Pakistan J. Zool., vol. 53(3), pp 1131-1147, 2021 DOI: https://dx.doi.org/10.17582/journal.pjz/20200621160632

Review Article

Animal Genetic Resources of Serbia: Situation and Perspectives

Natalija Grittner[1], Radomir Mandić[2,*] and Milivoje Urošević[3]

[1]Faculty of Applied Ecology "Futura", Bulevar Vojvode Mišića 37, Belgrade, Serbia
[2]Faculty of Applied Ecology "Futura", Bulevar Vojvode Mišića 37, Belgrade, Serbia
[3]COAR-Center for the Preservation of Indigenous Breeds, Vere Dimitrijević 9, Zemun-Belgrade

ABSTRACT

This paper presents animal genetic resources of Serbia. Breeds of horses, donkeys, cattle, buffalo, sheep, goats, pigs, chickens, geese, turkeys, ducks, guinea fowls, dogs and bees were analyzed. The number of populations these indigenous breeds in Serbia has been shown in this paper. It is proposed that 15 breeds (13 breeds and 2 strains), which are not protected by the Decree of the Ministry of Agriculture of Serbia on animal genetic resources, be included in the Decree in the future, in order to preserve and improve their numbers. An urgent establishment of the animal gene bank of Serbia has been also proposed. It is given a proposal of measures for further activities on the preservation and improvement of the state of animal genetic resources in Serbia.

Article Information
Received 21 June 2020
Revised 23 August 2020
Accepted 21 September 2020
Available online 30 March 2021

Authors' Contribution
NG collected literature data and wrote the paper. RM and MU helped in collecting literature data and data and participated in writing of the paper.

Key words
Animal genetic resources, Indigenous breeds, Horses, Donkeys, Cattle, Buffaloes, Sheep, Goats, Pigs

INTRODUCTION

In year 1999, the International Food Organization (FAO) realized the importance of animal genetic resources in the world and because of that FAO drafted the Strategy for their Conservation (FAO, 1999) and the Conservation Action Plan with the Declaration, which was adopted in Interlaken (FAO, 2007).

According to the data of the Global bank on the state of animal genetic resources in the world (DAD-IS, 2014), the number of registered indigenous mammal breeds in 1993 was 2,719 and in 2014 already 11,062. According to the same source, the number of recorded indigenous bird breeds in 1999 (no previous data) was 1,049 and in 2014 is 3,807. The number of countries that submitted data, ranged from 131 in 1993 to 182 in 2014 (FAOSTAT, 2012). FAOSTAT (2012) reported that the world's cattle population has reached 1.5 billion individuals, sheep about 1.2 billion, goats about 1 billion, pigs about 1 billion and poultry about 21 billion individuals.

According to the FAO estimations, the demand for animal products in the world will increase by 20-30% in the next 20-30 years (FAO, 2007). Serbia has been actively involved in all activities of the FAO organization from the very beginning, in 1999. Indigenous breeds have gained, and are gaining more and more importance of preserving healthy, adapted breeds and as a permanent reservoir and source of genetic material for future breeding and selection work in animal husbandry (Drobnjak *et al*., 2012).

The paper first describes the environment that determined the state of animal genetic resources in Serbia: the position of the state, nature, climate and the socio-economic situation related to this topic. All the published research data related to animal genetic resources in Serbia were collected and analyzed. The data of Ministry of Agriculture and DAD-IS FAO which are related to Serbia were analyzed and compared with other published data. The survey method was used to collect data from certain municipal herding services in areas, known, for breeding of old breeds of animals and from companies and managers of protected natural assets that deal with this activity. Data were collected from the Serbian Chamber of Commerce about the number of hives and honey production in Serbia, from the Annual Report of the Kennel Club of Serbia for 2017 and 2018, and international reports (FAO I and FAO II report) on animal genetic resources were also analyzed. International norms (Interlaken Declaration) and domestic regulations were analyzed.

In order to visually understand the state of genetic resources in Serbia, data has been presented in the form of tables and figures. The presented data on population size, degree of engagement and the number of breeders in Serbia shows the current status of Serbian genetic resources.

The decree of the Ministry of Agriculture on Animal Genetic Resources (Službeni glasnik RS, No. 33/17) defines the categories of endangered species as: I (critically

* Corresponding author: radomir.mandic@futura.edu.rs
0030-9923/2021/0003-1131 $ 9.00/0

endangered), II (highly endangered), III (potentially endangered), IV (not endangered). The FAO has defined endangered species as: (i) extinct breed, (ii) critical, (iii) critical with appropriate measures (critical maintained), (iv) endangered, (v) endangered with appropriate measures (endangered maintained), (vi) not at risk, and (vii) unknown.

SERBIA AND ITS BIODIVERSITY

Serbia is located in southeastern Europe and in the heart of the Balkan Peninsula (Fig. 1), a region that is not geographically old, but with a geographical position and geological, topographical and climatic diversity that created an environment very suitable for very high biodiversity level at the species, communities and ecosystems. There are two units in Serbia-lowland: Pannonian lowland and hillys mountainous region. The southern edge of the Pannonian Peninsula includes alluvial plains and river terraces along the Danube and Tisa rivers, forest plains 100 to 400 m high (Banat, Titel, Telečka and Srem) and hilly mountain heights - Fruška Gora and Vršac. The mountainous area of Serbia is very complex and consists of five units: Rhodopes, Carpathians, Balkan, Dinaric and Skardopind mass (Stevanović *et al*., 1995; Myers, 1999). The northern part of Serbia-Vojvodina is flat, belongs to the Pannonian Peninsula, with a continental semi-arid climate. Central Serbia has a temperate continental climate. In the western part of the country, the average annual rainfall is 720-900 mm, in the mountains 1500 mm; in the southeast 650–700 mm, and in the mountains 1000 mm. Average annual temperatures vary between 9.5–11.7°C in the lowlands (0.5–5°C in the mountains). The coldest month is January with an average between -0.6°C in the mountains and 0°C in the lowlands, while the warmest month is July with an average of 11-22°C in the lowlands and 11-16°C in the mountains. The natural vegetation of Serbia consists primarily of moderately continental forests dominated by numerous species of beech (*Fagus*), oak (*Quercus)* and several species of conifers (Pinaceae). Serbia's forest cover is 29.1% (Banković *et al*., 2009).

According to the data listed in the Strategy of Biodiversity of the Republic of Serbia for the period 2011-2018, Serbia is characterized by great genetical and species diversity, but also ecosystem diversity. The high mountainous and mountainous area of the Republic of Serbia is one of the 6 centers of European biodiversity and one of 153 world centers. The following biomes are also found in Serbia: (i) steppe zonobiome, (ii) biome of deciduous forest, (iii) biome of coniferous forest, and (iv) biome of alpine tundra.

The Mediterranean area is one of 34 centers of biodiversity in the world (Myers *et al*., 2000). The Mediterranean region has about 13,000 endemic plant species (10% of the world's floristic endemism) and 235 endemic vertebrates (2.4% of the world's vertebrate endemism). The periphery of the center belongs to a part of Serbia, primarily to the Šarplanina and Prokletije, as a high mountainous rim of the Mediterranean area.

According to the estimations for 2018, the number of inhabitants in Serbia was 6,982,604, and the average age is 43.2 years. In Serbia is registered over 700,000 agricultural holdings and approximately 44% of the total population lives in rural areas, of which 33% are engaged in agricultural activities (Statistical Yearbook for 2019).

ANIMAL GENETIC RESOURCES OF SERBIA

Genetic resources in Serbia are very rich; they include the large number of indigenous varieties of cultivated plant species and breeds of domestic animals. Genetic resources, which are important for food production and agriculture are maintained in traditional agricultural systems or in *ex-situ* conditions. By the term animal genetic resources, we mean all species, breeds and strains that scientifically, culturally and economically contribute to the importance of one country (Stanković, 1962). Indigenous breeds of domestic animals represent a unique genetic heritage.

Table I. Total number of domestic animals in the Republic of Serbia in the past 10 years (Republic Statistical Office).

Year	Cattle	Pigs	Sheep	Goats	Horses	Poultry
2009	1,002,000	3,631,000	1,504,000	143,000	14,000	22,821,000
2012	920,762	3,138,508	1,635,218	235,576	11,414	18,234,160
2013	913,147	3,144,207	1,616,220	225,077	15,605	17,859,921
2014	920,068	3,235,658	1,748,110	218,603	15,606	17,167,364
2015	915,641	3,284,378	1,789,144	202,828	15,222	17,449,938
2016	892,751	3,021,167	1,664,895	200,150	-	16,242,111
2017	898,650	2,910,525	1,704,192	182,558	-	16,338,172
2018	878,336	2,792,286	1,711,677	195,934	-	16,231,800
2019	898,178	2,903,007	1,641,827	191,280	-	15,779,914

Serbia has unique breeds and strains of domestic animals, which came into existence by a long-term process of selection by man and the natural conditions that prevail in certain territories. The disappearance of numerous breeds and strains of domestic animals was caused by the neglect and abandoning of livestock production, or depopulation of mountainous areas. According to the data of the Republic Statistical Office of the Republic

of Serbia, on December 1, 2019 (Statistical Yearbook, 2019), Table I shows the registered number of heads by species in Serbia.

Fig. 1. Map of Serbia with the geographical position on the Balkan Peninsula.

Observing the ten-year average (2009-2018), it can be recognized, that the total number of cattle was decreased by 2.5%, pigs by 9.1%, goats by 12.9% and poultry by 13.1%, but the number of sheep increased by 0.7% (Table I). Looking at these data, we conclude that the total number of domestic animals has decreased by 37% in the past 10 years. The number of horses on the territory of the Republic of Serbia was monitored until 2016, and then was recorded an increase of 8%, compared to 2009.

Ministry of Agriculture of Serbia was adopted the Rulebook on the List of genetic reserves of domestic animals, the manner of preservation genetic resources of domestic animals, as well as the List of indigenous breeds of domestic animals and endangered indigenous breeds ("Službeni glasnik RS", No. 33/17) and involved the following breeds as genetic animal resources in Serbia (Table II).

Indigenous domestic breeds of animals are mainly bred in individual households in Serbia, in eastern Serbia (Stara Planina), western Serbia (Pešterska visoravan), the area of Vojvodina (Subotica, Senta, Čoka, Sremska Mitrovica, Deliblatska Peščara, etc.). Organized breeding of old breeds by the managers of protected natural areas is in the Special Nature Reserve "Zasavica" in Vojvodina (Domaći brdski konj - Domestic-Mountain Pony, Podolsko goveče-Podolian, Balkanski magarac-Balkan donkey and Mangulica–Mangulica), Special Nature Reserve "Ludaško jezero", Nature Park "Palić" and others.

INDIGENOUS EQUIDAE IN SERBIA

There are two indigenous breeds of horses, the Domaći brdski konj (Domestic-Mountain Pony), and Nonius (Nonius) and one breed of donkey, called Balkanski magarac (Balkan donkey). Trailović and Savić (2019) list three more breeds of horses: Domaći hladnokrvnjak, Jugoslovenski kasač i Domaći polukrvnjak, for which they do not provide status data. Stanišić *et al*. (2020), specify another breed of donkey in Serbia, the Banatski magarac (Banat donkey). The population trend of indigenous domestic horses and donkeys is shown in Figure 2 and Table III.

Horses (*Equus ferus*)

Domaći brdski konj (Domestic-Mountain Pony)

It is a descendant of old wild przevalski horses and tarpans that were crossed with arabian horses. This horse is lower growth by nature and belongs to the group of ponies. Most often is the height at the withers by adult males 130 cm,

Table II. List of indigenous breeds of domestic animals and endangered indigenous breeds.

	Species	Breed
Cattle	*Bos taurus*	Podolsko goveče (Podolian), Buša (Busha)
Buffaloes	*Babulus bubalis*	Domaći bivo (Domestic buffalo)
Horses	*Equus ferus*	Domaći brdski konj (Domestic-Mountain Pony), Nonius (Nonius)
Donkeys	*Equus asinus*	Balkanski magarac (Balkan donkey)
Pigs	*Sus scrofa domesticus*	Mangulica (Mangulica), Moravka (Moravka), Resavka (Resavka)
Sheep	*Ovis aries*	Bardoka (Bardoka), Vlaško-vitoroga ovca (Vlashko - Vitoroga sheep), Karakačanska ovca (Karakachan sheep), Krivovirska ovca (Krivovirska sheep), Lipska ovca (Lipska sheep), Pirotska ovca (Pirotska sheep), Svrljiška ovca (Svrljig sheep), Cigaja (Tsigai sheep), Čokanjska cigaja (Chokanj sheep), Šarplaninska ovca (Sharmountain sheep)
Goats	*Capra aegagrus hircus*	Balkanska koza (Balkan goat), Domaća bela koza (Serbian white goat)
Chickens	*Gallus gallus domesticus*	Banatski gološijan (Banat Naked Neck), Kosovski pevač (Kosovo Singer), Svrljiška kokoš (Svrljig Hen) and Somborska kaporka (Sombor Crested)
Turkey	*Meleagris gallopavo f. domestica*	Domaća ćurka (Domestic turkey)
Float	*Anas platyrhynchos domesticus*	Domaća plovka (Domestic duck)
Goose	*Anser anser domesticus*	Domaća guska (Domestic goose)
Guinea fowl	*Numida meleagris f. domestica*	Domaća biserka (Guinea fowl)
Pigeons	*Columba livia domestica*	50 breeds (50 breeds)
Been		*Apis mellifera* carnica
Dogs	*Canis lupus familiaris*	Jugoslovenski ovčarski pas šarplaninac (Yugoslavian shepherd dog – Sharplanina), Srpski gonič (Serbian Hound), Srpski trobojni gonič (Serbian tricolour hound)

and the weight is 380 kg. The height of females at the withers is about 125 cm, and the weight is about 330 kg. Their hair color can be dark brown (dorat), black (vranac), gray (sivac) and light brown (alat). Domaći brdski konj is one of the pack animals (it can carry up to 120 kg on a saddle), so it is most often used for carrying the cars, working in agriculture and riding.

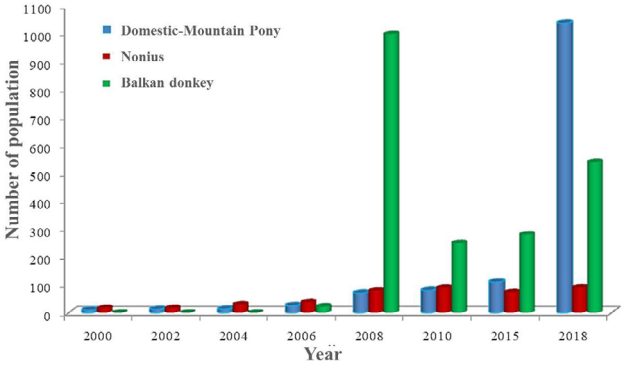

Fig. 2. Population trend of indigenous domestic Equidae from 2000-2018.

Table III.- Number of donkeys in Serbia according to the DAD-IS database.

Year	No. of heads in breeding
2008	100-1000
2009	500-1000
2012	500-1000
2013	500-1000
2014	500-1000
2015	500-1000
2016	500-1000
2017	500-1000
2018	500-1000

Nonius (Nonius)

It is a breed of horse that originated in the first half of the 19th century, in Austro-Hungary, by multiple crosses of Arabian horse, Lipicaner horse, Norman and English thoroughbred mares with stallions imported from Normandy. It belongs to the group of medium to large breeds of horses. Their height at the withers is about 160 cm. Males weigh about 600 kg and females about 550 kg. Due to its high endurance, nonius was first used for military purposes, later, at the beginning of the 20th Century; this horse was used for carrying cars, in agriculture, and as a competitive horse in long-distance riding.

Trailović and Savić (2019) specify another indigenous breed of horse: a jugoslovenski kasač, whose status is maintained.

Jugoslovenski kasač (Yugoslavian Trotter)

It is a relatively new breed of horse. According to Adžić (2015), the existence of this breed began at the beginning of the 20th century. Several foreign breeds of trotters (kasač) participated in the formation of this trotter, and the most important are: američki kasač, ljutomerski kasač, norfolški kasač, francuski i italijanski kasač, orlov kasač, mađarski kasač, nemački kasač. There is also a part of the Finnish and Swedish trotters in the blood of this trotter. The weight of males is about 550 kg, and of females 450-500 kg. The average height at the withers is 150-155 cm. The most common color is dark brown (dorat), but light brown (alat) and black (vranac) can occur. Jugoslovenski kasač (Yugoslavian Trotter) - state is maintained.

Donkey (*Equus asinus*)

Balkanski magarac (Balkan donkey)

It is descendant of the African donkey (*Equus asinus africanus*) and represents the varieties of donkeys in the world. It's relatively small, a strong and resilient animal that can carry or pull a load disproportionately large in relation to its size. The average height at the withers is 105 cm, the weight of males is around 250 kg, and females around 200 kg. Stanišić (2017) determined that there are two gene pools in the total sample, the first represents the heterogeneous breed Balkanski magarac and includes two subpopulations, and the second includes a certain number of individuals in the Zasavica and differs from the breed Balkanski magarac. If we take into account the phenotypic characteristics of individuals of the second gene pool, it is assumed that these individuals belong to the breed "Banatski magarac".

Banatski magarac (Banat donkey)

It is a descendant of a Spanish donkey that Hapsburg's Queen Maria Theresa transferred to Banat in the 18th century, for mostly working in vineyard. This donkey is today traditionally bred in the northeastern part of Serbia (Banat region). It differs morphologically and genetically from Balkanski magarac and can be recognized as a new, special breed of donkeys in Serbia, on the Balkan and around the world. Therefore, urgent and well-planned mating strategies are necessary to preserve this breed and maintain the original characteristics (Stanišić *et al*., 2020). This breed, Banatski magarac breed should be included in the List of Genetic reserves of the Republic of Serbia. Banatski magarac (Banat donkey) state is critically endangered.

INDIGENOUS CATTLE AND BUFFALOES

In this group are included Buša (Busha), Podolsko goveče (Podolian) i Domaći bivo (Domestic buffalo).

Cattle (*Bos taurus*)

Buša (Busha)

It used to be the most common breed of cattle on the Balkan Peninsula, which is why it is also known as "Balkan cattle". It belongs to the group of short-horned cattle (*Bos brachyeros europeus*). Buša and its crossbreeds are located in undeveloped hilly and mountainous and areas. Oxen are exclusively used for work, they have relatively small body, the average height of the ridge is about 105 cm. The weight of a cow, if the conditions of keeping are improved, can reach 290 kg and the bull can weight more than 300 kg. They live in extensive conditions but can live 10-12 years and during that time they can calve up to 9 times (Romčević *et al*., 2007). The authors state that milk yield depends on the strain and housing conditions, and 1000 kg of milk can be obtained in lactation for 261.2 days.

Podolsko goveče (Podolian)

Itis a direct descendant of *Bos primigenius*, and belongs to the group of endangered-maintained breed. Podolsko goveče is extremely important for Serbia, because he had participated in the formation of Kolubarsko goveče (Romčević *et al*., 2007).

Podolsko goveče is large animal with rough constitution, the height of the withers is about 130 cm, by larger strains, it is about 140 cm. The weight of cows is from 400 to 600 kg, and bulls from 750 to 1000 kg. The colors that dominate are gray, gray white. The muzzle, the peaks of the horns and the hooves are always darkly pigmented. It has extremely large horns, which length can be up to 1 m and a range of up to 1.5 m. Cattle are late - maturing, the females get a full maturity from 2 to 2.5 years of age. Calves weigh between 18 and 40 kg during process of calving. Lactation is short and milk yield is low and ranges from 700 to 1000 liters of milk.

Kolubarsko goveče (Kolubara)

It was widespread in northern Serbia in the Kolubara region and in area of Mačva. It is believed that this breed was formed originally by crossing buša and podolsko goveče. Urošević *et al*. (2019) believe that the Kolubarsko goveče is not extinct and that status of this breed should be redefined and returned to the list of indigenous breeds of Serbia. The average height at the withers is about 125 cm. The weight of cows is from 350 to 380 kg, and bulls from 600 to 750 kg. The colors are gray, dirty gray or gray brown. It was used for work (http://www.cepib.org.rs/). Kolubarsko goveče (Kolubara) - there are no data available, it is believed that this breed is extinct.

Buffalo (*Babulus bubalis*)

Domaći bivo (Domestic buffalo)

It belongs to the Mediterranean type and this breed was used for work and production of milk and butter. These are large animals. Generally, the height of females at the withers is 122.68 cm with an interval of variation from 106 cm to 136 cm. The average height male heads, up to 5 years of age, at the withers was 121.17 cm, and the males older than 5 years is 124.04 cm (Stepić *et al*., 2019). The body weight of older female buffaloes is 350-400 kg, and male buffalo is 420-500 kg (Hrasnica *et al*., 1964). They are mostly black, rarely have some spots. Their head is narrow, the horns are strong and curved, darkly pigmented, as well as the muzzle. As stated by Stepić *et al*. (2019), a decrease in the number of buffaloes was observed in Serbia in the period from 2010 to 2016, but in 2017 and 2018 sudden increase was recorded in the number of buffaloes. In 2018, 1031 buffaloes were registered (Figs. 3 and 4).

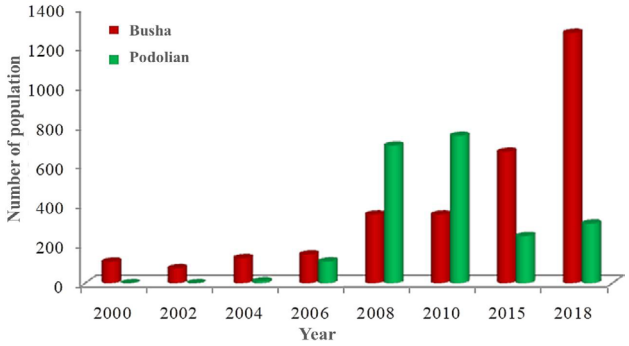

Fig. 3. Population trend of indigenous domestic cattle in Serbia from 2000-2018.

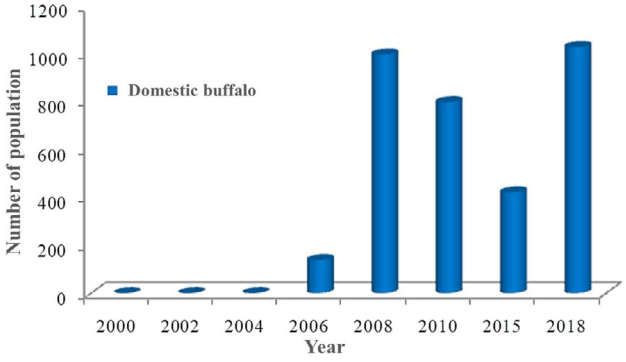

Fig. 4. Population trend of indigenous domestic buffaloes from 2000-2018.

INDIGENOUS BREEDS OF SHEEP
Ovis aries

In Serbia, there are two indigenous breeds of sheep: (i) Pramenka (Pramenka sheep) for which have 11 strains (Trailović and Savić, 2018), The most famous strains are: Svrljiški (Svrljig sheep), Sjenički (Sjenica sheep), Krivovirski (Krivovirska sheep), Pirotski (Pirotska sheep), Bardoka (Bardoka), Karakačanski (Karakachan sheep), Vlaško-vitoroga (Vlashko-Vitoroga sheep), Lipski (Lipska sheep) and Šarplaninski (Sharmountain sheep. (ii) Cigaja (Tsigai sheep) with strains Somborska (Sombor tsigai) and Čokanska cigaja (Chokanj tsigai).

Pramenka (Pramenka sheep)

It is the most widespread Serbian indigenous sheep, with combined production characteristics. Pramenka matures late, at approximately 16-18 months of age. This sheep adapts well to the modest conditions in which it is grown and is very resistant to diseases. Over a period of time, separate strains have been developed in different biogeographical regions which differ in appearance and production characteristics. They are characterized by a narrow neck, medium length, long and narrow head. Their body is slightly longer than the height at the withers, and their thorax is medium length, deep, narrow and flat. The ribs are flat and extend obliquely backwards. Sheep are often without horns, while rams are usually horned. The strains of svrljiška and sjenička pramenka are considered as non-endangered strains because their number is estimated at 10,000-100,000 individuals.

Cigaja (Tsigai)

It is a lowland breed of sheep, with combined abilities, used mostly for the production of milk, wool and meat. This sheep originates from Asia, from where was spread to Eastern Europe. Cigaja arrived in Serbia from Romania in the 18th century. She has a strong constitution and is one of the medium-sized breeds of sheep. The height at the withers is about 67 cm, and of rams about 75 cm. The body is deep, relatively narrow, medium long, rectangular in shape. The breasts are deep, narrow, the legs are high and always overgrown with black or brown hair. All over the body, wool is white, except on the head, ears and lower parts of the legs, which are black. Sheep give an average of 2.5-4 kg, and rams 3.5-5 kg of unwashed wool. The body weight of adult sheep is on the average 70-75 kg, and rams 110-120 kg. Cigaja as a breed is not considered as endangered sheep breed in Serbia. The only available data for sheep Baluša (Balusha) in 2009 is that there are only about 100 individuals (Fig. 5). Šarplaninska pramenka (Sharmountain sheep) -state is unknown. Somborska cigaja (Sombor tsigai) - status is unknown.

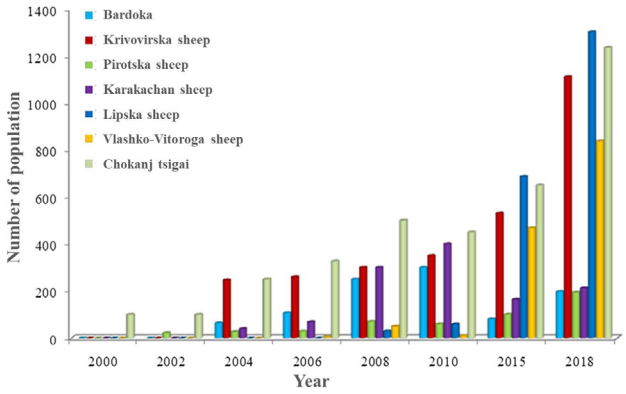

Fig. 5. Population trend of indigenous domestic sheep from 2000-2018.

GOAT BREEDS
Capra aegagrus hircus

Two indigenous goat breeds have been recorded in Serbia: Balkanska koza (Balkan goat) and Domaća bela koza (Serbian white goat).

Balkanska koza (Balkan goat)

The average height of this goat is about 65 cm in the ridge, and her weight is 34-40 kg. Urošević *et al*. (2014) determined that the average height of the ridge of a female cub of colorful Balkanska koza, at the age of 5-6 months, is 49.25 cm with an interval of variation from 44.50 cm to 53.00 cm. When it is discussed about the white strain of the Balkanska koza, Urošević and Jocović (1986) report that the average height at the withers of males is 79.50 cm, and of females is 67.66 cm. The hair are long and occur in all varieties of colors. Males have large and well-developed horns on head, while in females horns are smaller. Females are just fertile from the age of 2 and can obtain 1-2 cubs. Lactation is short, about 7-8 months. These goats are very resistant to low temperatures. They are most widespread in the hilly and mountainous areas of Serbia and are mostly grown and bred extensively.

Domaća bela koza (Serbian white goat)

This goat was formed by crossing Balkan goats from the lower regions and goats of the San breed. The weight of adult goats is about 40, and males about 50 and more kilograms. The characteristic of this breed is that it is adapted to very poor growing conditions, such as poor nutrition and unfavorable land terrains. Cekić *et al*. (2018) has listed only 145 trapped heads of this breed, while there are no other data (Fig. 6).

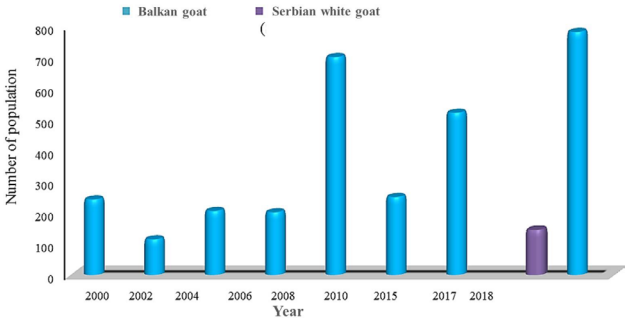

Fig. 6. Population trend of indigenous domestic goats from 2000-2018.

INDIGENOUS BREEDS OF PIGS

Sus scrofa domesticus

Mangulica (Mangulica)

This kind of pig was very important for the overall pig breeding in Serbia. Mangulica is bred in Bačka, Banat, Srem, Mačva, Stig, Pomoravlje in Serbia. Distribution area is related to areas with corn production (Mitic *et al*., 1973). There are two strains of mangulica: white (bela) and hairy (lasasta). The white (bela) mangulica originally came from Hungary, and the basis for formation of this pig was another pig called šumadinka. Unlike the white mangulica, lasasta originally came from Srem, the western part of Serbia. The center of cultivation of this strain of mangulica is the village Buđanovci (city Ruma). The hairy (lasasta) mangulica was named because of the weasel. This pig, like the weasel, has brown hair on its back, and the curly hair on the abdomen and yellowish-white hair on insides of the legs (Hrasnica *et al*., 1964). Its head and ears are medium length, muzzle is bent, and body is overgrown with thick and long curly bristles. This breed of pig is very vital, long-lived, disease-resistant, adapted for cultivation in continental climates, and grows well in both - plains and hilly, mountainous areas. Fertility is not special, on average 5 piglets with a variation from 1 to 12. This is a typical breed for fat production, because when they have a lot of fat, they can reach a weight of up to 250 kg. Due to the increased demand for mangulica meat, which has proven to be beneficial, as it leads to the formation of positive cholesterol (HDL cholesterol), the number of mangulica has increased, especially in the last decade.

Moravka or Moravska svinja (Moravka)

It originated in the Morava river basin (that is why it got that name) by crossing the local pig breed, šumadinka (Serbian breed), with berkšir (Berkshire), and then mangulica and jorkšir (yoksir). The appearance is characterized by a long and wedge-shaped head with half-fitting to flapping ears, a long and narrow body. The weight of a boar is about 135 kg, and a sow about 120 kg. The skin is blackish gray, overgrown with black, sparse and smooth bristles. The average number of piglets is 8 to 10 piglets, and even 12 sometimes.

Resavka (Resavka)

It was formed by unplanned crossing of šumadinka and berkšir in the area of the Velika Morava, Mlava and Resava river basins, as well as in the eastern hilly parts of Serbia. The head is long and narrow with flapping or semi-flapping ears. It is colorful, with thick and flat bristles of yellow-black color. Resavka belongs to the middle-aged breeds of the meat-fat type. Sows weigh about 140 kg and boars about 160 kg. Sows can have usually 7-8 piglets, which are born in different colors and are very resistant, so the mortality is not high.

Figure 7 shows population trend of indigenous domistic pigs from 2000-2018.

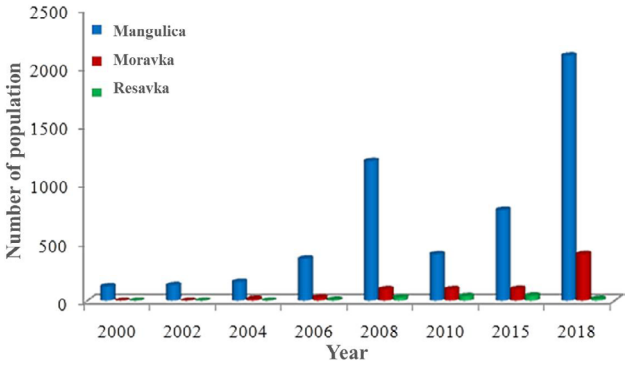

Fig. 7. Population trend of indigenous domestic pigs from 2000-2018.

Šiška (Shishka)

It is a primitive indigenous breed of pig. This pig is characterized by the exterior characteristic, that on the lower side of the body, there are fringes which they called cones, and because of that this pig got a name Šiška (cone) (Hrasnica *et al*., 1964). This characteristic is considered to be typical for the direct descendants of the European wild boar. It is assumed that the Slavs brought the ancestors of Šiška with them to this area. This pig was kept extensively in beech and oak forests on pasture. Today, it is believed, that šiška have disappeared from these areas, and it is difficult to find this pig in remote mountainous areas. With the appearance and characteristics, she remembers a wild pig. They have a large, narrow, long head, straight profile lines. The ears are short, the neck flat. Her back is carp. The front part of the body is more developed. The bristles are thick and sharp, white, yellow or brown. Šiška is a late-

growing pig, so it takes up to 3 years for full development. Šiška can give birth to 4-6 piglets. Šiška (Shishka) - no data available about population and number of šiška, it is assumed, that šiška is extinct.

Šumadinka (Sumadinka pig)

It was bred in the area of Šumadija in Serbia (that is how it got its name). It is assumed, that she disappeared from this area. She participated in the formation of mangulica, moravka and resavka. She is a medium-sized pig and of rough constitution. It is overgrown with curly bristles, white-yellow to gray. The head is long, narrow with medium-sized and flabby ears. The back is carp. The body is cylindrical. Fertility is poor, only can give birth to 3 to 6 piglets. It has poor fattening abilities, but it is quite resistant to diseases and is adaptable in an extensive way of breeding. There are no official data on the status and size of the population of this pig in Serbia. Šumadinka (Sumadinka pig) - no data available about population and number, it is assumed, that šumadinka is also extinct.

INDIGENOUS POULTRY BREEDS IN SERBIA

1. Indigenous breeds of chickens (*Gallus gallus domesticus*)

The list of indeginous breeds of domestic animals and endangered indigenous breeds of the Ministry of Agriculture of the Republic of Serbia (Službeni glasnik RS, No. 33/17), includes the following breeds of chickens: Svrljiška kokoš (Svrljig Hen), Somborska kaporka (Sombor Crested), Banatski gološijan (Banat Naked Neck) and Kosovski pevač (Kosovo singer). In the literature (Vučićević and Resanović, 2019), the breed of Pogrmuša, (Pogrmusha) is also mentioned and is considered to be almost extinct.

Svrljiška kokoš (Svrljig hen)

It can be found in eastern Serbia, in the wider vicinity of Svrljig, where it is mostly bred. Roosters of this breed can reach a weight of 2 kg, and hens about 1.5 kg. They have a medium-sized head, which is covered with feathers around red eyes. Beak is medium large and black, with prominent nostrils. They have a red crest, chin pads and mumps. Their neck is thin and long, and their breasts protrude. The back is saddle-shaped and the tail is high and fan-shaped. The wings of this breed are covered with thick feathers, they are large, well developed, which allows them to fly. The legs are long and high, the thighs are quite strong, and the claws are dark black (Mitrović and Đekić, 2013). The color of the skin is white-pink, and the feathers are black with a herbaceous reflection. Svrljiška kokoš loves space, is not a food picker, and is resistant to diseases and climate change. It is estimated that hens lay about 100-120 eggs a year.

Somborska kaporka (Sombor crested)

It is an autochthonous breed of chicken, arised at the beginning of the 20th century in the vicinity of Sombor (northern Serbia), by crossing a primitive domestic chicken with a Štajer chicken. The combined crossings with the hens of the Hzdan and Sulmtaler breeds contributed to the definitive shaping of this breed. As a result of such crossing, it differs significantly from other domestic breeds of chicken (Milošević and Perić, 2011). It has a tuft present on the top of the head of the same color as the body. Its head is medium in size and has a well-developed beak. The crest is simple and reaches the beak above the nostrils. The neck is strong, the body small, and the chest protruding, strong and wide. This breed has an ornate tail, which is worn upright. By roosters, the tail is moderately developed with a few developed sickle feathers, and by hens, it is harmonious, medium-sized and quite closed. Somborska kaporka can have feathers of various colors (white, black, blue, etc.). The legs are strong, not feathered, medium length, they have four toes. Somborska kaporka is a resistant hen with good production characteristics - she lays less than 100 eggs a year.

Banatski gološijan (Banat naked neck)

It originated in the area of Banat (Vojvodina) by crossing primitive domestic chickens and foreign breeds. Milošević *et al*. (2013) state that in addition to the unknown path of origin of this breed, it can be assumed that this type of chicken originally came from the east, from Asian fighters (one chicken breed) who have undergone certain genetic mutations in the past. This type of chicken is considered in several countries as an indigenous breed. These countries are Hungary, Romania and Serbia. The gološijan from Transylvania (Transilvanski gološijan) was brought to Serbia (Banat) in the middle of the 19th century. The domestic breeds of chickens that lived in this area were crossed with the newly arrived chickens. At the poultry exhibition in Vienna in 1875, this breed was also presented with Transilvanski gološijan (Vacaru-Oprip *et al*., 2007). It should be borne in mind that at that time Transylvania and Vojvodina belonged to one state. The head of the Banatski gološijan is oblong and medium size, the feathers are present less and only on the nape. The crest is simple and upright. The neck is medium length and is worn upright. It is not feathered but the skin is very thick. The back is medium size, wings are strong, and they fly easier than breeds with similar constitution that are grown in Serbia. The legs are relatively high and

strong, not feathered and have 4 toes. The tail is set at an angle of 45º degrees, and the color of the feathers is gray or partridge. This type of chicken flies well and lays her eggs devotedly, so they are good mothers. Chickens are very resistant, progress slowly, but very easy to raise (Milošević *et al*., 2013). Banatski gološijan has better production characteristics than the two breeds, described previously, because it lays up to 160 eggs with an average weight of 60 g a year. Roosters weigh 3 kg.

Figure 8 shows population trend of indigenous chicken from 2000-2018.

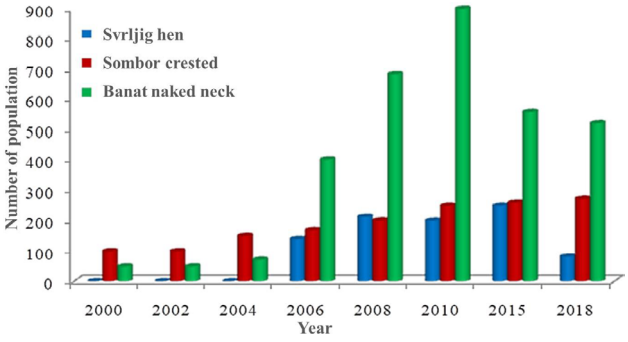

Fig. 8. Population trend of indigenous chickens from 2000-2018.

Kosovski pevač (Kosovo Singer)

It lives in the area of Kosovo and Metohija and we do not have status data about this breed (due to the political situation in this area). It is assumed that it is an autochthonous breed, brought from Turkey during the occupation of the Balkans. The ability of laying on eggs and carrying is very weak by this breed. The average hatching does not exceed 160 eggs per year, they are white colored and weigh from 55 to 60 g. The hens lay well on the eggs and have very good behavior to their chickens. Kosovski pevač belongs to the breeds, which are early in full maturity and they obtain early their feathers. Roosters start singing at 6 or 7 months, and hens are starting to lay on eggs at 8 months. They use their food well. Roosters can reach a weight of 4 kilograms, and hens about 3 kilograms. This breed is one of the most interesting breeds of poultry, primarily due to the sound (song) produced by roosters. Their song (croaking) is longer and rougher than from other breeds, on average, from 15 to an incredible 40 seconds. It happens sometimes, that the hens make the same sound but much shorter. Their basic color of the body is black, but they are also found in white, blue, black with a red cloak, and blue with a red cloak (https://poljoinfo.com/threads/kosovski-turski-peva%C4%8D.449/). Their status is at risk. Size of population in Serbia is 10-100 individuals in 2004 (data source DAD-IS FAO). Kosovski pevač (Kosovo singer) - lives in Kosovo, status is unknown (no data available because of current political situation).

Pogrmuša (Pogrmusha)

It is one of the strains of domestic chicken (Petrović, 1988). It originates from the Balkan (Central European) chicken. It is assumed, that pogrmuša has almost completely disappeared (Vučićević and Resanović, 2019). This breed is very similar to the wild hen, because all individuals are extremely small. Pogrmuša (Pogrmusha) - it is belived, that is extinct breed.

2. Indigenous breeds of geese in Serbia (*Anser anser domesticus*)

In the list of indigenous breeds of domestic animals and endangered indigenous breeds of the Ministry of Agriculture of the Republic of Serbia (Službeni glasnik RS, No. 33/17), there is only one breed of Domaća guska (Domestic goose) while Vučićević and Resanović (2019) list 4 breeds of geese: Novopazarska (Novi Pazar goose), Podunavska tršava (Danube tufty goose), Vojvođanska (Vojvodina goose) and Šumadinska (Sumadija goose) (Table IV).

Novopazarska guska (Novi Pazar goose)

It is the largest goose in Serbia and, according to Vučićević and Resanović (2019), it is presented in a couple of small flocks in the vicinity of Kraljevo, Kragujevac and Novi Pazar (central and western Serbia) but has almost disappeared. The carrying of egg capacity is up to 15 eggs, the flying instinct is perfectly preserved, males reach a body weight of 9 kg, while females are lighter and reach a weight of 7 kg.

Table IV. Population trend of autochthonous breeds of other poultry in the Republic of Serbia from 2004-2018.

Species	Breed	2004	2005	2018
Geese	Vojvođanska	-	-	-
	Podunavska	10-100	-	-
	Novopazarska	10-100	-	-
	Šumadinska (extinct)	-	-	-
Turkey	Domaća ćurka	-	100-1,000	500 - 1,000
Duck	Domaća patka	-	-	-
Guinea fowl	Domaća biserka	-	-	-

Podunavska tršava guska (Danube tufty goose)

It is also called curly goose because of its curly

feathers, which sometimes descend to the ground (Snežana Bogosavljević Bošković, Mitrović 2005). The feathers can reach a length of up to 35 cm. Podunavska tršava guska can be found on the territory of the Danube region and the Black Sea Basin. There geese are white, slightly lighter than Novopazarska guska and lay fewer eggs. There is no data available about the number of populations of this breed.

Vojvođanska guska (Vojvodina goose)

It is distinctly white. It can be found on the territory of Vojvodina. There is no data on the abundance of this breed.

Unfortunately, Šumadinska guska (Sumadija goose) has already disappeared in the middle of the 20th century. According to the available descriptions and data, it is known that this goose was bred around Kragujevac and Topola (central Serbia), with the fact that males were white, and the females had colorful wings and thighs.

3. Indigenous breeds of turkeys (*Meleagris gallopavo* f. domestica)

Domaća ćurka (Domestic turkey)

The list of indigenous breeds of domestic animals and endangered indigenous breeds of the Ministry of Agriculture of the Republic of Serbia (Službeni glasnik RS, No. 33/17), includes the breed of Domaća ćurka. Domaća ćurka is widespread on the territory of Serbia and with its phenotype resembles a wild turkey. Depending on the area it inhabits, certain strains (jagodinska, palanačka, dobrička) also came into existence. Domaća ćurka is white, although sometimes specimens can be found with colorful feathers (bronze, black, yellow, gray). If the turkeys are well cared and fed, they can be used more times for laying on eggs for one year. They take care of their chicks very well and are good mothers. The chicks are very sensitive in the first weeks (about two months), that is until the berries came out on their heads and necks. Domaća ćurka lays 30-50 eggs a year, with an average weight of 85 g. The eggs are spotted. The weight of adult females ranges from 3-5 kg and males between 5 and 8 kg.

4. Indigenous breeds of ducks (*Anas platyrhynchos domesticus*)

Domaća plovka (patka) (Domestic duck)

The list of indigenous breeds of domestic animals and endangered indigenous breeds of the Ministry of Agriculture of the Republic of Serbia (Službeni glasnik RS, No. 33/17), includes the breed of domaća plovka (patka). It originates from a wild duck and was created by its domestication. It is present mainly in the plains and river basins. This kind of duck is used to produce meat and eggs. Domaća patka can not fly. The color of the feathers is like the color of the feathers of a wild duck, but white and colorful specimens can appear. Domaća patka lays about 60 light green eggs a year. Body weight is from 2 to 2.5 kg. There is no official data available on the size of the population of this breed on the territory of Serbia, but they have the status of an endangered breed. (http://veterina.info/zivina-i-ptice/139-rase-zivine/1174-domaca-patka).

5. Indigenous breed of guinea fowls (*Numida meleagris* f. domestica)

Domaća biserka (Guinea fowl)

Domaća biserka came originally from West Africa, where it was domesticated about 3 000 years ago. In terms of exterior appearance, domaća biserka differs very little from the wild one. It has a relatively small head on which, instead of a crest, there is a horny growth in the shape of a spike, gray black in color. This horny growth is more developed by males than by females. The most common color of feathers is gray ash, although it can appear white, blue, purple, etc. All colors are characterized as pearly white round fields in the shape of pearls, which are properly distributed throughout the body. They got their name because of that. They reach a full maturity late (around 1 year), although there are strains that reach full maturity earlier, as early as 7 months. Depending on the strain and breeding technology, the average annual hatching range is from 100 to 150 eggs. The eggs are dark yellow to light brown colored, weighing 45 to 50 g. The incubation period of eggs lasts 26 to 28 days. (https: //www.facebook.com/StocarstvoZootehnika/posts/874484925971737/).

INDIGENOUS BREEDS OF DOGS (*Canis lupus familiaris*)

1. Internationally recognized dog breeds in Serbia

In the list of indigenous breeds of domestic animals and endangered indigenous breeds of the Ministry of Agriculture of the Republic of Serbia (Službeni glasnik RS, No. 33/17), there are three breeds of internationally recognized dogs: Srpski gonič (Serbian Hound), Srpski trobojni gonič (Serbian Trocolour Hound) and Jugoslovenski ovčarski pas šarplaninac (Yugoslavian shepherd dog – Sharplanina). Urošević and Drobnjak (2019) state that in addition to these registered dog breeds in Serbia, there are still three not registered specific dog breeds in Serbia: Srpski žuti gonič (Serbian yellow Hound), Srpski pastirski pas (Serbian shepherd dog) i Vojvođanski pulin (Vojvodina pulin).

Figure 9 shows population trend of dog breeds in the period 2017 and 2018.

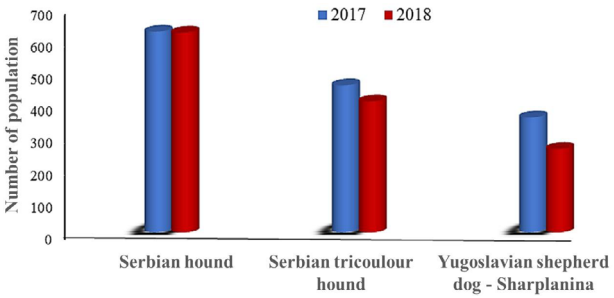

Fig. 9. Population trend of dog breeds in the period of 2017 and 2018.

Srpski gonič (Serbian hound)

Today's name "Serbian hound", FCI (Federation Cynologique International) was adopted on November 12, 1996. The number of FCI standards is 150. Serbian hound is strong, temperamental, reliable, durable and energetic dog. It is medium in size. The height at the withers of males is 46-56 cm, and females 44-54 cm. The ideal height at the withers of males is 51-52 cm and females 48-49 (FCI Standard 150). This dog has short, thick and shiny fox-colored hair with a black coat. The black color reaches the head, and above each eye is a black spot. On the chest there is whiteness not larger than 2 cm in diameter. This dog is normally used for hunting, it is very persistent, can produce very deep and high voice tones, it hunts large and small hairy wild animals (Urošević and Drobnjak, 2019). During 2017, 161 litters with 625 puppies were registered in Serbia. The sex ratio was: 304 female and 321 male puppies. The following year, 2018, 155 litters with 622 puppies were registered, including 294 females and 328 males (Kennel Club of Serbia 2018, 2019).

Srpski trobojni gonič (Serbian tricolour hound)

It is a breed of dog that has the same development path as Serbian hound and was known as the "tricolor". The FCI officially recognized the breed and published the standard on July 25, 1961. The name was changed in 1996 in the Serbian tricolour hound (Urošević, 2006). This dog has a strong body, is temperamental, lively, energetic, and enduring. The height at the withers is 45-51 cm, ideally 51 cm, and for females 44-54 cm, ideally 49 cm. (FCI Standard 229). It has tricolor fur, and a combination of deep red or fox red, black that can reach the head and white, which occupies 1/3 of the body surface. Serbian tricolour hound is an exceptional hunter of small wild animals (foxes, rabbits, wild boars), has a fantastically developed sense of smell which can be used when searching for prey. On finding the prey, it informs the hunter with penetrating barking (Urošević and Drobnjak, 2019), (https: / /ksrs.rs/fci-standardi/srpski-trobojni-gonic/, http://www.cepib.org.rs/?page_id=165). During 2017, 117 litters of srpski trobojni gonič were registered on the territory of the Republic of Serbia, and 458 puppies, 218 females and 240 males were born. During 2018, the Kennel Club of Serbia reported 100 litters of this breed. There were 408 puppies with 208 females and 200 males (Kennel Club of Serbia 2018, 2019).

Jugoslovenski ovčarski pas šarplaninac (Yugoslavian shepherd dog – Sharplanina)

It is a lighter type of molossoid dog, from which directly originated the last valid standard (number 41) of the Yugoslavian shepherd dog - Sharplanina in 1970. These dogs are strong, robust, fearless, excellent guards, loyal to their master. They are harmonious, have broad shoulders, muscular chest, head proportional to the body, body longer than height, tail is muscular, bent at the top. The height at the withers of males is 62 cm, and females 58 cm. Males shorter than 56 cm and females below 54 cm are not suitable for breeding (FCI Standard 41). The weight of males is 35-45 kg, and females 30-40 kg. Yugoslavian shepherd dog - Sharplanina has abundant thick hair in one color composed of two layers, and the color usually varies in shades of gray, although other colors may be present (white, brown, honey color, etc.). This dog breed is used as a shepherd dog, guardian of flocks, other animals and households, and due to its intelligence, it was also used in the army (Urošević and Drobnjak, 2019).

During 2017 on the territory of Serbia was registered 133 nests of this dog with 358 puppies, 175 females and 183 males. Next year, in 2018, 114 litters were registered with 260 puppies, 118 females and 142 males (Kennel Club of Serbia 2018, 2019).

2. Internationally unrecognized dog breeds in Serbia

Žuti srpski gonič (Serbian yellow hound)

For this dog breed and its registration has been prepared necessary documentation and necessary research and measurements have been performed (Urošević *et al*., 2002). Žuti srpski gonič is medium sized, strong and durable. The average height at the withers of males is 47.12 cm, and females 45.45 cm. Its head is proportional to its body, muzzle is wedge-shaped, ears are medium long, and neck is strong (approximately as long as his head) (Drobnjak *et al*., 2012). The color of the hair is yellow to yellow red, it is short, shiny, close to the body with a good undercoat. White hair color can appear on the head, paws, front legs and top of the tail. This dog hunts large

and small wild animals. Although žuti srpski gonič is not yet recognized by the International Kennel Club, it is very popular among hunters in Serbia, especially in the eastern and southeastern part in Serbia. It is estimated that the size of the population counts 500-600 heads. Žuti srpski gonič (Serbian yellow Hound) – it is estimated that the number of populations counts 500-600 individuals.

Srpski pastirski pas (Serbian shepherd dog)

It is a noble shepherd breed that has existed for centuries on the hills and mountains of Serbia. It originates from the shepherd dogs of Tibet, Central Europe and North Africa. Srpski pastirski pas is big, proud, strong, calm, affectionate, brave, energetic, loves children, and is a very good herdsman. The average height of males is from 58 cm to 69 cm, and females from 55 cm to 65 cm. Males weigh up to 50 kg, and females up to 45 kg. Its body is harmonious, rectangular in shape, head is medium size, jaw is strong, eyes are almond-shaped, ears are triangular set high, neck is of medium length, back is strong and wide, and chest is muscular. It has very strong, muscular legs and thighs, with round paws. The tail is strong at the root. Its body is covered with medium-thick, pigmented skin, which has a soft, firm undercoat (Urošević, 2009, Urošević and Drobnjak, 2019). There are no precise data on its number. Srpski pastirski pas (Serbian shepherd dog) – no precise data available about the number of populations for this breed in Serbia.

Vojvođanski pulin (Vojvodina pulin)

It is a very famous dog in the area of Vojvodina. Its ancestor is sojenički dog northern type, and it is believed that the Vojvođanski pulin originates from the Pannonian breeds of shepherd dogs. Vojvođanski pulin is an intelligent, loyal, hardy, resourceful, energetic dog, who loves and respects its owner. It has a pointed head, large dark eyes, pointed high-raised ears, body is regular, covered with black or white hair (rarely yellow and gray), tail is set high and upright. It is medium height, the height at the withers of males is 52 cm and more, and females 47 cm and more (Urošević *et al*., 2002), (https://paszavas.com/vojvodjanski-pulin-ponos-ravnice/). There are no precise data on its number. Vojvođanski pulin (Vojvodina pulin) no precise data available about population number in Serbia.

INDIGENOUS BREED OF BEES

The honeybee (*Apis meliffera carnica*) is widespread, it is found all over the Balkans. It is resistant to diseases and adapts well to climate change. It is one of the best breeds of honeybees. Its body is black, overgrown with gray-silver hairs. It is the main queen of good fertility. Honeybees belong to the peaceful bees, and the worker bees have a good instinct for collecting food.

According to the data of the Serbian Chamber of Commerce (Information of the Serbian Chamber of Commerce on the condition of beehives and honey production in Serbia, 2020), the number of beehives in Serbia has been growing steadily since 2014, and thus honey production and export (Table V). In 2018, Serbia had 914,000 hives, which is 35% more than in 2014 and 8% more than in 2017 (Fig. 10). Honey production in 2018 amounted to 11,427 tons, which is 160% more than in 2014 and 63% more than in 2017.

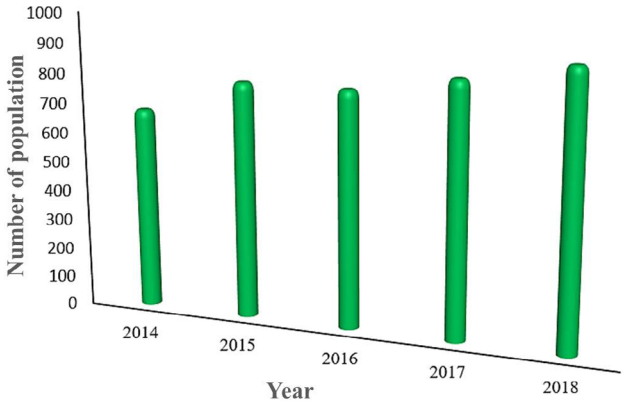

Fig. 10. Number of hives (in thousands) in the period 2015-2018.

Table V. Number of hives and honey production in the Republic of Serbia from 2014 to 2018.

Year	Beenhives (x 1000)	Honey production (t)
2014	677	4383
2015	792	12263
2016	792	5761
2017	849	7014
2018	914	11427

Data from the Serbian Chamber of Commerce (2020).

INDIGENOUS BREEDS OF PIGEONS

In the list of indigenous breeds of domestic animals and endangered indigenous breeds of the Ministry of Agriculture of the Republic of Serbia (Službeni glasnik RS, No. 33/17) are listed 50 breeds of pigeons (*Columba livia domestica)*, which have no special ecological and agronomic significance, so they are not shown and described in this paper.

Table VI shows all indigenous breeds of animals in Serbia. The + mark indicates that these breeds are in the list of the decree of the Ministry of Agriculture of Serbia

(Službeni glasnik RS, No. 33/17) and for which state can grant subsidies, while the sign - indicates that those breeds are not in the Ministry's list and for which the authors believe that these 15 animals (13 breeds and 2 strains) should be included in the List of Regulations in order to preserve and improve their condition.

Table VI. Overview of indigenous breeds in Serbia with status and representation on the List of the Ministry of Agriculture.

Species	Breed		Status		List of the Min. of Agric.
			Srb	FAO	
Horses, *Equus ferus*	Domaći brdski (Domestic-mountain pony)		Potentially endangered	V	+
	Nonijus (Nonius)		Highly endangered	III	+
	Jugoslovenski kasač (Yugoslavian Trotter)		No data available	VII	-
Donkeys, *Equus asinus*	Balkanski (Balkan donkey)		Potentially endangered	V	+
	Banatski (Banat donkey)		Critically endangered	III	-
Cattle, *Bos taurus*	Buša (Busha)		Potentially endangered	V	+
	Podolsko goveče (Podolian)		Critically endangered	III	+
	Kolubarsko goveče (Kolubarska)		Disappeared	I	-
Buffalo, *Babulus bubalis*	Domaći bivo (Domestic buffalo)		Potentially endangered	V	+
Sheep, *Ovis aries*	Pramenka/ strains (Pramenka)	Bardoka (Bardoka)	Critically endangered	III	+
		Vlaško-vitoroga (Vlashko-vitoroga sheep)	Potentially endangered	V	+
		Karakačanska (Karakachan sheep)	Critically endangered	III	+
		Krivovirska (Krivovirska sheep)	Highly endangered	III	+
		Lipska (Lipska sheep)	Highly endangered	III	+
		Pirotska (Pirotska sheep)	Critically endangered	III	+
		Šarplaninska (Sharmountain sheep)	No data available	VII	+
		Svrljiška (Svrljig sheep)	Not endangered	VI	+
		Sjenička (Sjenica sheep)	Not endangered	VI	+
		Baluša (Balusha)	Highly endangered	III	-
	Cigaja/strains (Tsigai)	Somborska (Sombor tsigai)	No data available	VII	-
		Čokanjska (Chokanj tsigai)	Not endangered	VI	+
Goats, *Capra aegagrus hircus*	Balkanska (Balkan goat)		Critically endangered	III	+
	Srpska bela (Serbian white goat)		Critically endangered	III	+
Pigs, *Sus scrofa domesticus*	Mangulica (Mangulica)		Not endangered	VI	+
	Moravka (Moravka)		potentially endangered	V	+
	Resavka (Resavka)		Critically endangered	III	+
	Šiška (Shishka)		Disappeared	I	-
	Šumadinka (Sumadija pig)		Disappeared	I	-
Chicken, *Gallus gallus domesticus*	Svrljiška (Svrljig Hen)		Highly endangered	III	+
	Somborska kaporka (Sombor Crested)		Highly endangered	III	+
	Banatski gološijan (Banat Naked Neck)		Potentially endangered	V	+
	Kosovski pevač (Kosovo singer)		Critically endangered	III	+
	Pogrmuša (Pogrmusha)		Disappeared	I	-
Geese, *Anser anser domesticus*	Novopazarska guska (Novi Pazar goose)		Critically endangered	III	-
	Podunavska tršava guska (Danube tufty goose)		Critically endangered	III	-
	Vojvođanska (Vojvodina Goose)		No data available	VII	-
	Šumadinska (Sumadija Goose)		Disappeared	I	-
Turkeys, *Meleagris gallopavo f. domestica*	Domaća ćurka (Domestic Turkey)		Potentially endangered	V	+
Ducks, *Anas platyrhynchos domesticus*	Domaća patka (Domestic Duck)		No data available	VII	+

Continues on next page.....

Species	Breed	Status		List of the
		Srb	FAO	Min. of Agric.
Ducks, *Anas platyrhynchos domesticus*	Domaća patka (Domestic Duck)	No data available	VII	+
Guinea fowls, *Numida meleagris f. domestica*	Domaća biserka (Guinea Fowl)	No data available	VII	+
Dogs, *Canis lupus familiaris*	Srpski gonič - Serbian Hound	Potentially endangered	V	+
	Srpski trobojni gonič – Serbian tricolour Hound	Potentially endangered	V	+
	Šarplaninac – Yugoslavian Shepherd dog - Sharplanina	Potentially endangered	V	+
	Žuti srpski gonič (Serbian yellow Hound)	Critically endangered	III	-
	Srpski pastirski pas (Serbian Shepherd dog)	No data available	VII	-
	Vojvođanski pulin (Vojvodina Pulin)	No data available	VII	-
Beens	*Apis meliffera* carnica	Not endangered	VI	+

The List of the Ministry Decree lists Domaća guska as a breed, and the authors propose four breeds of indigenous domestic goose. FAO categories: I, extinct; II, critical; III, critical with appropriate measures; IV, endangered; V, endangered with appropriate measures; VI, not endangered; VII, unknown.

CONCLUSION

Based on the analysis of available data on indigenous breeds in Serbia, the authors propose to amend the current list of the decree of the Ministry of Agriculture of Serbia with 15 more breeds or 13 breeds and 2 strains, in order to ensure the preservation and improvement of these breeds in Serbia, especially those that are highly and critically endangered and those for which there is strong belief that they have already disappeared.

Animal genetic resources have agroecological and economic significance. Agroecologically, it is reflected in the fact that these breeds are more resistant and easier to grow, traditionally present and less demanding and especially suitable for organic production. Preservation of their gene pool is of great importance for ecosystem and species diversity at the national and international level. The economic significance is in the inclusion of these breeds in the production of more biologically valuable food, which also brings greater economic benefits.

The bank of animal genes in Serbia has not yet been formed (there is only a bank of plant genes), so its formation is needed as soon as possible due to the possibility of *in vitro* - cryopreservation in the bank of genes, eggs, embryos, somatic cells, DNA and other biological material, which can be used to reconstitute animals or the most endangered breeds.

The Ministry of Environmental Protection should also provide incentives for the cultivation of indigenous breeds in protected natural assets (national parks, nature reserves, etc.) for companies, which manage protected natural assets, as well as for the population living in the area of protected natural assets.

The Ministry of Trade and Tourism should provide incentives and support for branding products from animal genetic resources (meat, dairy products, etc.), as well as for organizing fairs and exhibitions of indigenous breeds and their products on national and international level.

Greater media affirmation of autochthonous breeders in Serbia and product affirmation are also needed.

Statement of conflict of interest

The authors have declared no conflict of interests.

REFERENCES

Adžić, N., 2015. Konj (*Equus caballus*) (Horse), Crnogorska akademija nauka i umjetnosti. Podgorica.

Annual report on the work of the Kennel Club of the Republic of Serbia for 2018 and 2019, Beograd.

Banković, S., Medarević, M., Pantić, D. and Petrović, N., 2009. Nacionalna inventura šuma Republike Srbije (*National Forest Inventory of the Republic of Serbia*): Šumski fond Republike Srbije, Ministarstvo poljoprivrede, šumarstva i vodoprivrede Republike Srbije, Uprava za šume. Planeta print, Beograd.

Biodiversity *Strategy of Serbia with the Action Plan 2011-2018*. Službeni glasnik RS, br. 13/11.

Bogosavljević-Bošković, S. and Mitrović S., 2005. Gajenje različitih vrsta živine (*Breeding different types of poultry*), Agronomski Fakultet, Čačak.

Cekić, B., Petrović, P.M., Ružić, Muslić D., Maksimović, N., Caro-Petrović, V., Živković, V. and Marinković, M., 2018. Genetički resursi u ovčarstvu i kozarstvu centralne Srbije. Selekcija i semenarstvo (Genetic resources in sheep and goat breeding in central Serbia. *Select. Seed Product*., **24**: 2018, broj 1. Institut za stočarstvo, Zemun-Beograd.

DAD-IS Database, 2014. FAO UN.

Drobnjak, D., Urošević, M. and Matarugić, D., 2012. *Conservation of genetic resource of indigenous*

breeds domestic animals in Serbia. Book of abstract of the I International symposium and XVII scientific conference of agronomists of Republic of Srpska. Trebinje, BiH, pp. 131.

Drobnjak, D., Urošević, M., Ograk, Y. and Matarugić, D., 2012. Basic exterior characteristics of Serbian yellow hound in Southern Serbia. *Eurasian J. Vet. Sci*., **28**: 111-115.

FAO, 1999. *The global strategy for the management of farm animal genetic resources*. *Executive brief*. FAO, Rome. Available at: http://dad.fao.org/cgi-bin/getblob.cgi?sid=-1,50006152.

FAO, 2007. *Global plan of action for animal genetic resources and interlaken declaration*. Commission on Genetic Resources for Food and Agriculture, Food and Agriculture Organization, Rome.

FAOSTAT, 2012. *Statistical database.* Food and Agriculture Organization, Rome. Available at: http://faostat.fao.org/

Hrasnica, F., Ilančić, D., Milosavljević, S., Pavlović, S., Rako, A. and Šmalcelj, I., 1964. Specijalno stočarstvo (*Special livestock*), Zavod za izdavanje udžbenika Socijalističke Republike Srbije, Beograd.

Information of the Serbian Chamber of Commerce on the condition of hives and honey production in Serbia, 2020. Beograd.

Milošević, N. and Perić, L., 2011. Tehnologija živinarske proizvodnje (*Poultry production technology*), Univerzitet u Novom Sadu, Poljoprivredni fakultet, Novi Sad.

Milošević, N., Perić, L., Đukić-Stojčić, M., Trivunović, S., Rodić, V. and Bjedov, S., 2013. Autochthonous hen breeds in the Republic of Serbia – Banat Naked Neck and Sombor Crested. *World's Poult. Sci. J*., **69**: 153–162.

Mitić, N., Srećković, A. and Šljivovački, K., 1973. Svinjarstvo (*Pig farming*), Nolit, Beograd.

Mitrović, S. and Đekić, V., 2013. Organska živinarska proizvodnja (*Organic poultry production*), Univerzitet u Beogradu, Poljoprivredni fakultet, Beograd.

Myers, N. and Cowling, R.M., 1999. *Mediterranean basin*. https://doi.org/10.1371/journal.pone.0063926

Myers, N., Mittermeier, R.A., Mittermeier, C.G., Fonseca, G.A.B. and Kent, J., 2000. Biodiversity hot spots for conservation priorities. *Nature*, **403**: 853-858.

Petrović, V., 1988. Živinarstvo (*Poultry farming*), Naučna knjiga, Beograd.

Romčević, L., Trifunović, G. and Lazarević, L., 2007. Govedarstvo Srbije (*Cattle breeding in Serbia*), Poljoprivredni fakultet Beograd-Zemun.

Stanišić, L., 2017. Fenotipska i molekularno-genetička karakterizacija populacije balkanskog magarca u Republici Srbiji (*Phenotypic and molecular-genetic characterization of the Balkan donkey population in the Republic of Serbia*), Doktorska disertacija, Beograd.

Stanišić, L., Aleksić, J.M., Dimitrijević, V., Kovačević, B., Stevanović, J. and Stanimirović, Z., 2020. *Banat donkey, a neglected donkey breed from the central Balkans, Serbia*.

Stanković, S., 1962. Ekologija životinja (*Animal ecology*), Zavod za izdavanje udžbenika Narodne Republike Srbije, Beograd.

Statistički Godišnjak, 2019. Republički zavod za statistiku, Republike Srbije (*Statistical Yearbook for 2019 Republic Statistical Office, Republic of Serbia*), Beograd.

Stepić, S., Perišić, P., Stanojević, D. and Stojanović, S., 2019. Stanje populacije i parametri kvaliteta mleka domaćeg bivola u Srbiji (*Population status and parameters of domestic buffalo milk quality in Serbia*), Simpozijum "Zaštita agrobiodiverziteta i očuvanje autohtonih rasa domaćih životinja. Fakultet Veterinarske Medicine, Beograd, Zbornik Radova, pp. 45-54.

Stevanović, V., Jovanović, S., Lakušić, D. and Niketić, M., 1995. Diversity of vascular flora in Yugoslavia with review of internationally important species. In: *Biodiversity of Yugoslavia Jugoslavijewith review of internationally important species* (eds. V. Stevanović and V. Vasić). Biological Faculty in Belgrade and Ekolibri, Belgrade, Serbia.

Trailović, R. and Savić, M., 2019. Perspektiva održivog razvoja autohtonih rasa domaćih životinja u Srbiji (*Perspective of sustainable development of autochthonous breeds of domestic animals in Serbia*), Zbornik radova, Fakultet veterinarske medicine Univerziteta u Beogradu, pp. 26-31.

Urošević, M. and Drobnjak, D., 2019. Autohtone rase pasa u Srbiji i regionu. Zaštita agrobiodiverziteta i očuvanje autohtonih rasa domaćih životinja (*Indigenous breeds of dogs in Serbia and the region. Protection of agrobiodiversity and preservation of autochthonous breeds of domestic animals*), Zbornik radova, Fakultet veterinarske medicine Univerziteta u Beogradu, pp. 64-90.

Urošević, M. and Jocović, M., 1986. Breeding condition and some external measures of domestic white goats on the individual sector in Pančevački rit. *Vet. Stanica*, **17**: 1-4.

Urošević, M., 2006. Srpski i slični goniči (*Serbian and similar hunters*), Kinološki savez Republike Srbije, Beograd.

Urošević, M., 2009. *Behavior of shepherd dogs*. Kinološki savez Republike Srbije, Beograd.

Urošević, M., Drobnjak, D., Stojić, P., Matarugić, D. and Ograk, Y., 2014. Eksterijerni parametri ženske jaradi balkanske koze (*Exterior parameters of female Balkan goat cubs*), Zbornik naučnih radova XVIII Savetovanja agronoma, veterinara, tehnologa i agroekonomista. **20**: 235-240.

Urošević, M., Drobnjak, D., Trailović, R., Stanišić, G. and Stojić, P., 2019. Kolubarsko goveče Mit-Istorija-Realnost (*Kolubara beef, myth-history-reality*), COAR-Centar za očuvanje autohtonih rasa, Zemun.

Urošević, M., Turina, P., Stanivuković, G. and Jovanović, M., 2002. Balkanski pastirski psi (*Balkan shepherd dogs*), Izdavač Milivoje Urošević, Beograd.

Vacaru-Oprip, I., 2007. *Tratat de avicultura.* Bukurešt. Ceres Publishing House

Vučićević, M. and Resanović, R., 2019. Autohtone rase živine u Srbiji: Stanje i mogućnosti održivog uzgoja i proizvodnje (*Indigenous poultry breeds in Serbia: Status and possibilities of sustainable breeding and production*), Zbornik radova, Fakultet veterinarske medicine Univerziteta u Beogradu, pp. 55-63.