as the studied species of domestic chicken (*Gallus gallus domesticus*) is classified as an animal with high reproductive capacity.

Factors other than those used in determining risk status were evaluated: genetic diversity of the breed, phenotypic characteristics of the breed, and cultural or historical value of the breed (FAO, 2013). Based on the proposed methodology for determining the status of farm animal breeds for Bulgaria, proposed by Nikolov and Duchevev (2022), a calculation of thresholds for endangerment of the studied breeds was made.

Data processing was carried out using Microsoft Excel 16.0 (2018, for Windows).

RESULTS AND DISCUSSION

According to the degree of distribution, Bulgarian breeds can be divided into two groups - with a wide

distribution and with a weak (local) distribution. Figures 1 and 2 present the main areas of distribution of Bulgarian breeds of chickens, respectively standard and bantam. The widest range of distribution is shown by S, BD, and SB, mainly concentrated in the Western part of Bulgaria.

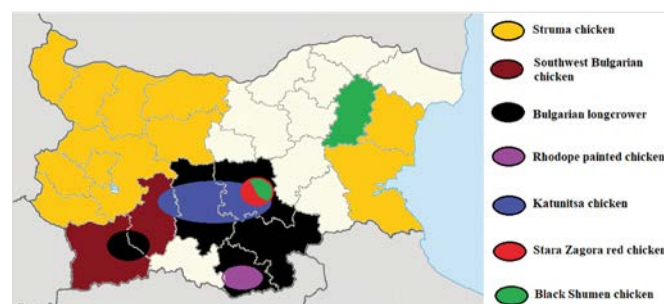


Figure 1. Bulgarian standard chicken breed distribution

This can be explained by the attractive appearance of the representatives of the breeds which emphasizes their decorative value, and this excites a large part of amateur poultry breeders in the country. Locally distributed breeds include SZR, RP, and SWBD. The remaining breeds show a comparatively more extensive distribution, covering two, three or more regions of the country for the main part of their population. The area of distribution is important not only for the popularity of a given breed, and its adaptation possibilities but also has an impact on its conservation status (Alderson, 2009), which should be taken into account when determining it (FAO, 2013). As critical for the status of a breed, Alderson (2009) defines a concentration of 75% or more of the population in a territory with a radius of 25 km. In a proposal to define a methodology for determining the status of farm animal breeds for Bulgaria, Nikolov and Duchevev (2022) indicate 50 km as the limit radius of concentration of 75% of the population of a given breed.



Figure 2. Bulgarian bantam chicken breed distribution

In addition to population concentration, the number and size of farms where a given breed is grown and bred also has an impact on conservation status (Nikolov and DucheV, 2022). The research carried out covers 325 amateur bird breeders from all over the country with the main share being located in Western and Southern Bulgaria. Two of the breeds (BS and SZR) were raised and maintained in the specialized selection farm at the Agricultural Institute, Stara Zagora, and were bred by panmixia at a ratio of 50:300 (Lalev et al., 2012; Migineishvili et al., 2021). As can be seen from Figure 1 at BS, two population cores are observed - one is part of the maintained national gene pool, based on the above-mentioned farm in the region of the city of Stara Zagora, and the other is composed of private farms of amateurs in the region of the city of Shumen. Unlike BS, the main part of the population of SZR is concentrated in the area of Stara Zagora. The specificity of amateur poultry farming is not related to raising a large number of birds in the given livestock facility. In the research, we found that the average number of birds of a given breed kept on one farm is 17.6 (between 15 and 20 birds). Only in the case of the SWBD, the average number of bred breeding birds is below 15, an average of 11.1. Regarding the number of breeding sites, more than 50 breeding sites are reported only for BD and S, indicated as a limit value by Nikolov and DucheV (2022). BS and SZR are the most critical in terms of this criterion because the number of farms in which they are bred is less than 10. Here it should be considered that the real number of amateur poultry breeders raising most Bulgarian breeds of chickens is significantly larger than the one covered in the present study.

An idea of the interest in a given breed, albeit indirect, can be given by social groups on the Internet, and in particular groups specialized to a given breed on the most popular social platform for Bulgaria - Facebook. Social platforms can reach a large number of people from different socio-demographic groups (Bergman et al., 2022) with about 4.76 billion registered users and Facebook remains the most popular platform with 2.958 billion consumers (Datareportal, 2023). For Bulgaria, the number of users for 2022 was about 4.06 million (Statista,

2022), making up 60% of the country's population. Recently, social media has been considered a unique and wide-ranging source of data for scientists related to species conservation (Di Minin et al., 2015). Although it is increasingly entering zoology, this source of information is still undervalued by animal science. After analyzing the data, it can be summarized that there are 16,798 users of the largest social network in Bulgaria who are interested in breeding Bulgarian breeds of chickens. According to the number of registered users, the interest in Bulgarian breeds is as follows: K (26.7%), BD (21.1%), S (19.7%), RP (18.5%), SWB (8.8%), SB (4%) and SWBD (1.1%). From the questionnaire conducted among 224 breeders of Bulgarian breeds of chickens in the Facebook group "Bulgarian breeds of chickens" with 954 registered users, it can be summarized that all Bulgarian breeds of chickens are represented in a ratio that largely corresponds to the main stage of this study, presented below (Figure 3). According to the number of registered breeders in the survey, the breeds are distributed in the following order by number of breeders: BD (25%), S (21.4%), SB (14.7%), SWB (13.8%), K (9.82%), RP (4.5%), SWBD (3.6%), BS (3.13%), SZR (2.2%) and BL (1.8%).

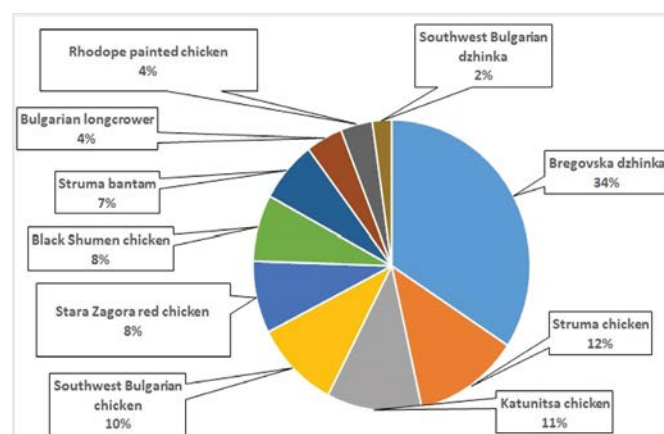


Figure 3. Relative share of Bulgarian chicken breeds

The results for the distribution of the Bulgarian breeds of chickens in a study covering 325 amateur poultry breeders and two flocks of the breeds BS and SZR, kept at the Agricultural Institute, Stara Zagora, are presented in Figure 3. Table 1 represents the data regarding the number of breeding birds and gender ratio. The largest share among Bulgarian breeds of chickens is BD, accounting

for about 1/3 of the total share of the representatives of the Bulgarian breeds. This is supported by the great interest in this breed, both on social networks and among the international poultry community, with breeders from Romania, Serbia, North Macedonia, Hungary, Germany, etc. (Lukanov, 2017).

The most popular plumage color is spangled, covering over 80% of the population. Black mottled and white plumage color are the next most popular with about 10% and 5% share respectively. Although rare, other plumage colors are also found, but they are not standardized. The next breed, which probably shows widespread distribution and popularity due to its attractive appearance, is the S with about 12% of the total number of breeding birds registered. The breed has great popularity, which in the last decade has crossed the borders of the country, being bred in Romania, Serbia, Macedonia, Turkey, Germany, and some others (Lukanov, 2017). There is a significantly greater variety of plumage colors in this breed with the main part of the population having variations of mottled - red mottled and, to a lesser extent, black mottled. The difference between the number of covered S and K is very small with the latter being third in number and the most popular Bulgarian breed of chicken on social networks. They show an attractive appearance but also excellent meat-producing characteristics (Nikolov and Gerzilov, 2011; Teneva et al., 2015) for purebred birds, which inevitably underlies their popularity. Recognized colors in the breed are dark red and dark orange, with both colors equally distributed. There is also a blue color in the breed, which is not widely distributed and not recognized by UFSDABB (Lukanov, 2017). SWB has about 1/10 share, the most popular of which are the birds in different variations (light, standard and dark) of spangled plumage color (over 90% of the population). There are also birds in black/blue mottled (6%), white, and red color. The situation of the two breeds (BS and SZR) that are under selection control and the only ones mentioned here in the Domestic Animal Diversity Information System database (DAD-IS, 2023 a, b) is interesting. Thanks to the flocks maintained at the Agricultural Institute, Stara Zagora, their individual share is about 8% of the total number

of Bulgarian chicken breeds. The share of birds of both breeds kept in the Agricultural Institute and in private farms is 58/42%, respectively for SZR and 42.2/57,8% for BS. Unlike many of the other breeds, there is no significant interest from amateur poultry breeders (Lukanov, 2017), which poses a serious risk to their existence, due to the concentration of the main part of the population and the small number of breeding sites in which they are bred (Nikolov and Duchevev, 2022). In contrast to them, there is a serious interest in recent years to breed SB with a purely decorative purpose, including from foreign fanciers (Lukanov, 2017). The most popular colors are similar to S (red-mottled and black-mottled) with millefleur variations being observed here. BL shows a relatively widespread distribution, covering several areas, but the interest in this breed is quite variable, which is also expressed by the relatively small number of breeding birds with typical characteristics. A serious problem here is the crossing with Denizli, as well as the different directions of selection. In the last few years, information has emerged about a local chicken breed from the Eastern Rhodopes area - RP, which quickly gained popularity among poultry farmers because of its attractive appearance, unpretentiousness, and very good laying capacity. However, its main distribution range remains concentrated in the region of settlements around Momchilgrad and Dzhebel, which carries a serious risk to their existence. Although over 90% of the population has black-mottled plumage color, there are also birds with a red-mottled plumage color. The least represented breed is SWBD, which, in addition to the small number, shows a large concentration of the population. A serious risk of its existence is also the growing popularity of the Ispench chicken breed and the probable future uncontrolled crossing between them since the two breeds have close exterior characteristics (Pavlova et al., 2021b). The main plumage color in which the breed occurs is spangled and significantly less black-mottled, which also corresponds to the data presented by Lukanov and Pavlova (2021).

Data from the analysis of the main factors on which the determination of the population status of a breed depends are presented in Table 1.

Table 1. Bulgarian chicken breeds population status and risk factors

Breed	BD	S	K	SWB	SZR	BS	SB	BL	RP	SWBD
Overall population size, n	2201	791	713	635	517	474	441	276	240	144
Males, n	556	129	91	72	67	73	93	43	37	29
Females, n	1645	662	622	563	450	401	348	233	203	115
Roosters/100 hens, n	34	20	15	13	15	18	27	18	18	25
Ne*	1163.5	302.3	222.3	178.7	163.3	172.9	205.5	101.6	87.6	64.8
ΔF , %	0.04	0.17	0.22	0.28	0.31	0.29	0.24	0.49	0.57	0.77
r	1.08	1.07	0.97	1.18	0.97	0.93	1.01	1.09	1.2	1.2
N ₅	2460	913	537	1294	382	285	373	362	515	288
Concentration**	No	No	No	Yes	Yes	Yes	No	Yes	Yes	Yes
Generation interval (L), years	0.95	1.4	1	1.05	0.85	0.9	1	1.1	0.9	0.95
DAD-IS risk categories	NR	E	E	E	E-M	E-M	E	E	E	E
Refined risk categories**	NR	E	C	E	C-M	C-M	E	E	C	C
Risk categories***	NR	NR	NR	NR	E	E	E	E	E	E

BD – Bregovska dzhinka; S - Struma chicken; K - Katunitsa chicken; SWB - Southwest Bulgarian chicken; SZR - Stara Zagora red chicken; BS - Black Shumen chicken; SB - Struma bantam; BL - Bulgarian longcrower; RP - Rhodope painted chicken; SWBD - Southwest Bulgarian dzhinka.

Ne – effective population size; ΔF – prediction rate of inbreeding; r – population growth rate; N₅ – predicting population status after a 5-year period. NR - Not at risk; E/E-M - Endangered/Endangered-maintained; C/C-M - Critical/Critical-maintained.

*corrected Ne (Santiago and Caballero, 1995); **Concentration of a major part of the population in a restricted geographical area or in a few flocks;

***Risk categorization by methodology proposed for Bulgaria (Nikolov and Dutchev, 2022).

It should be borne in mind that the number of birds covered is one part of the population of a breed. In popular and widespread breeds such as BD, S, K, SWB and SB, the real population size is significantly larger, as evidenced by the analysis of interest in them from social networks. Unlike farms under selective control, in amateur poultry farming, it is impossible to make such an accurate analysis of the condition of a given breed, but the trends are clearly expressed. The rarer and less widespread a breed is (geographical concentration in a small number of breeding sites), the more precisely its status in the conditions of amateur poultry farming can be determined. These kinds of breeds are BL, SWBD, RP, SZR, and BS.

A characteristic feature of birds bred in the conditions of amateur poultry farming is the significantly narrower gender ratio. On the one hand, this is related to the

specific reproductive characteristics of some breeds, and on the other hand, to the selection goals set by hobby breeders. As can be seen from Table 1, with the narrowest sex ratio are bantam chicken breeds, which is a serious plus for maintaining low levels of inbreeding, even with a small population size. The predicted rate of inbreeding or so-called hypothetical inbreeding (ΔF) for these breeds ranges from 0.04% for BD to 0.77% for SWBD, which also corresponds to the minimum-maximum values reported for all Bulgarian breeds of chickens. The increase in the number of male birds compared to the number of females, i.e. narrowing the gender ratio is a priority in breed conservation aimed at maximizing Ne (Zanon and Sabbioni, 2001).

The effective population size (Ne) determines the degree to which gene frequencies are faithfully transmitted across generations (Wright, 1931) and corresponds to

the size of an idealized population in which individuals evenly contribute to the gene pool (Spalona et al., 2007). To avoid the risk of extinction due to genetic effects, in the short term, the size of N_e should not be less than 50, and in the long term - 500 (Taberlet et al., 2008). On the other hand, Nikolov and Ducheve (2022) indicate as a limit value for N_e 245 when determining the endangerment of a given breed. Our results for reduced N_e clearly show that only two breeds have values above 245: BD and S. Comparing the original N_e and taking into account the incomplete coverage of the population of the widespread breeds, it can be concluded that above the critical values ($N_e > 245$) are also the breeds K and SWB. The breed with the lowest value of reduced N_e is the SWBD (64.8), which is above the critical short-term limit presented by Taberlet et al. (2008). Regarding the long-term limit for $N_e > 500$, only BD shows similar population stability.

According to the primary categorization of FAO (2013), the reporting of the breed status is mainly based on three parameters: numerical scarcity (number of breeding females); inbreeding rate (ΔF); and presence of active conservation programmes. With regard to the number of female individuals in the population, none of the studied breeds is included in „Critical“ category, with minimal values in SWBD (115 females) and maximum at BD (1645). By number of female individuals, all breeds except for BD fall in the category “Endangered” ($>100 \div 1000 <$ females). The values reported by us regarding forecasting levels of inbreeding for Bulgarian breeds are below 1%, which is also the critical value indicated by FAO (2013) for the status “Endangered”. For this reason, only RP ($\Delta F = 0.57\%$) and SWBD ($\Delta F = 0.77\%$) can be attributed to “vulnerable”, falling in the range $>0.5-1.0 <$ (FAO, 2013). In research with other European breeds, some authors report significantly higher levels of inbreeding by 25% in Belgian breed Poulet de Zingem (Larivière et al., 2011).

In another similar study, comparing the results between 2005 and 2010 on the state of Belgian breeds Moula et al. (2014) present a decrease in these values for Poulet de Chair, Zingem breed from 25% (2005) to 8.75%. Unlike the studies cited, in a thorough study of 41 chicken breeds

raised in Europe, Spalona et al. (2007) present comparable to our results in terms of both ΔF (from 0.02 to 0.71) and the reported gender ratio N_m/N_f (0.1 to 0.43). Campo et al. (2000, cited by Larivière et al., 2011) are also close to our results in a study, covering 10 Spanish chicken breeds (ΔF from 0.2% to 0.7%). Of all these Bulgarian breeds under active conservation programs (Executive Agency on Selection and Reproduction in Animal Breeding, Bulgaria) are only SZR and BS, referred to by DAD-IS (2023a, b) as “Endangered-maintained”.

Another factor reported by FAO (2013) in the risk categorization of breeds is the trend of growth of populations, whether it shows a positive or negative direction. In the investigated Bulgarian breeds, the values of the Population Growth Rate (r) range from 0.93 in BS to 1.2 in SWBD and 1.21 in RP (Table 1). Based on r , the population status was provided for a period of five years (N_5), also presented in Table 1. The reported risk status, according to the frame specified by FAO (2013) can also be seen in the table, as well as the status when adding the “Population Concentration” factor, which observes the transition from “Endangered” to “Critical/Critical - maintained” category in K, SZR, BS, RP and SWBD. Table 1 also presents the categorization proposed by Nikolov and Ducheve (2022) after the calculation of the marginal thresholds for the endangerment of agricultural species in Bulgaria. The methodology itself in agricultural birds, based on the threshold of 750 female individuals, considers the effect of geographical concentration; the number of livestock sites; the size of the farm; cryopreservation of reproductive material; breed -related products and services market. According to the results obtained, according to this methodology, 6 out of 10 Bulgarian breeds are considered endangered.

Table 2 presents data on other factors with respect to determining the conservation value of a breed, other than risk (FAO, 2013). They can be divided into three main groups: genetic diversity, phenotypic characteristics, and cultural or historical value of the breed. The first group covers two factors related to the uniqueness of the breed and the variety of traits in the population, at the

genotype level. The second group covers the phenotypic features of the representatives of the breed, which means that the two groups of factors are indirectly linked. Breeds that show distinctive phenotypic characteristics (behavioral, physiological, or morphological) should be prioritized for national conservation programs since they can have unique alleles or gene combinations. It can be summarized that many Bulgarian breeds have unique characteristics that clearly distinguish them from the other known breeds. Typical examples of this are S, K, BD, BL, SB, and SWB. Due to the peculiarities of the creation of the SZR (Nozhchev and Tsonkov, 1969), it is the least appreciated by this criterion. The presence of close-ups in exterior and productivity with other breeds, place some local and locally adapted Bulgarian breeds such as BS (Herve chicken, BE; Svrlijig Chicken, RS), RP (Asturian painted chicken, ES) and SWBD (Ispenc, TR) with an average evaluation by the genetic uniqueness criterion. The second group shows the level of selection in the given breed and the presence of variations in the phenotype of birds. To be appreciated with a high level of intra-breed genetic variation, the population must show certain phenotypic differences between individuals. In this regard, FAO (1999) presents a broader interpretation of the term "breed", according to the direction and level of selection and phenotypic variation dividing the breeds of "Traditional populations", "Standardized breeds", and "Selected breeds" (FAO, 2012). Of all the Bulgarian

chicken breeds, only BL does not have a status recognized by a state institution or an amateur structure such as UFSDABB. The lack of an accepted standard framework for exterior selection also leads to wide phenotypic/genotypic variation in the population. Another breed with a relatively wide phenotypic variation is K, where there are two directions - exhibition (exterior), with two plumage colors recognized within an active standard, and productive, where the main direction of selection is meat production. The RP fits into the definition of "Traditional populations", there is a recognized standard from 2022, according to which purposeful selection for the exterior is conducted, which will lead to a greater unification of their phenotype in the foreseeable future. There are two breeds with traits showing the potential for high economic importance: K (meat productivity) and SZR (egg productivity). RP, although no scientifically based tests have been carried out, shows a high potential for laying capacity in extensive rearing conditions. Although all studied breeds show good adaptability to different rearing conditions, with the highest adaptation to a specific environment are the breeds created and bred extensively for decades in the Western and Eastern Rhodopes: SWB and RP. Depending on the cultural and historical value of a given breed, for the country or region of creation, Bulgarian breeds are grouped in all three proposed levels, with the greatest importance given to those in which there is continuity between generations and family

Table 2. Accounting for factors other than risk status

Breed		BD	S	K	SWB	SZR	BS	SB	BL	RP	SWBD
Genetic diversity of the breed	Genetic uniqueness of the breed	***	***	***	***	*	**	***	***	**	**
	Genetic variation within the breed	**	**	***	**	*	*	**	***	***	*
	Traits of economic importance	*	*	***	*	***	*	*	*	**	*
Phenotypic characteristics of the breed	Unique traits	***	***	**	***	*	*	***	***	*	***
	Adaptation to a specific environment	**	**	**	***	**	**	**	**	***	**
Cultural or historical value of the breed		***	**	*	***	*	***	*	***	**	***
Conservation value of a breed		***	**	***	***	**	**	**	***	**	**

BD – Bregovska dzhinka; S - Struma chicken; K - Katunitsa chicken; SWB - Southwest Bulgarian chicken; SZR - Stara Zagora red chicken; BS - Black Shumen chicken; SB - Struma bantam; BL - Bulgarian longcrower; RP - Rhodope painted chicken; SWBD - Southwest Bulgarian dzhinka.

*low; **middle; ***high.

traditions in their breeding. FAO (2013) suggests that breeds of similar historical and cultural importance to the country or a given region are appropriate to be given a higher conservation priority.

Considering everything stated up to this point, it can be summarized that the Bulgarian breeds of chickens, with the exception of BD, are in an endangered status, and even critical for some of them. Due to the medium or high degree of conservation value and taking into account the condition of the populations, involvement of state institutions in their conservation is imperative. In order for this to become a reality, the Executive Agency on Selection and Reproduction in Animal Breeding of Bulgaria must expand its scope in relation to non-productive Bulgarian animal breeds. At this point, they are supported solely by the interest and desire of hobby chicken breeders. At the level of the European Union, the main culprit for maintaining the genetic diversity in farm birds is also the hobby poultry breeders. In this regard, the following critical moments within the European Union can be pointed out, related to the preservation of the diversity of farm poultry breeds within the community:

1. The lack of a pan-European policy to support the maintenance of this valuable genetic resource by hobby poultry breeders;
2. Legislation obstacles to the legal exchange of genetic material;
3. Legal obstacles to the promotion of poultry breeds through international exhibitions within the EU;
4. The increasing requirements for the conditions of rearing farm birds in yard conditions;
5. Increase in the average age of amateur poultry breeders and the lack of continuity between generations;
6. Urbanization and related bans on raising farm animals in a number of settlements;
7. Avian influenza (HPAI) epidemic in Europe.

CONCLUSION

The conducted research gives us reason to summarize that all Bulgarian breeds of ornamental chickens show a trend of population increase, in contrast to the typically productive ones (K, SZR, and BS). However, the risk factors affecting the population's degree of endangerment, respectively its status, clearly show a serious risk for most of them, assigning them to Endangered or Critical. Of all described breeds, only BD is not at risk. Only two breeds are under state control, and the rest are subject to decorative poultry farming. Amateur poultry farming is a neglected and underappreciated linchpin in maintaining genetic diversity in poultry, both nationally and internationally.

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