

Analysis of reintroduction and formation of European bison populations in Belarus

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Abstract: Reintroductions of European bison to various regions of Belarus were performed in 1994–2000, and in 2005 under the framework of “The program for conservation, distribution and use of European bison in Belarus”. In total 95 European bison – founders of new free-living populations were captured in National Park “Belovezhskaya Pushcha”. Four populations and 2 herds were formed up to 2012. The population size of European bison have grown from 347 individuals in 1994 to 1156 individuals (excluding mortality and elimination) in 2012, i.e. by 3.3 times. Created populations have reached various sizes and are at various phases of forming. Aspects of reproduction, population dynamics, mortality and main factors influencing them are given in this publication.

Key words: European bison reintroduction, conservation program, Belarus

Introduction

There were three free-living European bison populations in Belarus in 1994, all in national parks “Belovezhskaya Pushcha” (290 individuals), “Pripyatsky” (23 individuals) and Berezinsky Biosphere Reserve (34 individuals). The total numbers of Belarusian population were then 347 individuals, that was about 10.6% of the whole world population of the species. The growth of this population almost ceased in the late 80s and beginning of 90s of the XX century in Belarus (Kozla 2005), decreased by 2.5 times in the Ukraine (Kryzhanovski, Samchuk 2004), and by about 10 times in Russia (Sipko *et al.* 1999). The main factors driving this trend were less effective protection, considerable decrease of supplemental feeding and veterinary aid, and a disease of urogenital system (*balanoposthitis*) (Bunevich 1999). Despite obligations undertaken at Soviet-Polish meetings regarding the problems of breeding, reintroductions, exchange of animals (“blood-refreshing”), reconstruction of Lowland and Lowland-Caucasian lines etc. became invalid after disintegration of the former USSR. So in 1994 the Institute of Zoology (after 2008 – The State Research-Production Association “The Scientifically-Practical Centre of The National Academy of Sciences of Belarus on bio-resources”) initiated the national “Program for conservation, distribution and use of European bison in Belarus” (hereinafter referred to as Program “Bison”) (Kozlo 1999). The first stage of its implementation ended in 1994–2000. In total 96 European bison were caught

in NP “Belovezhskaya Pushcha” and became the founders of six new free-living populations.

The aim of the Program “Bison” was the development of new approach – a concept of meta-population model and a dual status of subpopulations of European bison in Belarus. Its main goals were:

- the extension of the area of occurrence by creation of new free-living populations in ecologically different regions;
- increase of total numbers, improvement of animals’ condition and vitality;
- determination of adaptation abilities of European bison (considering limited gene pool and inbreeding) to anthropogenically transformed ecosystems through studies on ecological (nutrition, behavior) and biological (fertility, birth, survival rate, mortality) population properties;
- development of action plan for determination of optimal population numbers, and management rules for E. bison populations.

In general the goal set up 18 years ago was reached and tasks were completed. There were 1156 European bison in 2012 in Belarus, the half this number in populations created under the framework of the Program “Bison”.

A course of formation of new populations and key factors that determined their size are presented in this publication. Perhaps the experience obtained there, will to some degree enrich the theory and practice of European bison reintroduction with new knowledge that can help to avoid or minimize mistakes that were made by us.

Material and methods

Areas (30–40 thousand ha) chosen for introduction and establishment of new populations were inspected in details including contiguous habitat patches (about 20–25 thousand ha). Following standard methods (Korochlina 1972; Dunin, Kozlo 1992) studied were: landscape-hydrological conditions (marshlands, network of watercourses and reservoirs, species and age structure of tree stands and their area); species composition of understory and their density; species composition and biomass of ground vegetation. A population census of European bison was performed in winter by visual registration and photographs. Determined were the density (number of individuals per 1000 ha of forest); recruitment rate, and reproduction coefficient (ratio of calves vs. fertile females). Analyzed were reports of *post-mortem* examination and trophy evaluation forms.

Results and discussion

Populations created due to the Program “Bison” have reached various sizes and stage of forming, so they can be divided into three groups: 1 – well formed populations, 2 – satisfactorily formed populations; 3 – undeveloped populations, that remain at the stage of small herds.

Group 1. Well formed populations

It includes two populations – Osipovichskaya and Oziorskaya, inhabiting central Belarus – Osipovichsky forestry and North-Western Belarus – kolkhoz “Oziory of Grodno region” respectively.

Osipovichskaya population. Forests growing at its territory are continuous and compact. They consist of broad-leaved forests (30.6%), deciduous forest plantations (11.2%), clearings, waste grounds, glades and hayfields (22.4%), and 9.0% of alder forests. There is a small portion of pine forests (5.9%) and fir stands (8.8%) on uplands, i.e. the area of coniferous stands there is by 10–12 times lower than in other forests in the middle of Belarus. Forests there are characterized by high trees density, and well developed understory consisting of species preferred by E. bison. Forest ecosystems of Osipovichsky forestry considerably differ from those in national park “Belovezhskaya Pushcha” regarding their trophic conditions. The presence of glades, clearings, overgrown cleared spaces, where herbs are well developed, is an important ecological factor supporting European bison population. Since 2000 in autumn-winter period and in early spring European bison there use to graze at agricultural fields, where they damage winter rye and rape, corn, potato etc.

In February-March of 1997, 15 animals were brought to Osipovichska forestry from Belovezhskaya population, among them there were 7 from the most northern Yazvinska group and 8 from the most southern Korolovo-Mostovskaya group. Not closely-related founders of Osipovichskaya population and favourable ecological conditions at the area of reintroduction allowed for successful passing the adaptation period, high reproductive coefficient, and growth rate. During 16 years population numbers there raised from 15 to 204 individuals, i.e. by 13.6 times (Tabl. 1). From 1997 to 2012 there were born 197 calves, or in average 12.3 calves per year. Especially high number of offspring was in 2008–2012 (excluding 2010) – from 10 to 28 individuals. The birth index was between 9.2% and 33.3%, on average 17.2% and index of fertility was 21.0–50.0% and 29.8% respectively. As for comparison we should say that in Belovezhskaya Pushcha birth index is lower – 14.7%, but index of fertility is higher – 37.8% (Kozla, Bunevich 2009). But it is necessary to remember that the latter measure is not very reliable, because the identification of fertile European bison females in the wild is very hard.

In comparison with other similar European bison populations Osipovichskaya favourably differs by minimal losses in the population: due to wounding, illegal hunting, scapula breaking etc. 6 individuals deceased. Diseases and deaths due to other reasons were not revealed. In 2002–2012, 16 males and 3 females were eliminated, thus the total lost was 25 individuals. Then, the total numbers of this population reached 230 individuals. This is the highest rate of growth among all populations created under the framework of the Program “Bison”.

Table 1. Dynamics of main population parameters in Osipovichskaya and Oziorskaya European bison populations

Year	No of individuals	% increase or decrease	Calves born	Index, %		Decrease		
				fertility	birth	total	natural	elimination
Osipovichskaya								
1997	15	–	3	42.8	20.0		–	–
1998	18	+20.0	3	37.5	16.6		–	–
1999	21	+16.0	7	50.0	33.3		–	–
2000	28	+33.3	4	23.5	14.3		1 ♀	–
2001	32	+14.3	6	30.0	18.7		–	–
2002	40	+25.0	4	20.0	10.0		–	1 ♂
2003	50	+25.0	12	30.8	24.0		2 ♂	1 ♂
2004	59	+18.0	8	21.0	13.5		–	2 ♂, 2 ♀
2005	63	+6.7	11	26.2	17.4		–	1 ♀
2006	72	+14.3	9	21.4	12.5		–	2 ♂
2007	92	+27.8	20	33.3	21.7		–	2 ♂
2008	114	+23.9	23	31.5	20.2		–	1 ♂
2009	128	+12.2	24	32.8	18.7		1 ♂, 1 ♀	2 ♂
2010	152	+18.7	14	24.1	9.2		–	5 ♂
2011	186	+22.4	28	28.5	15.0			
2012	204	+9.6	21	22.8	10.3			
Total	1274	287.3	197	476.2	275.4			
Average	79.6	17.9	12.3	29.8	17.2			
Oziorskaya								
1998	18	–	7	77.7	38.8		–	–
1999	25	+38.8	10	62.5	40.0		–	–
2000	35	+40.0	4	28.5	11.4		–	–
2001	39	+11.4	7	38.8	17.9		–	–
2002	46	+17.9	7	30.2	15.2		–	–
2003	52	+13.0	9	36.0	17.3	1		1 ♂
2004	60	+15.4	11	40.7	18.3	5	–	3 ♂, 2 ♀
2005	69	+15.0	12	48.0	17.4	2		2 ♂
2006	79	+14.5	10	38.5	12.6	4	2 ♂	2 ♂
2007	93	+17.7	12	24.0	12.9	6	1 ♂	5 ♂
2008	110	+18.2	13	27.0	11.8	1	–	1 ♂
2009	124	+12.7	14	27.4	11.3	3	1 ♂	1 ♂, 1 ♀
2010	139	+12.1	15	29.4	10.8	2	–	2 ♂
2011	164	+18.0	20	30.3	12.2	4	–	3 ♂, 1 ♀
2012	185	+12.8	19	23.4	10.3	5		5 ♂
Total	1988	257.5	170	562.4	258.2			
Average	132.5	17.2	11.3	37.5	17.2			

Oziorskaya population. European bison were reintroduced to the Grodnensky forestry, a small forest area in kolkhoz “Oziory” with agricultural fields assigned for the production of forage for the cattle. The area designated for European bison reintroduction was 15–20 thousand ha composed of compact forest without human settlements, bordering with fields. Dominating there are pine forests (60%), followed by alder forests (12.0%), birch woods (10%), fir stands (7%), lowland swamp (about 11%). A majority of stands are in middle age or mature. Understory is dense and consists of main species composing the diet of European bison.

Eighteen individuals – the founders of Oziorskaya population were brought to kolkhoz “Oziory” from Belovezhskaya Pushcha in 1998. Among them there were 4 males (2 were 1.5 years old, 2 were 3 and 7 years old) and 14 females (1 was 2.5 years old, 2 were 3 years old, 5 were 3.5 years old and 6 were 4; 5.5; 5; 6; 8 years old). The enclosure and other infrastructure were built for the temporary maintenance of animals in forest compartment n. 45.

The development and forming of Oziorskaya population were very fast in comparison with other populations. Its numbers grew from 18 to 185 individuals during first 15 years. Nine European bison died during this period (Tabl. 1). Elimination of defective individuals was introduced from 2003. In total there were eliminated 29 individuals (25 males and 4 females). Thus the total population decrease was 38 individuals. Together with animals counted in 2012 the overall numbers are 223 individuals. The analysis of population data has proved that the elimination of a small proportion of males does not have an effect on reproduction. The ratio between fertile males and females can be maintained in proportion 1:3 or even 1:4.

Average annual index of population increase was there 17.2%. Since 1998 there were born 170 calves. Average index of fertility is the highest among all populations – 37.5% (from 23.4 to 77.7%) and index of birth is the same as in Osipovichskaya populaton – 17.2%. Undoubtedly high development rate of Oziorskaya population is a result of good all year long habitat conditions and effective protection.

The analysis proved that Oziorskaya population lives in the most favorable ecological conditions in comparison with other populations. To a high degree it is connected with specialization of local agriculture towards hayfields. Fields are mowed at regular intervals to feed the cattle that stay in farms. There are also fields with perennial herbs (trefoil, alfalfa), pea, corn and other plants that are very good grazing ground for European bison. Therefore, they have an access to green forage from early spring until late autumn. Nevertheless, studies performed in 2007 have shown that in spite of forage abundance in agricultural fields European bison consumed a number of species growing in various types of forest ecosystems.

Oziorskaya population remains within originally chosen territory. The major factor that prevents it from moving away and emigration is the presence

of hayfields. In spring-summer period its home range is about 12 thousand ha, in autumn 8–9 thousand ha, and in winter it decreases to 6–7 thousand ha. Successful reintroduction and creation of this population allows to conclude that forests mixed with agricultural fields are very perspective for European bison introduction.

Group 2. Forming populations

There are 2 European bison populations in this group – Volozhynskaya, created in central Belarus in Volozhynsky forestry (from 2005, the territory belongs to the State Landscape Reserve “Nalibokski”) and Poleskaya that lives in Polesky State Radiation-Ecological Reserve. The development of the second population is very interesting case, because it lives in extreme conditions of radioactive pollution caused by a disaster at Chernobyl nuclear power plant. According to data from Deryabina (2012), in European bison habitat, the level of ^{137}Cs pollution is in the range from 15 to 40 and over Ku/km^2 , so the radiation dose within reserve’s territory is over 20 mSv per year.

Volozhynskaya. Fifteen European bison – the founders of new population were brought to Volozhynski forestry in 1994. Among them there were 5 males of 1.5; 3; 4.5; 5; and 6 years old and 10 females of the following age structure: 2; 3; 5 (3 individuals); 7 (2 individuals); and two 8 years old. Animals stayed in the enclosure (6 ha) up to the end of May.

120 calves were born there from 1994 until 2012 (Tabl. 2). Calving took place in May, but about 15 individuals were born in later months. Average annual number of calves was 6.3, maximally 13 individuals. Birth index on average was 15% and average fertility index 32.5%, ranging between 16 – 60%. These indexes are significantly lower than in Osipovichskaya and Oziorskaya populations. Including natural decrease and elimination of defective animals (old, sick, wounded) average annual increase of Volozhynskaya population was 9.6% (between 6 and 32.1%). During 19-years period of formation the Volozhynskaya population, natural decrease amounted to 18 individuals. Causes of decrease were: respiratory system diseases, heart failure, illegal hunting, emigration. Total decrease, including eliminated animals was 42 individuals. The analysis of main population parameters shows that the first stage of reintroduction and forming of European bison population Volozhynskaya up to 2005 passed successfully. But in 2005 established was the State Landscape Reserve “Nalibokski” with area 77 540 ha. According to rules for all landscape reserves there were no additional feeding, protection of European bison was weaken, also increased the numbers of wolves (50 wolves were counted from helicopter in 2008). All of these facts contributed to worse life conditions for European bison. Some animals emigrated to neighboring forests – Ivjevski and Stolbtsovski.

The present home range in winter is about 6.5–7.5 thousand ha, in summer – 30–35 thousand ha. The population density is 8.5 and 1.6 individuals per

Table 2. Dynamics of main population parameters in Volozhynskaya and Poleskaya European bison populations

Year	No of individuals	% increase or decrease	Calves born	Index, %		Decrease		
				fertility	birth	total	natural	elimination
Volozhynskaya								
1994	15	–	6	60.0	20.0	2	2	
1995	17	13.3	3	30.0	17.6	1	1	
1996	19	11.7	6	42.8	31.5	–	–	
1997	24	26.3	5	29.4	20.8	1	1♂	
1998	28	16.6	7	41.2	25	–	–	
1999	37	32.1	6	31.5	16.2	3	3	
2000	39	5.4	5	23.8	12.8	4	1	1♂, 2♀
2001	44	12.8	8	36.4	18.2	5	1♂	2♂, 2♀
2002	46	4.5	7	31.8	15.2	4	2	1♂, 1♀
2003	47	2.2	6	27.2	13.0	5	1	2♂, 2♀
2004	53	12.8	8	34.7	15.1	2	1	1
2005	56	5.6	5	22.7	8.9	4	1	3♂, 1♀
2006	54	-3.6	7	31.8	12.9	3	2	1
2007	60	11.1	7	30.4	11.7	1		1
2008	67	11.7	7	30.4	10.4	1	1	
2009	63	-6.0	5	20.8	7.9	1	1	
2010	76	20.6	13	56.5	17.1			
2011	82	+7.9	4	16.0	4.9	1	–	1
2012	80	-2.4	5	20.0	6.3	3		3
Total	907	182.6	120	617.4	285.6			
Average	47.7	9.6	6.3	32.5	15.0			

1000 ha of forest area respectively. In summer the home range is limited by river Izled' from the south, river Isloch' from the west and in the north it extends to the boundary of forest complex Nalibokskaya Pushcha.

Poleskaya. Introduction of European bison to Polesky Radiation-Ecological Reserve was risky decision. Results of study on radiation influence upon wild boar (*Sus scrofa*), moose (*Alces alces*), and roe deer (*Capreolus capreolus*) populations inhabiting this territory showed that only during 3–4 years after Chernobyl nuclear power plant disaster, reproduction of those species was by

Table 2. continued

Year	No of individuals	% increase or decrease	Calves born	Index, %		Decrease		
				fertility	birth	total	natural	elimination
Polesskaya								
1996	18		4	50.0	25.0	1	1	-
1997	19	+18.7	2	28.5	10.5	2	2	-
1998	21	+10.5	2	28.5	9.5			
1999	24	+14.3	3	37.5	12.5			
2000	26	+8.3	2	22.2	7.7			
2001	30	+15.4	4		13.3	from 2001 until 2006 there were no data		
2002	33	+10.0	3		9.1			
2003	36	+9.0	4		11.1			
2004	42	+16.6	6		14.3			
2005	47	+11.9	6	30.0	12.7			
2006	56	+19.1	9	39.1	16.1			
2007	63	+12.5	7	28.0	11.1			
2008	68	+7.9	11	40.7	16.2			
2009	71	+4.4	6	24.0	21.4			
2010	76	+7.1	7	26.9	25.0			
2011	85	+11.8	8	28.5	9.4			
2012	93	+9.4	12	37.2	12.9	5		5
Total	808	186.9	92		212.8			
Average	47.5	10.9	5.8		13.3			

Notice. Amount of calves born, indexes of birth and fertility during the 1st year of European bison introduction to Polessky radioactive-ecological reserve were not taken into account because they originated from Belovezhskaya population, that lives on non radiation polluted territory

2–3 times lower than usual and then it came back to normal and their numbers were growing quickly (Kozlo *et al.* 1995). Favorable landscape-cover conditions, plenty of forage in forest ecosystems and especially at former agricultural fields, strong protection regime over the great territory (216,500 ha) made the reserve an attractive place for European bison reintroduction. Sixteen European bison (4 males and 12 females at the age between 2 and 6 years) were brought into Polessky Radiation-Ecological Reserve in 1996. For almost 1.5 years animals stayed in the enclosure (75 ha). In the same year one female died, but 4 calves were born (3 males and 1 female), but the last one on January 2nd of 1997 drowned in the waterhole. On the beginning of the 1997 there were 19

European bison there: 12 females, 3 males, 3 calves born in 1996 and one calf born on the 10th of May 1997 (Tabl. 2). During 16 years of its forming 92 calves were born in Polesskaya population, on average 5.8 per year. During 1996–2003 while E. bison numbers were between 16 and 47 individuals and during next years when they raised up to 93 individuals, from 6 to 12 calves were born every year. Perhaps during first 6–7 years radiation could negatively influence the reproduction, analogically like in the case of other ungulates (Kozla *et al.* 1993; 1998). During this period European bison fertility index was on average 29.2% and birth index was on average 10.1%. Since 2001, and notably since 2004 the reproduction became to increase. In 2012, there were already 93 animals. Average annual index of increase was almost 11%. Total decrease due to our data and other published data (Deriabina 2012) during all period of Polesskaya population forming was 25 individuals, i.e. average annual death rate was 1.5 individuals. Mainly, there were natural cases: old age, blindness, drowning, and anthropogenic: illegal hunt, unsuccessful immobilization and others. Thus during 17 years the numbers of European bison in Polessky Radiation-Ecological Reserve became by 3.6 times higher than in Berezinsky Biosphere Reserve during 38 years: 93 individuals vs. 26 respectively. Present home range of European bison population Polesskaya, is about 15 000 ha. In grazing period the density of population is 3.9 individuals per 1000 ha, and in the period of supplemental feeding (fall-winter) it is by 1.5 times higher – 5.9 individuals per 1000 ha. Since 2005 some males went out of the territory of reserve towards agricultural fields. It should be mentioned that in the Ukraine population of Przewalski's horse (*Equus p. Przewalskii* Poljakow, 1881) has been successfully formed in the same conditions.

Comparative analysis of results of research showed that both forming populations – Volozhynskaya and Polesskaya are characterized by similar indexes and reached similar numbers – 80 and 93 individuals, amount of calves born – 114 and 92 calves, index of birth – 15.0% and 13.3% respectively. However they differ regarding indexes of decrease because the first population belongs to species' reserve gene pool and the second belongs to main (insurance) gene pool and due to that it remains under absolute protection, i.e. almost without human interference like planned elimination of sick and defective animals. Total lost including elimination was 41 individuals in Volozhynskaya (23 were eliminated) and 25 individuals in Polesskaya (3 were eliminated and 2 were unsuccessfully immobilized).

Group 3. Undeveloped populations

They are represented by Naydianskaya and Lyaskovichskaya herds, that live on the South of Belarus in so called Pripjat' Polesie on the left bank of the river Pripjat' at the territory of experimental hunting enterprise "Lyaskovichi" of the National park "Pripjatski". In comparison with other 4 populations

these two herds were established not very long ago. The first was initiated in 2000, and the second in 2005.

Naydianskaya herd. The territory (about 20 000 ha) selected for E. bison introduction and formation of Naydianskaya population is situated within upper part of river Pripyat' flood-plain, that differs from neighboring areas because of intact and relatively natural conditions of mature forests and water-meadows ecosystems. The percentage of marshlands there is not high – 7.7%. The terrain is elevated, with not many hills. There are 178 species of herbs and dwarfshrubs, 135 of them (76%) are eaten by European bison. Out of this number, 101 species (57%) belongs to main and supplemental items in E. bison diet. This territory surpasses regarding the amount of biomass of natural forage all other territories where European bison reintroduction took place. It has to be mentioned that in 2002–2003 European bison emigrated from the territory of reintroduction. They moved to the north direction at the distance of 12–15 km into afforested and shrubby area situated between forests and fields and the agricultural fields of experimental hunting enterprise “Lyaskovichy”. Crops of winter rye and rape, corn and other plants are available there for European bison during whole autumn and in early spring, and fields with non ploughed corn are available from September until March. Perhaps one of the reasons for leaving the original territory was a discomfort caused by a lot of blood-sucking insects in flood-plain. In February-March of 2000, 13 European bison (10 females: 2 at the age 2.5 years, 3 at the age 4 years, 2 at the age 6 years, 3 at the age 6, 8 and 9 years; and 3 males at the age 2, 3.5 and 4 years) were brought there. Animals were kept in the enclosure (15 ha) until October. During 13-year period of the existence of this population it reached its maximum in 2008 (23 individuals), i.e. increased by 1.8 times, but in 2012 there were only 20 individuals left there (Tabl. 3). The main factors inhibiting the growth rate and formation of the population were: low initial numbers of animals, aggressive female that killed 3-year old female and a calf, illegal hunting and unexplained disappearance of some animals. Total estimated decrease was 24 individuals. 27 calves were born there from 2000 until 2012, on average 2.0 calves per year, a maximum were 3 calves in one year. Average index of birth there was 12.0%, average index of fertility 28.9% (ranging between 12.5 and 42.8%), and birth index was between 7.7 and 21.4%. To create a stable population there it is recommended to deliver additional 12–15 European bison in reproductive age. Taking into account ecological conditions of the habitat there, the acceptable target numbers are estimated for 60 to 70 individuals, but if rules for this herd would be changed (lowering the protective status of the herd), it will be possible to maintain 130–150 individuals there.

Lyaskovichskaya herd. Its home range is covered by forests in almost 80.0%, fields constitute about 15%, and clearings about 2% Remaining area cover marginal habitats. Mossy and bilberry pine forests, birch and aspen

Table 3. Dynamics of main population parameters in Naydyanskaya and Lyaskovichskaya European bison herds

Year	No of individuals	% increase or decrease	Calves born	Index, %		Decrease		
				fertility	birth	total	natural	elimination
Naydyanskaya								
2000	13		1	12.5	7.7	2	2	-
2001	11	-15.3	1	20.0	9.1	3	2	1
2002	14	+27.2	3	42.8	21.4	-	-	-
2003	16	+14.3	3	42.8	18.7	2	1	1
2004	16	0	2	33.3	12.5	2	1	1
2005	20**	+25	2	28.5	10.0	2	1	1
2006	18	-10	2	28.6	11.1	-	-	-
2007	21	+16.6	2	22.2	9.5	2	1	1
2008	23	+9.5	3	37.5	13.0	1	-	1
2009	19	-17.4	2	28.5	10.5	6	3	3
2010	16	-15.8	2	28.5	12.5	3	2	1
2011	18	+12.5	2	25.0	11.1	1	-	1
2012	20	+11.1	2	25.0	10.0	0	-	-
Total	225	57.7	27	375.2	157.1	24	13	11
Average	17.3	4.4	2.0	28.9	12.0	-	-	-
Lyaskovichskaya								
2005	14	-12.5	2	33.3	12.5	4	4	-
2006	16	+14.3	2	40.0	14.3	-	-	-
2007	17	+6.2	2	28.5	12.5	1	-	1
2008	17	0.0	2	28.5	11.8	2	2	-
2009	13	-23.5	2	20.0	11.8	6	6	?
2010	11	-15.4	1	25.0	7.7	3	1	2
2011	10	-9.1	1	33.3	9.1	2	1	1
2012	12	+12.0	2	50.0	16.6	?	?	?
Total	110		14	258.6	96.3	18	10	4
Average	13.7		1.7	32.3	12.0			

Notice.

* deceased due to various cases, emigrated and lost animals are included in natural decrease

** 2 animals joined from Lyaskovichskaya herd

forests dominate. There are not much oak and hornbeam woods. Swamps are mainly of lowland transitional type, small and spread in the forest.

The territory selected for European bison reintroduction and creation of new population includes enclosed hunting enterprise (3500 ha), that specializes on breeding wild boar (*Sus scrofa*), red deer (*Cervus elaphus*) and new species – fallow deer (*Dama dama*). The task of this hunting enterprise was the organization of commercial trophy hunting. Main part of delivered European bison was placed in one of the sectors of the enclosure, and smaller group was released to the wild. European bison living in the enclosure stay in optimal conditions. There are 500 ha of forage fields here, where various plants are cultivated: winter rye, oats, trefoil, earth apple and others. Additionally, for almost the whole year there is supplemental food provided for game species and European bison.

In February–March 2005, 16 European bison were brought to the enclosure (42 ha). Among them there were 4 young males: 2 at the age 1.5 years, 1 at the age 2 years, 1 at the age 3.5 years and 12 females: 4 at the age 1.5–2 years, 5 at the age 4–6 years and 3 at the age 7–12 years. The herd grew up until 2008, but during next 4 years it decreased to 12 individuals (Tabl. 3).

In 2005–2009 and in 2012, 2 calves were born annually, 1 calf annually was born in 2010–2011. In total 14 calves were born there, while mortality amounted to 18 individuals. One at a time animals were eliminated in 2007, 2010 and in 2011. One individual died, but the case of it's death and disappearing of other animals remain unknown. Average birth index was 12.0%, average index of fertility was 32.3%.

The main reasons of such slow forming of European bison herd Lyaskovichskaya are: probable deficiency of good males, early introduced elimination, and disappearance of animals due to unknown reasons.

Nutritional conditions in the enclosure of hunting enterprise are good, however animals there are exposed to various disturbance factors (shooting, probability of transmitted diseases, frequent human presence). That's why the status of "demonstrative" was assigned to Lyaskovichskaya herd. The optimal E. bison numbers there are estimated for 15–20 individuals. To prevent degeneration of this herd a 'blood refreshing' would be necessary through the exchange of some males with other populations

Conclusions

Reintroduction of European bison and creation of new free-living populations under the framework of the Program "Bison" has been successfully completed. The rate of forming the two populations (Osipovichskaya and Oziorskaya) was excellent, in case of other two populations (Vozhynskaya and Polesskaya) was good, but another two populations (Naydianskaya and Lyaskovichskaya) remain undeveloped because of negative anthropogenic factors. Total E. Bison

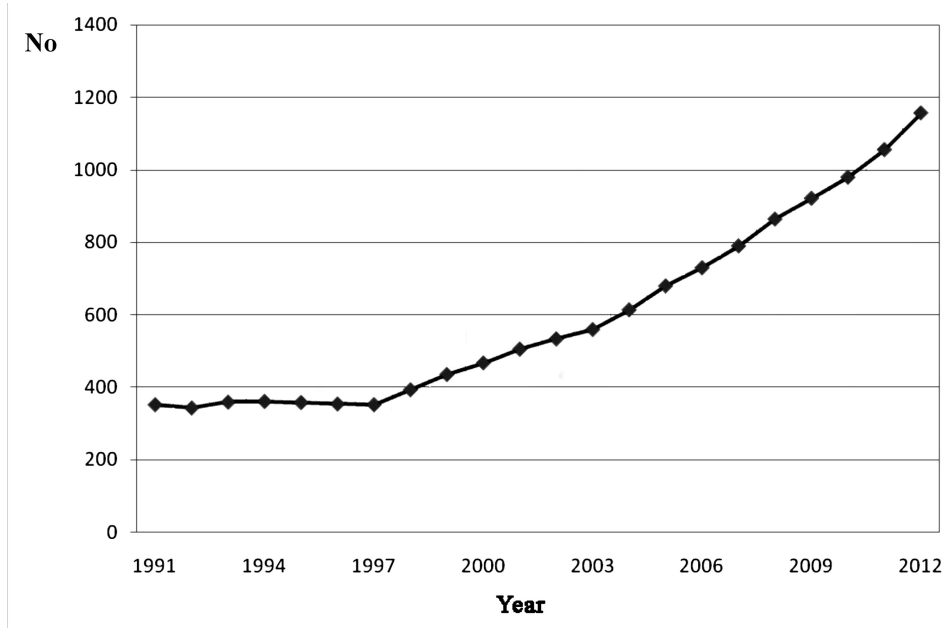


Figure 1. Dynamics of European bison numbers in Belarus

numbers in those populations in 2012 was 594 individuals or about 52% of total European bison numbers in Belarus. In fact, four populations, created at the territories of commercial use (forestries, kolkhoz “Oziory”) and at radiation polluted territory (Polesky Radiation-Ecological Reserve) during short period of time, exceeded the size of three populations (Belovezhskaya, Berezinskaya and Ozieranskaya), living in Berezinsky Biosphere Reserve and national parks for twofold longer period of time. Populations of European bison differ considerably regarding their growth rate (Fig. 2). Populations created and formed in 1994–1998 are characterized by high growth rate and populations established earlier grew much slower. Thus, the goal of increasing the numbers of European bison has been reached mainly because of reintroduction program. It appeared to be effective because of choice of introduction areas with favourable ecological conditions, and secondly – high interest of populations owners (forests, kolkhozes) in effective protection and provision of supplemental feeding.

For the first time in Belarus free-living population of European bison has been created in forest-agricultural ecosystem of kolkhoz “Oziory”, and with good results. During 14 years (1998–2012) the numbers of Oziorskaya population grew up from 18 to 185 individuals. This population became well adapted to forest-agricultural ecosystems, where agricultural crops are available at fields. Easy adaptation of European bison to anthropogenic landscapes indirectly confirms, that this species could originate from the steppe and later

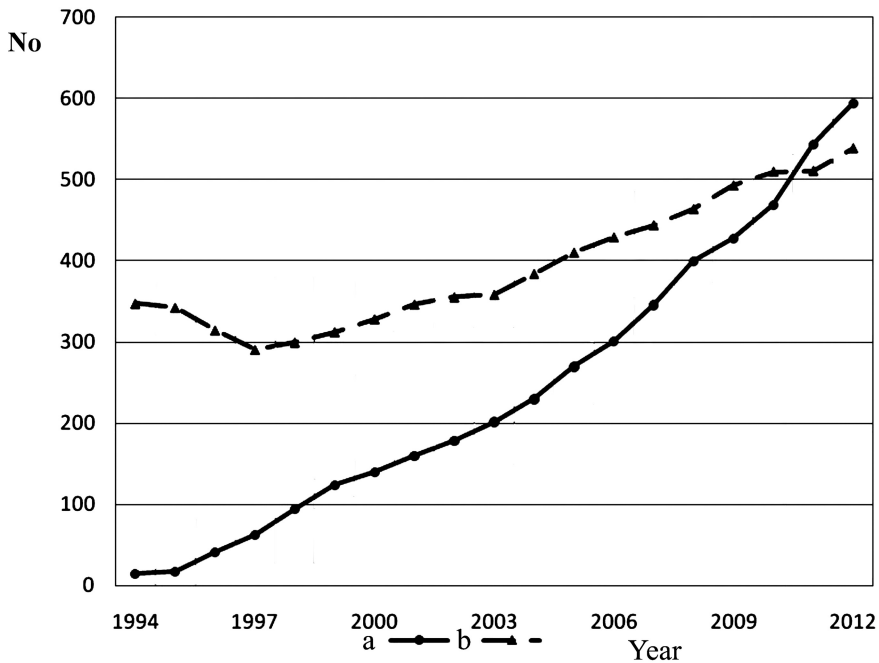


Figure 2. Dynamics of European bison population numbers in Belarus: a – created during the 1st stage of the Program “Bison”; b – created before 1994

on make periodical use of the forest. In all places of reintroduction the growth of *E. bison* numbers led to increase of home range area except the Polesky Radiation-Ecological Reserve. Usually after 4–5 years of reintroduction European bison wander into agricultural fields and use them as pasture. If there are available attractive crops (winter rye, corn, potatoes, beets etc.) damages are considerable. E.g. in case of Belovezhskaya population in some seasons about 50% of animals leaves the national park and feed at neighbouring agricultural fields.

It is obvious that the approach “put European bison to the forest, and let it become wild” is unjustified in modern conditions of forest ecosystems of Belarus. Existing small forests, their age and species structure, ground cover, that are the main European bison’s forage, greatly changed during last 2–3 centuries.

At present, there are about 200–250 individuals in 3 populations (Belovezhskaya, Oziorskaya, Osipovichskaya), that exceed ecological (nutritional, spatial) capacity of their habitats. These animals could be transferred to hunting enterprises and kolkhozes of Belarus. But further reintroductions and creation of new large populations in Belarus, would require a change of protection status of the species to a lower level, and secure an improvement of gene pool for the whole population.

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Analiza reintrodukcji i formowania populacji żubra w Białorusi

Streszczenie: Reintrodukcje żubra w różnych regionach Białorusi przeprowadzono w latach 1994–2000 oraz w 2005 roku w ramach projektu pt. „Program ochrony, rozprzestrzenienia i użytkowania żubra w Białorusi”. Łącznie 95 żubrów – założycieli nowych wolno-żyjących populacji odłowiono w Parku Narodowym „Białowieska Puszcza”. Cztery populacje i dwa stada utworzono do 2012 roku. Wielkość białoruskiej populacji żubra wzrosła z 347 osobników w 1994 roku do 1156 zwierząt (wyłączając śmiertelność i eliminacje) w 2012 roku, czyli 3,3 razy. Utworzone populacje osiągnęły różną wielkość i są na różnym poziomie formowania. W pracy omówiono aspekty reprodukcji, dynamiki populacji, śmiertelności i głównych czynników ją powodujących.
