

# Free living European bison population in Belarus

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**Abstract:** During the establishment of the state of Belarus in 1991, there were already three micropopulations of the European bison. A 'metapopulation strategy' for Belarus was proposed to counteract high animal densities. The strategy depended on the creation of 10–12 local groups of European bison (micropopulations) within the territory of Belarus in diverse natural conditions. To reduce negative consequences of isolation, a translocation of individual males between micropopulations at least once 1–2 times per generation was assumed. Originally, the populations were divided into two groups: "the main gene pool" and 'reserve gene pool' which depended on the location (protected areas or hunting grounds). For each population optimal numbers of individuals were assessed, but only animals from the 'reserve gene pool' could be hunted. Later the strategy was modified, and all animals, regardless the location" were included into a "the main gene pool". Currently European bison is distributed on the territory of Belarus in 10 separate micropopulations. The realization of metapopulation model allowed to reach high growth rate of European bison population in Belarus. The development of the majority of the population was relatively dynamic, especially in the first period after reintroduction. Currently, five out of ten micropopulations have exceeded assumed optimal number. In two micropopulations the optimal number was exceeded by over 100%. As a result, there is a real risk of population overcrowding, leading to faster disease transmission and damage to agricultural crops. There is a need for implementation of effective mechanisms minimizing the exceeding of the carrying capacity of the European bison population in Belarus.

**Key words:** European bison, Belarus, metapopulation strategy, population development, carrying capacity, optimal numbers.

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## Introduction

European bison *Bison b. bonasus* L., is one of the examples when timely taken measures to protect the species, saved them from complete destruction, and subsequently allowed to appear again over a vast range (Olech *et al.* 2019). In this case a positive trend is observed, the range of this species has increased

during the last decade. Despite this, the species is still included into IUCN Red List (VU by D1, IUCN ver. 3.1 criteria, 2008), and Red Books of Belarus, Lithuania, Poland, Russia, Ukraine (NT, IUCN, 2011). There are still real threats to the population and conservation measures are necessary (Olech et al. 2019). Currently, Belarus is the second country in the world in terms of numbers of free-living European bison. The information about the main stages of the development of free living European bison population within the territory of Belarus and its current state is given in this article. In Belarus, each free living population, within the designated forest complex is defined as a micropopulation and this terminology will be used in this article.

## **Study area and methods**

During the establishment of the state of Belarus in 1991, there were already three micropopulations of the European bison: Belovezhskaya, Berezinsko-Borisovskaya and Ozeranskaya (on the territory of the Pripyatsky National Park). The largest micropopulation was located in Belavezhskaya Pushcha (315 individuals) which constituted 96% of all free living individuals of this species in Belarus. The high density of animals in this population, affected negatively its development, as here was a risk of the emergence of various diseases (Bunevich, 1999). The high conservation status of European bison did not give also the possibility of more wide animal translocation, including hunting grounds. Therefore, there was a need to find optimal solutions.

In order to find an optimal solution for the contradictory and sometimes mutually exclusive tasks, a ‘metapopulation strategy’ for Belarus was proposed by Kozlo (1999). The idea of the strategy was the creation of 10–12 local groups of European bison (micropopulations) within the territory of Belarus in diverse natural conditions. This approach assumed to adapt European bison to various available habitats. To reduce negative consequences of isolation, it was envisaged to exchange genetic material between these groups at least once 1–2 times per generation of the European bison, by relocating single males among them. According to this approach all micropopulations within the borders of Belarus were regarded as one metapopulation. Such distribution aimed at protecting individual micropopulations from possible negative environmental factors, as well as diseases (Kozlo & Bunevich 2011).

The financial support for the creation of such micropopulations was a significant problem. The cases poaching on European bison were sporadic, due to its high conservation status until 1999. Due to the perspective of the resettlement of animals to hunting grounds, a legal regulations regarding the number of the individuals and their economic use had to be developed. Hence,

it was proposed to divide all micropopulations into two groups. Animals living in protected areas were included into 'the main gene pool'. Individuals from these micropopulations were managed according to the law concerning species included into the Red Book. Populations created on the territories of hunting grounds after reaching certain numbers (optimal numbers), could be used as a game species. This approach was aimed at encouraging hunters to actions to increase the size of *E. bison* micropopulations. At first, individuals who did not take part in the population development should be removed. For this purpose, a list of external features indicating suitability for elimination has been developed (Kozlo *et al.* 1996). The withdrawal could be carried out in terms of growth, but the population size should not decrease below the values established for each micropopulation. Animals in such populations were assigned to the 'reserve gene pool'. In case of the decrease of the micropopulation numbers of the main gene pool, the animals of reserve gene pool could be used for supplying these micropopulations.

Currently this concept is modified regarding the approach to the division of micropopulations. All European bison, regardless the place of occurrence (protected areas or hunting grounds) belong to the category of the 'main gene pool'. Moreover, regardless of the dynamics of the numbers of micropopulations, and their location, it is allowed to transfer animals from the 'main' to the 'reserve gene pool', and then carry out their withdrawal (Yanuta *et al.* 2016). A withdrawal can concern only the animals belonging to the 'reserve gene pool'. A commission of animal translocation has been established and within its competence is also to arrange the necessary transports of animals.

Currently European bison is distributed within the territory of Belarus in 10 separate micropopulations. They differ regarding the growth rate and local conditions. The dynamics of European bison numbers within the territory of Belarus and also the contribution of particular micropopulations in its development are given in the figure 1.

### **Description of the development of particular micropopulations BEREZINSKIJJ BIOSFERNYJJ ZAPOVEDNIK (Berezinsko-Borisov micro population)**

To create this population in 1974, five animals were brought from the Prioksko-Terrasny Nature Reserve (Russia), which, after a short-term hold in enclosure, were released into the wild. The area was unsuitable for European bison due to the domination of boggy habitats, besides, the animals came from breeding centers and were not adapted to such conditions. While searching for suitable habitats the animals migrated to the borders of the reserve. In

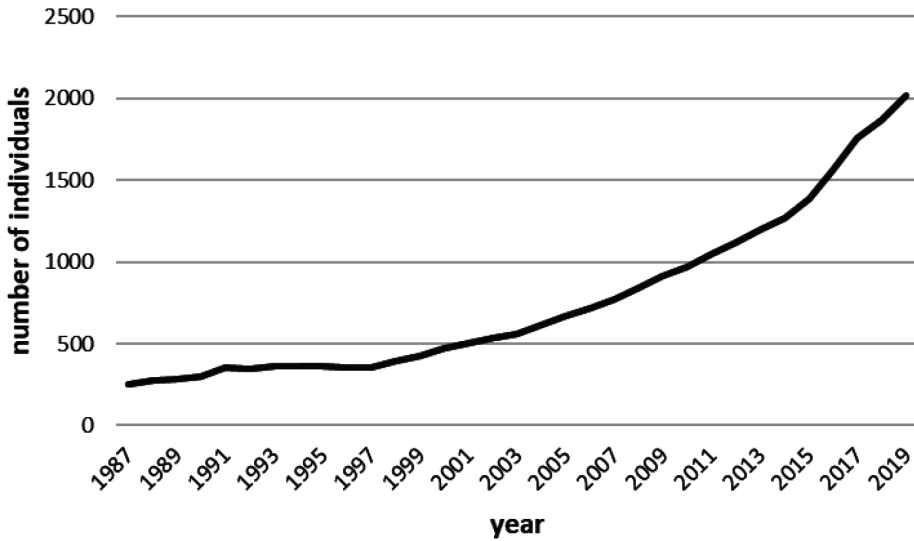


Figure 1. Population dynamics of European bison in Belarus

consequence, a death of two individuals was observed during two years. The attempts to supply a population with new individuals were ineffective, and in fact this micropopulation is still based on three individuals originating from breeding centers. Small numbers of the founders led to a low reproduction rate in the initial stage of population development. Maximum population size

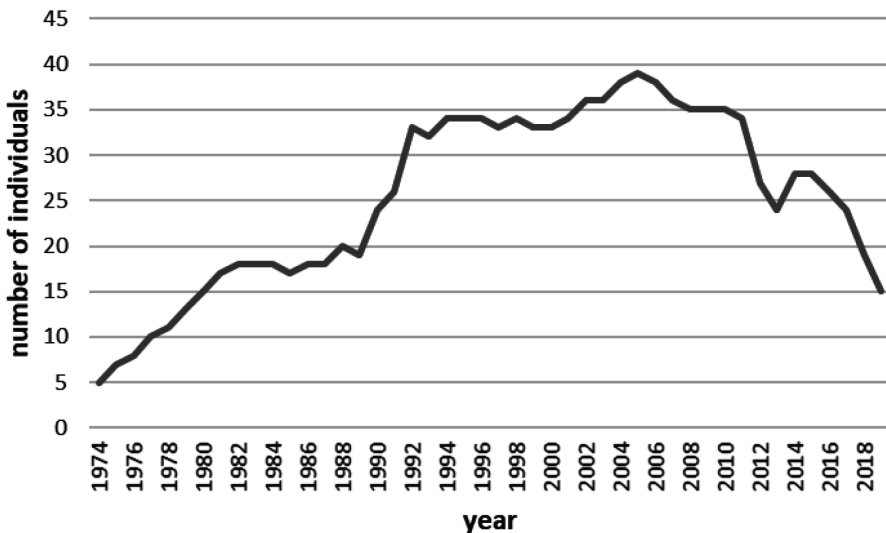


Figure 2. Population dynamics of European bison in Berezinskij biosfernyj zapovednik

was recorded in 2005 when 39 individuals were observed. Starting from this period a decrease in population size was observed. The average annual decline over the last 10 years equaled 7.4% (Fig. 2).

Currently, home range of this population covers approximately 28 000 ha, with domination of forest ecosystems (Kashtal'yan *et al.* 2006). Reproduction is very rare. One young individual was identified in 2013. Recently, the population is separated into herds consisting of 8–10 individuals (Springer 2019). The age and sex structure of the population is also extremely unfavorable. Based on the survey conducted in 2018, only two males were identified, in the age of about 18 years. In order to improve the population structure a transportation of new individuals from other micropopulations is needed (Kozlo & Bunevich 2011).

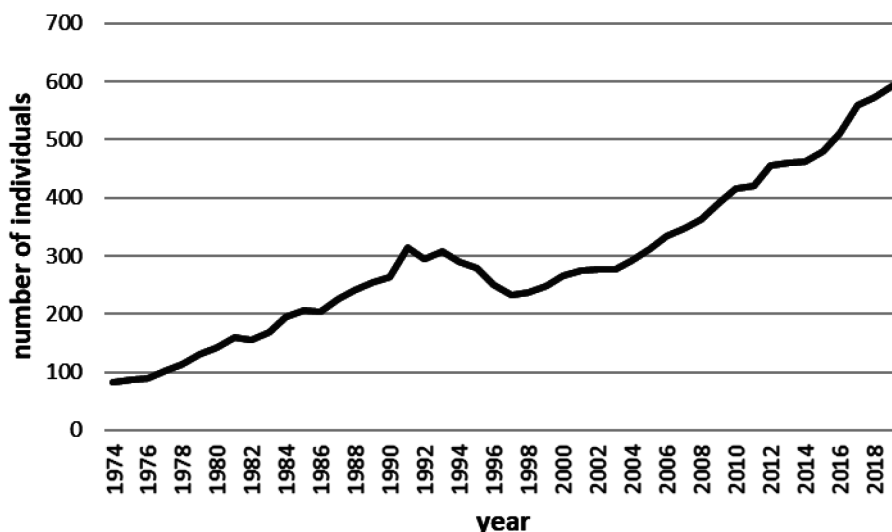
### **NACIONAL'NYJJ PARK «BELOVEZHСКАJA PUSHHA» (Belovezhskaja micro population)**

This micropopulation was established in 1946, when five European bison were imported from Białowieża (Poland). Other five individuals were brought from Prioksko Terasnyj Reserve (Russia) which belonged to lowland line in 1949. From 1946 until 1967 the total number of 53 European bison of the lowland line were transported to Belorussian part of Belovezhskaja Pushha (Bunevich *et al.* 2006). The free living population was created in 1953, when 7 young individuals were released. All other animals were released to the wild in 1966. During the initial stage, the population included both genetic lines: lowland and lowland-Caucasian, but all representatives of the lowland-Caucasian line were captured and translocated to breeding centers by 1968. Additionally, during this period, 38 individuals of purebred lowland line were translocated from the Prioksko-Terrasnyj Reserve (Russia).

At present, Belovezhskaya micropopulation of European bison consists of five groups: southern (home range area: 11000 ha, density: 7.3 ind./1000 ha), southwestern (home range area: 4700 ha, density: 8.5 ind./1000 ha), central (home range area: 25000 ha, density: 8.2 ind./1000 ha), northern (home range area: 5000 ha, density: 5 ind./1000 ha) and northeastern (home range area: 6500 ha, density – 8.9 ind./1000 ha) (Solovey *et al.* 2017).

The average annual growth of the population over the last 50 years was 4.6% (Bunevich & Korotsya 2019) (Fig. 3).

During years 1995–2004 a decrease in the population numbers was observed, which was an effect of removal of numerous of animals in order to create new micropopulations (destinations of the translocated animals: Landshaftnyjj zakaznik «Nalibokskijj», Osipovichskijj opytnyj leskhoz,



**Figure 3.** Population dynamics of European bison in Nacional'nyj park «Belovezhskaja pushha»

sel'skokhozjajstvennyj proizvodstvennyj kooperativ «Ozery Grodnenskogo rajjona», further okhotkhozjajstvo «Krasnyj bor»). At this time, the Belovezhskaya micropopulation was the only source population of European bison in Belarus.

Currently the total population numbers (for 2019) were estimated on 572 individuals, which exceeds assumed optimal numbers by 70%. Subsequently, this can lead to a decrease in population growth, intense migration of individual animals and small groups, and an increase of the area of summer home range of European bison. This will also lead to a significant impact on field crops during winter.

### **OSIPOVICHSKIJJ OPYTNYJJ LESKHOZ (Osipovichskaya micro population)**

This micropopulation was created in 1997. Founders were translocated from various herds from the area of Belovezhskaja Pushha. Fifteen European bison were located in the acclimatization enclosure in February-March 1997, and subsequently released to the wild. The average yearly population growth over the whole period of the micropopulation development equaled 17.4% (Fig. 4), which is higher comparing to other populations in Belarus. During first 10 years the annual increase of this micropopulation was approximately 20%. High rate of the population development resulted in the increase of the home

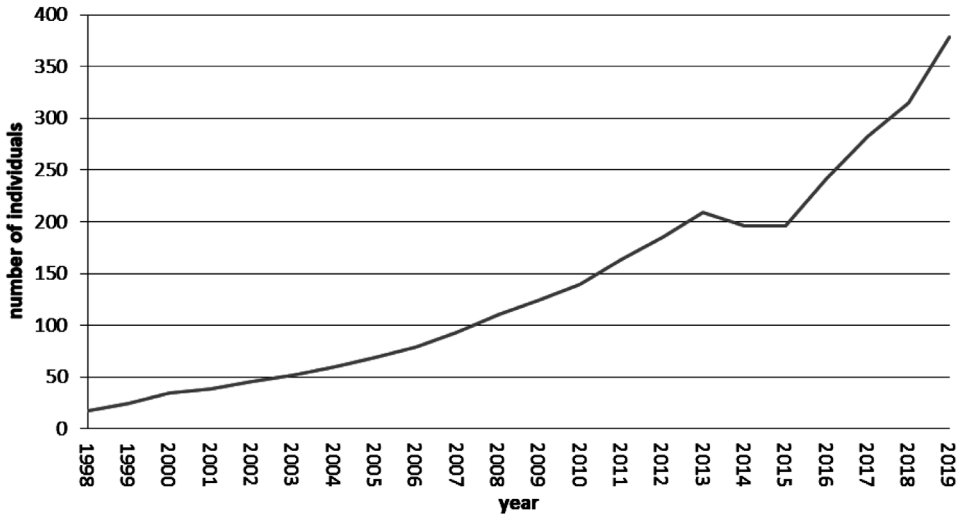


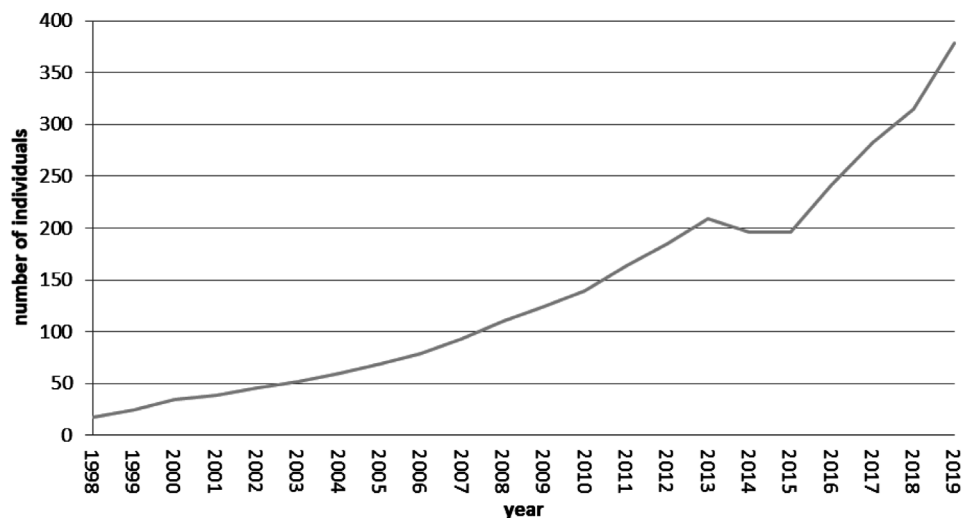
Figure 4. Population dynamics of European bison in Osipovichskij opytnyj leskhoz.

range. In the third year after the release, animals were observed in open areas (including field crops) located 8–12 km from the enclosure. Since 2009, the population growth rate decreased to 14.1% per year. The upper limit of the optimal population size was estimated on 130 individuals. This value was reached in 2010. At this time, the home range was 16.7 000 ha, with a density of 9.2 ind. / 1000 ha (Kozlo *et al.* 1996, Yanuta & Velihurau 2015; Yanuta *et al.* 2018). Agricultural areas constituted about 64% of the population home range during the period of intensive population growth. The home range increased by 3.2 times in 2018. Currently, agricultures also are the main land cover type within the home range (about 62% of the area). Currently, the micropopulation consists of 3 large herds of 40–120 individuals.

The further growth of the population will lead to the increase of animal influence on agricultural lands. A small number of food plots designed for the European bison did not provide an adequate food base, to prevent crop depredation. In addition, high density contributes to the migration of small groups of 3–5 individuals to neighboring areas. Therefore there is no possibility to carry on the spatial monitoring of the population for effective population management.

## SEL'SKOKHOZJAJJSTVENNYJJ PROIZVODSTVENNYJJ KOOPERATIV «OZERY GRODNENSKOGO RAJJONA» (Ozerskaya micro population)

This population was established with 18 European bison founders translocated from Belovezhskaja Pushha in 1998. A forest complex was chosen as a place of reintroduction, but intensively cultivated agricultural areas were in the neighborhood. The area intended for European bison population within the borders of hunting grounds covered approximately 15–20 thousand ha. The animals occupied the entire area during 10 years. However despite a twice increase of a population numbers, the home range did not significantly changed. The peculiarity of this area is the prevalence of agricultural areas. Due to this fact, the maximum value of optimal numbers was estimated on 160 individuals, which was reached in 2011 (Yanuta & Velihurau 2015). An average annual increase in the population for the whole period of population development was 16% (Fig. 5). This population was also a source of founders for Krasnoborskaya and Dyatlovskaya micropopulations.



**Figure 5.** Population dynamics of European bison in Sel'skokhozjajstvennyjj proizvodstvennyjj kooperativ «Ozery Grodnenskogo rajjona»

The population was fed not only during the winter, but also during a summer period (September to April). Due to intensive almost year-round feeding the density of animals reached 14.7 ind. / 1000 ha.



## OKHOTKHOZJAJSTVO «KRASNYJJ BOR» (Krasnoborskaya micro population)

First animals were translocated to this area in 2013. European bison were brought from three micro populations: Nacional'nyjj park «Belovezhskaja pushha», sel'skokhozjajstvennyjj proizvodstvennyjj kooperativ «Ozery Grodnenskogo rajjona», and landshaftnyjj zakaznik «Nalibokskijj». Animals were initially kept in three enclosures, and released into the wild in January 2015 and October 2016. The total number of released animals equaled 91 of which 12 were calves (Geshtovt 2019). At present, this micro population consists of 3 herds, with the overlapping home ranges. The total population numbers equal currently to 190 individuals (data for 2019). The total home range covers area of 16 800 ha. Similarly to other populations, at the initial stage of population development an average annual increase in the numbers was 18.3% (Fig. 6). The high rate of population growth is probably an effect of intensive winter feeding but also a crop depredation during summer.

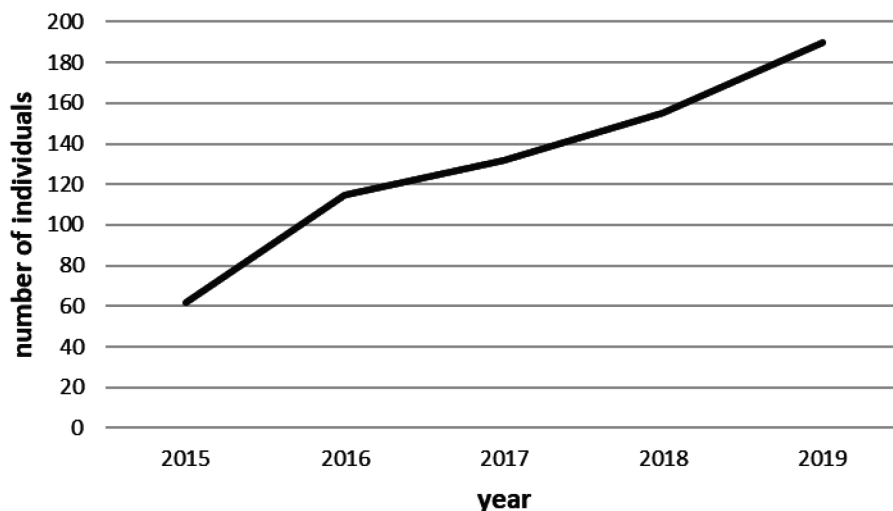
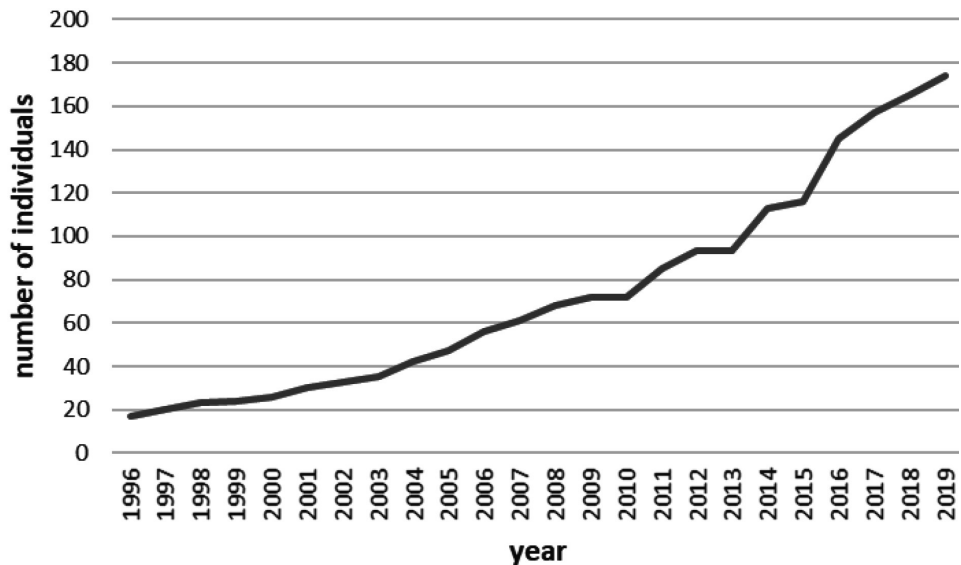


Figure 6. Population dynamics of European bison in okhotkhozjajstvo «Krasnyjj bor»

## POLESSKIJJ RADIACIONNO-EKOLOGICHESKI ZAPOVEDNIK (Polesskaja micro population)

Creation of this population began from the translocation of 19 European bison from Nacional'nyjj park «Belovezhskaja pushha». The animals have been kept in the enclosure for 1 year and 4 months (Yurchenko *et al.* 2019). After the release to the wild animals occupied the area of 10 000 ha. Later

the home range increased to 15 000 ha (Deryabina & Sysa 2006). Animals' density in vegetation period was about 3.9 ind./ha. From 2005, separate males of European bison were observed within agricultural areas adjacent to the reserve. However there is none published information about the number, structure and spatial distribution of herds. Some individuals or groups of 2–3 young animals went beyond the boundaries of the reserve. Population's density during that period was not high, but there is no information about any food support for this population. Unlike other populations, at the first stages of its existence, high growth rates were not noticed (Deryabina & Sysa 2006; Deryabina & Yurchenko 2009). Some authors suggest that this was an effect of high doses of radiation in this area (Kozlo & Bunevich 2011). However, an average annual increase for the whole period of population development was approximately 10,9 % (Fig. 7), which is comparable to other populations.

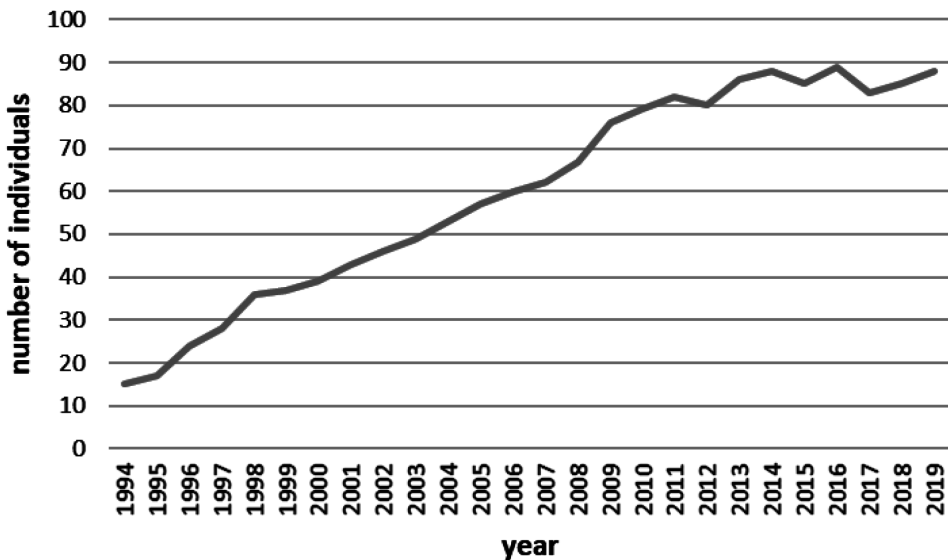


**Figure 7.** Population dynamics of European bison in Poleskijj radiacionno-ekologicheski zapovednik

### **LANDSHAFTNYJJ ZAKAZNIK «NALIBOKSKIJJ» (Nalibokskaja micro population, former Volozhinskaja population)**

Fifteen European bison transported from Belovezhskaja Pushha in 1994, were the founders of this micropopulation. After the animals have been released into the wild, a feeding site was set up in this place, which encouraged animals

to stay in this area. Not far from the feeding site there were meadows, which European bison occupied later. The average population density in summer was estimated on 1.6 ind. / 1000 ha (Kozlo & Bunevich 2011). In 2000, the supplementary feeding worsened, which was one of the factors that led to a division of the main herd into several small herds. The largest herd remained in the area of introduction not far from the enclosure; small herds began to occupy new habitats that were abundant in food. Until 2018, the numbers of large herd at the reintroduction site were about 60–65 animals. Smaller herds of 3–10 individuals migrated over a distance of 10 to 35 km. The herd structure was formed over a period of 2000–2005. It should be noted that the population density was quite low. Most of the new herds formed in large meadows in the floodplains of small rivers. The population is also characterized by a low average annual growth rate (7.7%) (Fig. 8).

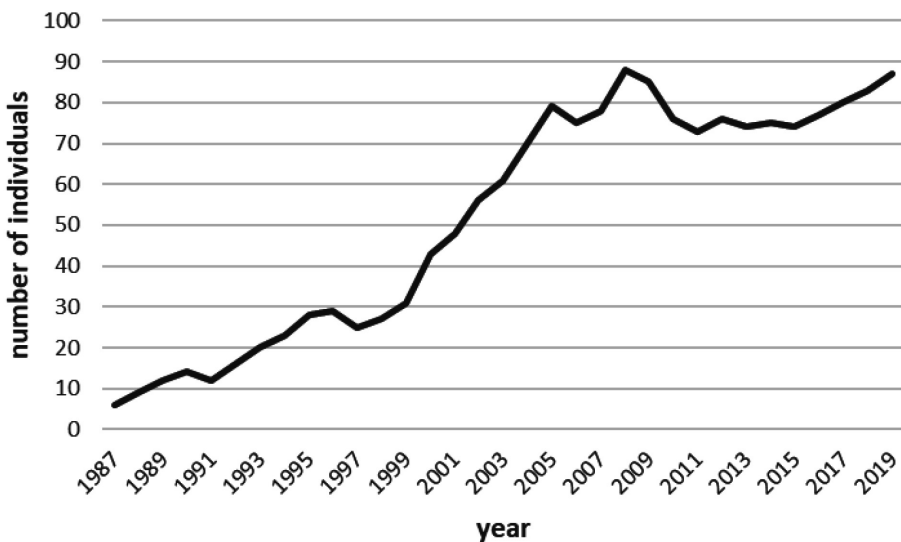


**Figure 8.** Population dynamics of European bison in Landshaftnyj zakaznik «Nalibokskijj»

During the formation of new micropopulations in Belarus, numerous animals were withdrawn from this micropopulation in 2014 and 2018. In addition, poaching on three males in 2012 significantly worsened the structure of the population, which also affected its further reproduction rate. Currently, this micropopulation counts 88 individuals, which is close to the assumed optimal numbers (estimated on 75–80 ind.).

### **NACIONAL'NYJJ PARK «PRIPJATSKIJJ» (includes two free-living micro populations: Ozeranskaya and Nadyanskaya and one Lyaskovichi semi-free herd)**

**Ozeranskaya** micro population was created in 1987 from animals transported from Prioksko-Terrasny Reserve (Russia). Other animals were also brought later in 1988 and 1992. Animals were kept in the enclosure during three years. Nine calves were born during that period. The population occupied mainly floodplains. After the animals were released into the wild, they formed two herds (Kozlo & Bunevich 2011). One herd remained not far from the enclosure. The second herd migrated over 20 km, which resulted in decrease of calves' numbers (probably due to a higher mortality). The population numbers increase was relatively low (2.8% per year) (Fig. 9). The area of current home range is about 18–20 000 ha with the density of 3,1 ind. / 1000 ha. Low density of the population, as well as slow population numbers increase, may indirectly indicate suboptimal habitats within the home range.



**Figure 9.** Population dynamics of European bison in Nacional'nyjj park «Pripyatskijj»

**Nadyanskaya** micro population. Created in 2000 from 13 animals transported from Nacional'nyjj park 'Belovezhskaja Pushha'. The animals were released from an enclosure in January 2001. The release was largely due to the aggressive behavior of one of the individuals, which led to the death of young animals. There were no food plots at the place of release. It was assumed that animals will occupy floodplains which occupied a large area in this forest

complex. Quite quickly, the herd moved to agricultural areas, which remain occupied until now. The density of the population was estimated on 1.8 ind. / 1000 ha. The average increase in the population is also on low level of 2.4 % (Yanuta & Bepalyg 2018).

### **DIATLOVSKIJJ LESKHOZ (Diatlovskaja micro population)**

This population is the newest in Belarus. It is currently in process of the formation. Its spatial structure is currently not fully formed. The herd was formed from individuals transported from two micro-populations: landshaftnyjj zakaznik “Nalibokskijj” (7 ind.) and proizvodstvennyjj kooperativ “Ozery Grodnenskogo rajjona” (11 ind.). The animals were kept in the enclosure for about 5 months, until the end of May 2018. Floodplains with a high proportion of meadows were foreseen as home range for this population. A feeding site was created in the place of the enclosure. The animals selected the most favorable habitats within the available area in 2019, which practically did not change in 2020. Based on the analysis of the dynamics of the spatial distribution of other micropopulations, it can be assumed that the optimal population size equals there to 50 individuals. With such a number, migration to arable lands will probably not occur, and forest habitats will not be degraded. Despite the long-term maintenance of animals in the enclosure, after the release into the wild, European bison created two herds, which are in the same area and do not migrate. Three new other feeding sites were later created in the home range of this population. In the fall of 2018, one migratory male joined the population. The total home range area of this population equals to about 6.2 000 ha, with domination of agricultural areas (71%, meadows and cultivated fields).

### **Summary**

An introduction of metapopulation model allowed to reach high growth rate of European bison population in Belarus. The development of the majority of the population was relatively dynamic, especially in the first period after reintroduction. Currently, five out of ten micropopulations have exceeded their assumed optimal numbers (Tabl. 1). In two micropopulations the optimal number was exceeded by over 100%. As a result, there is a real risk of population overcrowding, leading to faster disease transmission and damage to agricultural crops. There is a need for implementation of effective mechanisms minimizing the exceeding of the carrying capacity of the European bison population in Belarus.

**Table 1.** Development of the European bison micropopulations in Belarus, \* for period 1970–2019, ND—not defined

Population	Date of formation (release date)	Annual growth, %	Number of individuals in 2019	Assumed Optimal numbers	Surplus over the optimal number
BEREZINSKIJJ BIOS-FERNYJJ ZAPOVEDNIK	1974	3,1	15	60	–
NACIONALNYJJ PARK «BELOVEZHСКАЈА PUSHHA»	1953	5,0*	593	350	+ (69%)
OSIPOVICHSKIJJ OPYTNYJJ LESKHOZ	1997	17,3	470	130	+ (262%)
SEL'SKOKHOZJAJJSTVENNYJJ PROIZVODSTVENNYJJ KOOPERATIV «OZERY GRODNENSKOGO RAJJONA»	1998	16,0	378	160	+ (136%)
OKHOTKHOZJAJJSTVO «KRASNYJJ BOR»	2015	35,1	190	ND	
POLESSKIJJ RADIACIONNO-EKOLOGICHESKI ZAPOVEDNIK	1998	10,9	174	93	+ (87%)
LANDSHAFTNYJJ ZAKAZNIK «NALIBOKSKIJJ»	1994	7,7	88	80	+ (10%)
NACIONALNYJJ PARK «PRIPJATSKIJJ»	1990	8,0	87	60+80	–
DIATLOVSKIJJ LESKHOZ	2018	–	25	50	–

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### Wolne populacje żubra w Białorusi

**Streszczenie:** W czasie powstawania państwa Białoruś w 1991 r., istniały już trzy mikropopulacje żubrów. Kozło (1999) zaproponował „strategię metapopulacji” dla Białorusi, aby przeciwdziałać wysokiemu zagęszczeniu zwierząt. Koncepcja ta polegała na utworzeniu 10–12 lokalnych grup żubrów (mikropopulacji) na terenie kraju w zróżnicowanych warunkach naturalnych. Aby ograniczyć negatywne konsekwencje izolacji, założono translokację poszczególnych samców między mikropopulacjami przynajmniej raz 1–2 razy na pokolenie. Pierwotnie populacje podzielono na dwie grupy: „główną pulę genową” i „rezerwową pulę genową”, które zależały od lokalizacji (obszary chronione lub tereny łowieckie). Dla każdej populacji oceniono optymalną liczbę zwierząt, ale można było polować tylko na zwierzęta z „rezerwowej puli genowej”. Później strategia została zmodyfikowana i wszystkie zwierzęta, niezależnie od lokalizacji” zostały włączone do „głównej puli genowej”. Obecnie żubry są rozmieszczane na terenie Białorusi w 10 oddzielnych mikropopulacjach. Realizacja modelu metapopulacji pozwoliła osiągnąć wysokie tempo wzrostu liczebności żubrów na Białorusi. Rozwój większości populacji był stosunkowo dynamiczny, szczególnie w pierwszym okresie po reintrodukcji. Obecnie pięć na dziesięć mikropopulacji przekroczyło założoną optymalną liczebność. W dwóch mikropopulacjach optymalna liczebność została przekroczona o ponad 100%, w wyniku czego istnieje realne ryzyko przegęszczenia populacji, prowadzącego do szybszego przenoszenia chorób i niszczenia upraw rolnych. Istnieje potrzeba wdrożenia skutecznych mechanizmów minimalizujących przekroczenie pojemności środowiska przez populację żubrów na Białorusi.

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