

## **European bison in Russia – past, present and future**

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**Abstract** The area of the European bison during historical time Holocene is discussed with addition of new information published in last years. Northern border of an area corresponds 60° N. The area included average and southern Urals Mountains, the south of Western Siberia. On the east the European bison lived up to the Altay Mountains and Lake Baikal. The same area at a red deer having similar ecological needs. Increase of inbreeding level considerably and negatively influences adaptable and reproductive opportunities of a bison. This circumstance is especially shown in case of its reintroduction in mountain areas. The basic projects on cultivation of the European bison in Russia are discussed.

**Keywords:** European bison, geographical range, inbreeding, reintroduction

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### **Bison Habitat**

The studies on historical changes of European bison habitat are important both theoretically and practically. Historical geographical range of a species is the most favorable area for reintroduction and creation new free populations. In Pleistocene, the European bison range covered the most part of Eurasia (Flerov 1979). From the beginning of Holocene natural conditions changed (especially in the western part of the region). Glacier shield and vast pre-glacier lakes shortened and disappeared. Forest boundary migrated to the North. Humans occupied the area. Snow cover became deeper and lasted longer and become a limiting factor of European bison distribution at the Russian plain. All factors mentioned above served in drawing of northeastern boundary of European bison range in historic time (Heptner et al. 1961).

Observations on progress in adaptation of European bison in Vologda oblast (59°–60°N) and American bison at the Polar Urals (68°–69°N) show that distribution of European bison was limited more by anthropogenic influence than by snow cover.

The northern boundary of European bison range at the Russian plain reached probably 60°N, along the water divide of the Polar Ocean and the Caspian Sea (Fig. 1). At the historic time broadleaves forests reached 60°N (Popadiuk *et al.* 1994). European bison inhabited the southern Finland (Kalela and Salmi 1944, cit. after Sokolov 1959). European bison fossils dated about 17 Century were found at the shore of the Ladozhskoye Lake and near Novgorod (Sokolov 1959).

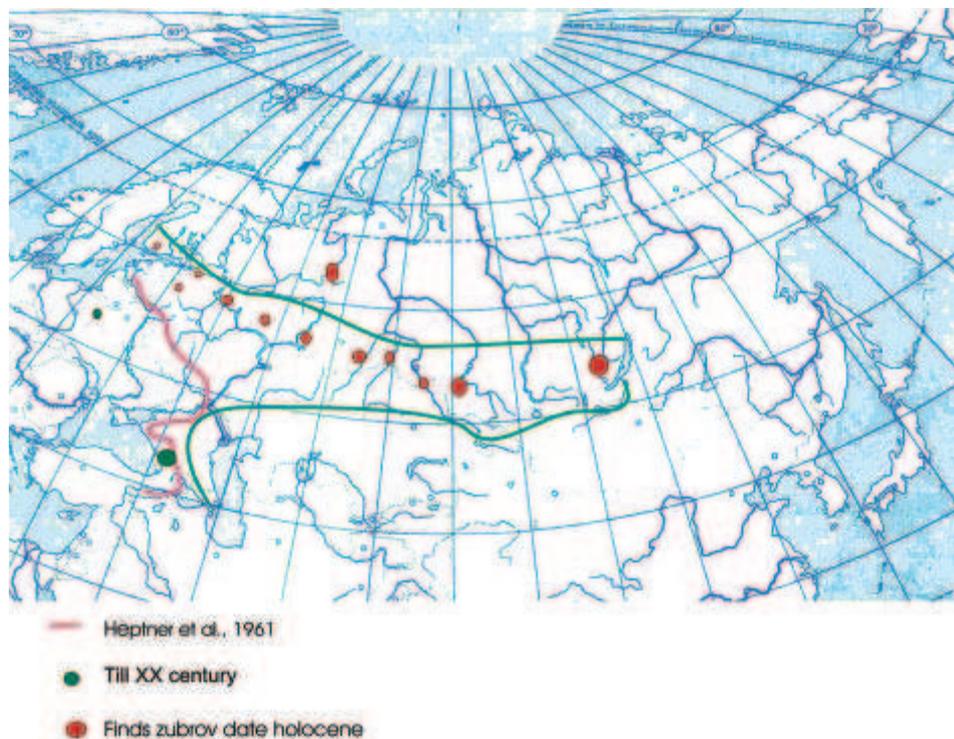


Figure 1. European bison range at the end of Holocene

European bison inhabited Novgorodskaya area and surrounding districts (Bogdanov 1889; Sokolov 1959). In XVII-XVIII centuries European bison were mentioned in Kostromskaya region and in the Volga valley (Dolmatov 1849; Kulagin 1919), as well as in Vyatka area and Kazan' region (Ruzski 1898). European bison fossils dated as 4000 years B.C. were found in the middle reaches of the Pechora river (Ponomariev 2001; Smirnov 2002). The same was the habitats of the red deer (Heptner et al. 1961), while currently the same area represents habitats of wild boar (Danilkin 2002) and roe deer (Danilkin 1999).

In historical times European bison distributed to the south Urals. At the 1<sup>st</sup> Millennium B.C. European bison inhabited steppe-forests of trans Urals and west Siberia (Smirnov 1976; Kosincev 1982, 1986, 1988), in Holocene the animal still inhabited the Kuznetsk depression (Wiereshchagin 1956; Alekseeva 1980), and in VIII-X centuries made a part of mammal fauna in the Altay and Baikal regions (Ermolova 1978; Okladnikov, Kirilov 1980; Smirnov 1980; Danilkin 2005). Thus reconstructed borders of European bison and red deer habitats closely overlapped (Fig. 2). It is note-worthy that ecological demands of both European bison and red deer are very close (Baskin 1979).

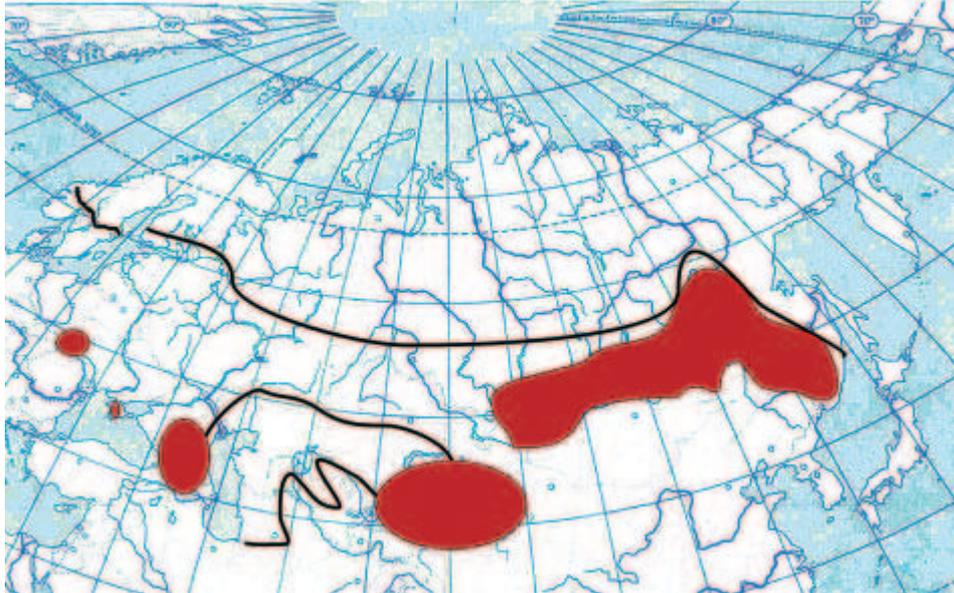


Figure 2. Red deer range at the end of Holocene

### Inbreeding level

Slatis (1960) underlined high inbreeding rates of European bison. Inbreeding coefficients were determined at the end of 80s of XX century on the level 26.28% for the Lowland-Caucasian line and 43.98% for Lowland line (Olech 1998). According to Kislovskiy (1965) it means too close inbreeding or incest. Besides all 12 predecessors themselves got high level of inbreeding (Sipko 2002), though the fact was not taken into consideration in calculations. The only exclusion was the outbred bull named Kaukasus, which was caught in free living population in Caucasus.

As calculation show, if effective population size is  $N_e = 50$ , inbreeding coefficient increases 1% per generation (Soule 1980). In European bison breeding centers in Russia effective size of populations never exceeded 10 so level of inbreeding increased more than 5% in each generation. We believe that a European bison generation is about 5 years in wild and about 8 years in captivity. It means that animals of each new generation got higher coefficient of inbreeding and consequently lower genetic polymorphism. As a result, adaptation potential and reproductive abilities of animals decrease. Data on reproduction of European bison relocated to the Caucasus (Table 1) prove the conclusion. It is easy to note that the later were bison reintroduced the worse was progress of the population started from the similar number of released animals. In spite of significant number of founders, reproductive success is

**Table 1.** Reproductive success in populations of the European bison

Population	Number of released animals		Years of creations	population size after 30 years
	total	females		
Caucasus				
The Kavkazsky Reserve	20	4	1940–1959	1300
Nal'chik hunting a facilities, Kabardino-Balkariya	35	17	1959–1967	380
Tseysky zakaznik and Severo-Osetinsy Reserve	48	32	1964–1968	270
Teberdinsky Reserve, Arkhyzsky cluster	29	13	1968–1981	55
Assinsky zakaznik (the Checheno-Ingushsky Reserve)	49	26	1970–1975	44
Canada				
Mackenzie (American bison)	18 (16)	10	1963	1700
Carpathians				
Bieszczady	63	29	1963–1982	241
Bukovynska	23	14	1970–1977	225

obviously lower comparing with non-breed population from the Caucasus Natural Reserve or population of American bison from Mackenzie, Canada.

The conclusion is that animals from nurseries are not suitable now for successful reintroduction to the Caucasian Mountains as well as, probably, to re-acclimatization in the Carpathian Mountains.

Regulation of inbreeding level in Russian bison centers started in 90<sup>ties</sup> due to mass import of animals from west European zoos with assistance of WWF. Positive influence of such “blood refreshing” cannot last longer then 2–3 generations as effective number of population remains low and bison-incomers are descendants of the same ancestors.

### **Main projects on European bison breeding**

Scientific achievements and practice of conservation of rare animal species in the XX Century led to a “rule of 50\500” (Soule 1987). According to the rule, the effective number of 50 animals is sufficient for a short period of survival of population and saving of its genetic polymorphism, while long period of species flourishing needs an effective number of 500 animals. Only then necessary adaptations appear to keep the species safe with its evolutionary potential under constant changes of surrounding environment. Effective

number ( $N_e$ ) depends on the number of animals with high reproductive ability, on sex rate in a population as well as on inbreeding (Kaidanov 1996), in the fact very important for European bison. Generally  $N_e$  is about 25–35% of the total number of ungulate population. Thus, only a sustainable population of 1,500–2,000 of bison could guarantee bison conservation. Besides, such circumstances like political situation, natural resources, epizootic disasters and many others have to be taken into account. The larger distance between two lands the lower probability that a disaster at one land will repeat at the other. Thus stability of species demands at least two large populations, significantly separated.

There are no suitable ranges in west Europe and only Russia could provide perfectly fitting habitats. Total number of European bison in the world is less than 4,000, besides high mortality and low level of reproduction (3–6% per year) prevent creation of necessary large population in visible future. We need concentration of all breeding resources of the world to solve the problem.

### **Altay region**

European bison were introduced to the Altay region in 1982–1984 from the Prioksko-Terrasny breeding center. At the beginning there were 12 animals (3 bulls and 9 cows) and one cow perished just a month later. All animals belonged to Lowland line, founded by 7 (later 5) founders only (Sipko 2002). All these animals were relatives. The bull Moran (N° 2729 EBPB) was already a father of two and, till 1987 was the main male. The goal of relocation was restoring recently extirpated European bison to their former range. European bison is an autochthonous species for Siberia and especially for Altay. We believe that the last animals lived in mountain valleys till XVIII (Wiereschagin 1956). Steppe-forest zones in mountains and valleys are perfectly suitable ranges for free roaming bison.

The breeding center occupies north west Altay mountains, with elevations 600–1,400 m. above sea level. The average year temperature is +2–3°C; in July +17°C; in January –14°C. Vegetation period lasts 170 days. Annual precipitation is 500–700 mm, the highest in summer (Pieskova, Popov 1987), so snow cover is moderate.

There were 41 European bison in the breeding centers in 2008 (15:26). Animals are strong and proportionally built with well developed, unaffected limbs. The latter means a good adaptation to life in mountains and dissected landscapes. Observation on bison during 25 years proved the success of adaptation process (Pieskova, Popov 1987; Popov 2000; Sharshov 2003), in spite of low adaptation abilities of bison from Lowland line. (As it was mentioned above, this line is highly inbred).

Breeding of bison in the Altay breeding center took place without import or export of bison during 25 years. It was reasonable in the first decade of the

experiment though later came into contradiction with breeding center goals: to create healthy bison breed for increasing of bison number and its further reintroduction. In fact, there were hardly self-recreation of the population, main number being 29 (lim. 23–41) animals. So the Altay bison group approach to the edge of inbred depression. As a result, high mortality of calves observed in recent years. “Blood refreshment” by import of new producers from other nurseries is badly needed. We recommend import of bison belong to the Lowland-Caucasian line, as they are not related to bison of Cherga. At the same time, there are 7 Zoos in Siberian Federal States, so bison from Altay breeding center would be readily taken by Zoos. Our main goal is creation of bison population of more than 1000 animals, for which Altay-Sayany region is mostly suitable. The recent task is to find there a range for a large population.

### **Vologodskaya Oblast**

This region, 400 km to the north of Moscow (58–60°N) is one of the best lands to maintain a sustainable European bison population, large enough to keep the species safe during a long period (European bison Conservation Action Plan, 2004). It is a terraced plain in the North Dvina river valley, with elevations 110–200m. Some hydro-technical constructions of Volga-Baltic Sea-White Sea Channel system occupy part of the territory.

The fact that a group of European bison since 1991 lives and reproduces there without winter food supply proves the suitability of the land for maintaining a European bison population. At the beginning only 5 animals were reintroduced in 1994, among them two cows. Now there are 31 bison. If the number of bulls-progenitors was higher and if cows were not of the Lowland line, the reproductive success of the group would be higher. Adaptability of animals of the Lowland line does not correspond with the region features.

The unique for the bison group is the birth of twins. It took place twice and in both cases twins survived (Gusarov 1999). The fact proves forage capacity of the area. As we calculated from data in the pedigree books twins were born only in 0.78% of documented bison births in the world, and in each case only one calf survived.

The central part of a future population, the Ust-Kubenskoye hunting husbandry, 260 sq. km in size, is bordered from the west by the “Russian North” National park, 1664 sq. km. The husbandry lands are bordered to the south by Lake Kubenskoye. State Forest foundation possesses lands of 8000 sq. km to the north and west of the Ust-Kubenskoye husbandry. Forests, mostly coniferous (55%) cover more than 64% of these State lands. Agriculture is not efficient so most of human population has migrated from the region and population density has become very low. Roads are rare. Vast abandoned agricultural lands as well as forest clearings are very attractive for European

bison. All mentioned factors are very favorable for European bison so we expect to create there a population of 1000 animals. The first task is an additional import of European bison to prevent increasing of inbreeding.

### **Orlovsko-Bryansko-Kaluzhsky Forest**

The single mass of broad-leaves forest covers the area from the Russian-Ukrainian border along the Desna river (Black Sea basin) to the north-east along upper reaches of the Oka river (Caspian Sea basin). The forest covers the area of 30–50 km width and 400 km long. There are no natural or anthropogenic obstacles, for migrations of European bison. Only two highways and two railroads close to one another, occupy a small part of Bryansk region. The forest served since XVI century as a part of the defensive ring around Moscow State against steppe nomadic invaders and kept by government till middle 18th century (Ponomarienko *et al.* 1994). It was strictly forbidden even to walk through these forests (“for not to make paths to provide approach of enemies”). So far it is one of the best conserved broad-leaves forests at the Russian Plain.

There is a system of protected territories in the forest. Later, when ecological frame of Russia is formed these areas will serve as ecological corridors. Desnyansko-Starogutski Natural park occupies the southern part, along the Ukrainian border. It was founded in 1999 and covers 162 sq. km. Natural Reserve “Bryansky Les”, 122 sq. km will be soon accompanied by “Near-Desnyansky Park” in the neighborhood. There is a chain of protected territories in Orlovskaya and Kaluzhskaya regions, e.g. National Park “Orlovskoye Polesie”, 842 sq.km, then the Nature reserve “Kaluzhskie Zaseki” 185 sq.km and National park “Ugra” 986 sq.km. There is the Nature reserve “Tul’skiye zaseki” 158 sq.km in the vicinity, in Tul’skaya region. Its activity was stopped in 1951, though now its status is to be restored.

European bison were brought in 1996 to the described area, which is excellently suitable for creation of a large bison population up to 1500 animals (Strategy for E.bison conservation in Russia 2002). First 85 animals were imported to the National Park Orlovskoye Polesie (Table 2), where now there are 189 bison. Bulls migrated very actively in surrounding forests. A group of 13 bulls and cows migrated to the Nature reserve “Kaluzhskie Zaseki” since 2001. An additional import from breeding centers is expected. Import of bison to the Nature Reserve “Bryansky Les”, in 1997 was improperly organized and failed. Bison moved toward cattle farms and preferred to live there, so they were taken out. Bison were brought in 2006 into the Karachevsky Zakaznik, to the south of the National Park Orlovskoye Polesie. In 2007 next 9 bison were settled in Petrovskoye hunting husbandry, 70 km to the north of the reserve “Kaluzhskie Zaseki”. Additional import of 10 animals took place in 2008 to the southern part of the reserve “Kaluzhskie Zaseki”.

**Table 2.** Sources of delivering European bison to Orlovskoye Polesie National Park

Breeding center	Country	Number
Prioksko-Terrasny Nature Reserve	Russia	31
Oksky Nature Reserve		24
Zoo of Rostov-na-Donu		1
Zoo of St. Petersburg		1
Belovezhskaya Forest	Belarus	2
Natuurpark Lelystad	Netherlands	14
Springe	Germany	6
Zoo of Dortmund		
Tierpark of Chemnitz		
Tierpark of Dahlholzly	Switzerland	4
Wildpark of Langenberg		
Zoo of Helsinki	Finland	1
Han-Sur-Lesse	Belgium	1
SUM		85

Genetic potential of the European bison population of Orlovsko-Bryansko-Kaluzhsky Forest is now the best among all European bison groups in the world (Sipko 2002; Bielousova *et al.* 2003). Additional bison introductions are necessary to achieve expected number of the population in the shortest time. It would be reasonable to add animals until the total number of the population will be 400 (i.e. 5–10 animals per year an till 2020). Since that time the annual increase of population is higher than any possible bison import. According to modeling, at 2033–2037 the population will reach the recommended number of 1500 animals (Sipko 2002; 2003).

### The Caucasus

The Caucasus Mountainous province along the water-divide ridge is as long as 1000 km. Landscape is dissected and natural conditions are various to maintain high biological diversity. Humidity and size of mountain forests increase from east to north-west along with deep of snow cover. The latter influences food resources and, consequently, numbers of ungulates. European bison inhabiting the province live on natural forage, without additional feeding. The province is suitable for creating of large population of European bison. Economic and social problems of local human population make unreal the realization of the task now and for a long time ahead. So far only the north-west Caucasus (the Kavkazsky

State Biosphere Reserve) gives good possibilities for bison breeding. Elevations of forested mountains are 500 – 3360 m. (Smidovitch Peak). High humidity (1000–1500 mm, some years up to 3000 mm) is unfavorable for agriculture and thus for big settlements. According to Nemtsev *et al.* (2003) the area could host up to 5000 European bison.

The history of bison extirpating and restoration in the Caucasus is published (Sipko 2002; Nemtsev *et al.* 2003). Number of European bison declined again since 1990s. It began because of abundant snow in winters 1991–92 and 1992–93 (as it is typical for the Caucasus each 5–7 years). Usually up to 20% of ungulates (including European bison) perish in extremely snow winters, though later their number restores. Warming trend, weather anomalies, social disasters in ex-USSR, lack of management, as well as heavy economic decline, wide distribution of rifles – all these reasons favored extirpating of bison (Nemtsev 1999; Bobyr 1999; Veinberg, Komarov 2004). In some nurseries like Ismaillinsky, Nal'chiksky, Sunzhensky European bison totally disappeared (Nemtsev *et al.* 2003). Small groups conserved in Tseysky Zakaznik (between the Ardon and the Fiagdon Rivers) and in the Teberdinsky Reserve, though in these areas there are no natural reasons for population increase (Jazan, Nemtsev 1985; Bobyr 1999).

The only vital group of free European bison (about 150 animals) (hybrids of European and American bison) inhabited the Kavkazsky Reserve, in spite of anthropogenic stress and direct extirpation. To the end of 1990s all local groups of European bison around reserve boundaries were totally extirpated. As a result of threatening and chasing of animals in their favorite habitats, like mountain-forested areas out of reserve, winter distribution of animals and population structure changed. Animals moved in winter to open spaced of alpine meadows, where they were not chased (Trepet 2004; 2005).

The population could survive due to higher adaptive potential, higher polymorphism, low inbreeding comparing with other groups of European bison in the Caucasus. Under anthropogenic stress, chasing and direct extirpation animals transformed and adapted to new conditions. Presently there is a steady growth of the population and their demographic features prove favorable natural conditions. Annual growth of population during recent 4 years is no less than 15% and number of population in 2008 was 400 animals.

First European bison were imported to the Caucasian Mountains in 1940, and they were released into free pasture in 1946 (Kalugin 1958; 1965). As no additional feeding took place, animals could widely migrate. Long experience of bison breeding in the Caucasus gave valuable data on distribution and migration of European bison in mountain landscape.

Habitat range of European bison in mountain landscape of the Caucasus covers valleys areas, Traverse over longitudinal mountain ranges is possible only by organized relocation of animals as it was made in the Kavkazsky Reserve (Nemtsev *et al.* 2003). Enlargement of European bison habitat range

is a very slow process (mostly towards mountain outskirts, if there are no obstacles like settlements or arable lands). In the Kavkazsky Reserve and its surroundings bison home range of a population as large as 1300 animals, enlarged to 1150 sq.km for 40 years (Trepets 2004). In Tseysky Reserve the size of range is 150 sq.km, providing the bulk of population inhabited the area 80 sq. km only, even at highest number of 260–270 animals (Kazmin 1989).

In the Teberdinsky Reserve 55 European bison inhabited 200 sq. km of mountain valley (Bobyry 1997)

Seasonal migrations of European bison in the north-west Caucasus are vertical as animals use river valleys. There are predominantly spring herds on the high mountain pastures (took place till 1954). Migratory routs are as long as 30 km. Young bulls settle apart toward outskirts, to valleys with human population (Nemtsev *et al.* 2003; Trepets 2005).

In the Teberdinsky Reserve and in the Tseysky Zakaznik European bison migrated to 5–10 km only, along the slope of one mountain range. As population grew the population density increased, not a size of home range. Main density reached 14 animals per 1000 hectares and to 70 animals in winter pastures, while safe limit is 10.7 animals per 1000 hectares (Lipnikovitz 1989).

European bison migrated and settled down Fiagdon valley (Pavlov 1999, Bobyry 1997; Tarasov 1977). It is noteworthy that bulls born and bred in breeding centers and later introduced to mountains cannot compete during rutting season with bulls which lived free in mountains, so the former do not take part in reproduction. Example is the Nal'chik population founded in 1959 by European bison captured in the Kavkazsky Reserve. Three generations of these animals bred in mountains. In 1967 13 animals (including 10 bulls) were introduced from the Oksky Reserve. All these newcomers spent their life at the spot of their introduction and never took part in reproduction as they were dominated by local bulls.

In 1973, seven bulls were relocated from the Oksky and Prioksko-Terrasny Reserves and added to a group of European bison of the Kavkazsky Reserve. Newcomers also never reproduced (Nemtsev 1988). The only possibility to evolve newcomers into reproduction is to eliminate local bulls, to settle them apart, as it was practiced in the Kavkazsky Reserve till 1960 (Kalugin 1968).

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