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# BEST PRACTICE MANUAL FOR PROTECTION OF EUROPEAN BISON



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## 1. A brief description of the species

European bison (Żubr) (*bison bonasus* L.) is the largest land mammal in Europe. It belongs to the order of Cetartiodactyla and the family of cavicorn Bovidae.

A characteristic feature for this species is sexual dimorphism, the body weight of an adult male amounts, on average, to approximately 650-750 kg, while a female weighs about 400-500 kg. There is also a noticeable difference in height measured at the withers, right behind the neck: the male measures between 158 and 188 cm, while the female between 137 and 167 cm.



The low-mounted European bison head tapers toward the nose and ends with a small muzzle. The eyes have dark-brown iritis. On the massive European bison head there are dark horns, almost perfectly circular in cross-section, directed to the sides and curved upwards and towards the centre. At the bottom of their head, European bison have a beard- a clump of long hair hanging down. An adult European bison has 32 teeth, while in the upper jaw there are only premolars and molars. Behind the neck, there are strongly developed spinous processes of thoracic vertebrae, which is manifested in the form of a “hump”, particularly noticeable in males. The European bison’s croup is relatively light, but strongly muscled. It ends with a tail of the length of approximately 50 cm and a bunch of longer fur. The European bison’s skin is thick, especially in the area of withers, but it is very stretchy. European bison have strong legs ending with hooves, however, front hooves are wider than back ones. While European bison can live more than 20 years, they usually live shorter in the wild than in captivity under human supervision.

European bison is a herbivorous animal whose diet consists of grass, sedge, herbaceous plants, as well as the leaves and twigs of trees and shrubs. It eats barks of oaks, hornbeams and ashes, but also of many other deciduous and coniferous trees. While acorns constitute European bison’s favorite food, it also is fond of beech mast. In summer, 2/3 of feed intake is composed of grass, sedge and herbaceous plants, while in herds that are intensively fed in winter, 3/4 of diet consist of meadow hay. An adult animal eats daily from 30 to 45 kg of fresh green mass. European bison use natural bodies of water- streams and small forest ponds. In winter, they make holes in the wet ground with their hooves, in which water and melting snow accumulate. Sometimes, they also eat snow directly.

European bison is a herd animal. Adult cows, calves and the young of both sexes form mixed groups guided by an older and more experienced cow. In a vegetative season, mixed groups consist of approximately 15-20 animals, and in winter they tend to form larger groups living in the areas where they are fed. The composition of mixed groups is changeable; very often an exchange of specimens occurs, mainly in case of younger ones, when various groups come together. Males at the age of 3-5 form small groups, whereas older bulls remain rather solitary. Adult bulls join a mixed group during the mating season.



European bison's hygienic practice includes licking, rolling, scratching, and rubbing. Aggressive behavior towards other members of a group is extremely rare and, as a rule, it is expressed as a passive attack, i.e. adopting merely an aggressive posture. Aggressive behavior occurs more often only among bulls, usually during the mating season, while fighting for a female, a result of which is sometimes the death of one of the specimens. It happens, particularly when cows are on heat, that bulls react to human presence not only by adopting an aggressive posture, but also by attacking people.

The period of reproductive activity in the majority of females begins at the age of three, which means that a female gives birth to its first calf at the age of four. Males achieve sexual maturity at the age of about two, however, being at large gives rise to a hierarchy, and only males that are fully developed in physical terms, i.e. at the age of 7-12, are involved in reproduction. European bison are seasonal animals and their climax of reproductive season falls between August and September. Pregnancy lasts, on average, 264 days, so calves are mainly born from May to July. Usually, a female gives birth to only one calf. The female calves most frequently at night or early in the morning. Before calving, the cow leaves the herd for several days and comes back with a calf. Separation from other European bison allows the mother and the calf to develop strong individual ties. The mortality rate of European bison calves amounts to approximately 2% and is very low in comparison with other large wild ungulates.

European bison devote their day to feeding, resting connected with ruminating, and exercising. A herd covers the distance of 2-14 km per day. Migration of herds takes place according to specific order. A cow-guide is at the head of the herd, while the rest follows it in single file. Although European bison are slow animals, they can gallop even 40 km an hour at short distances. When in danger, they can jump over an obstacle as high as 2 m. A herd of European bison usually leaves or even runs away from the place where man appears, keeping proper distance. A frightened group runs away, galloping about 150 meters, then stops and herds together very closely. In summer, the distance kept by European bison from people is usually bigger than in winter.

European bison can occupy various forest habitats. The fundamental thing for this large herbivore is a sufficient amount of food, i.e. grass and herbaceous plants. As a result, European bison feed on forest glades, meadows and pasture, as well as other open areas such as logging sites. A mixed group feeds on various areas, but maintains a certain type of conservatism in subsequent years. European bison make use of plants of the forest floor in various periods of the year, depending on the type of a habitat. The forest is of great significance for ensuring rest and protection to the European bison.

In historical times, European bison occurred in the forest areas of Western and Central Europe, up in the north as far as in Sweden, and in the southeast as far as in the Caucasus. In those days, the species was divided into three subspecies: the lowland European bison (żubr nizinny) (*bonasus bonasus*), the Caucasian European bison (żubr kaukaski) (*bonasus caucasicus*) and the Hungarian European bison (żubr węgierski) (*bonasus hungarorum*). European bison lived in England, Sweden and France up to the 6<sup>th</sup>, the 12<sup>th</sup> and the 15<sup>th</sup> century respectively. In Transylvania, the Hungarian European bison managed to survive to the end of the 18<sup>th</sup> century. The lowland European bison stayed alive in East Prussia to the mid-18<sup>th</sup> century, and the last anchor of that subspecies was Białowieża Forest. The Caucasian European bison lived in the Caucasian Mountains until the beginning of the 20<sup>th</sup> century.

Białowieża Forest had been Polish kings' hunting ground for many centuries, and European bison was provided with care as the rulers' game. The inhabitants of local villages had to feed and supervise European bison. After the loss of independence by Poland, Białowieża Forest



came under Prussian rule, however, successive tsars continued the European bison's protection, ordering as early as in 1803 that local peasants should feed those animals in winter. At the beginning of the 20<sup>th</sup> century, the European bison's population numbered 710 specimens, maintaining a similar level until August 1915. The Prussian and Russian armies, which supplied themselves with provisions in Białowieża Forest, contributed to a sudden decrease in the number of animals. The remains of the last poached cow were found in April 1919. It was the end of the last free-living herd of lowland European bison.

The idea of rescuing the species was introduced on the International Congress for Conservation of Nature in Paris in 1923 by the Polish naturalist Jan Sztolcman. A result of his speech was the establishment of the International Society for Protection of European bison, embracing representatives of 16 countries. The most active role was played by the representatives from Poland and Germany. The society's task was to maintain European bison through planned breeding and increasing their range, as well as to take care of species purity by keeping the European bison Pedigree Book.

European bison returned to Poland in 1924. Initially, a pair of European bison with the following names and pedigree numbers was transported to the zoological gardens in Poznań: 96 GATCZYNA and 101 HAGEN. In 1929, the European bison reserve in Białowieża imported two sisters, 93 BISERTA and 161 BISKAY, as well as the bull 163 BORUSSE, a descendant of KAUKASUS, i.e. a hybrid of subspecies. The breeding farm in Białowieża chiefly aimed at breeding pure-blood lowland European bison. To this end, the male 186 BJÖRNSON was transported from Stockholm in 1935. Unfortunately, the bull died as a result of a duel with BORUSSE. The male 229 PLISCH, transported later from Pszczyna, left numerous offspring.

At the beginning of 2012, there were 4663 specimens in Europe recorded in the European bison Pedigree Book, out of which 2980 stayed in free-living herds- apart from our country- in Russia, Belarus, Slovakia, Lithuania, and Ukraine. In 2012, the first European bison were released in Rumania. Both Germany and Denmark have plans concerning European bison's reintroduction. Remaining animals live in a total of 221 herds that are in captivity. Outside of our continent, there are merely 11 and 10 specimens in Brazil and Canada respectively. Table 1 presents the number of European bison in particular countries divided into free-living and semi-free herds, as well as herds living in captivity.



**Table 1.** The number of European bison in particular countries divided into free-living and semi-free herds, as well as herds living in captivity – the state at the end of 2011 (the European bison Pedigree Book 2011)

Country	Herds in captivity		Free-living		Semi-free		IN TOTAL	
	number of							
	herds	specimens	herds	specimens	herds	specimens	herds	specimens
Poland	23	197	5	1041			28	1238*
Belarus	5	9	8	1075			13	1084
Russia	20	123	13	537			33	660
Germany	78	521			1	28	79	549
Ukraine	4	8	7	246			11	254
France	12	87			1	36	13	123
Sweden	10	109					10	109
Lithuania	5	34	1	72			6	106
Romania	4	30			2	67	6	97
The Czech Republic	8	49					8	49
Holland	4	49					4	49
Spain	7	48					7	48
England	8	47					8	47
Latvia	2	37					2	37
Switzerland	4	36					4	36
Slovakia	4	22	1	9			5	31
Estonia	2	20					2	20
Hungary	3	19					3	19
Belgium	2	18					2	18
Ireland	1	15					1	15
Denmark	3	13					3	13
Brazil	4	11					4	11
Austria	3	10					3	10
Canada	3	10					3	10
Finland	2	7					2	7
Italy	1	5					1	5
Moldova	1	5					1	5
Croatia	1	4					1	4
Portugal	1	4					1	4
Bulgaria	1	3					1	3
Macedonia	1	1					1	1
Serbia	1	1					1	1
<b>IN TOTAL</b>	<b>228</b>	<b>1552</b>	<b>35</b>	<b>2980</b>	<b>4</b>	<b>131</b>	<b>267</b>	<b>4663</b>

\*In order to provide the most recent data, all the information concerning our country in this text comes from the end of 2012



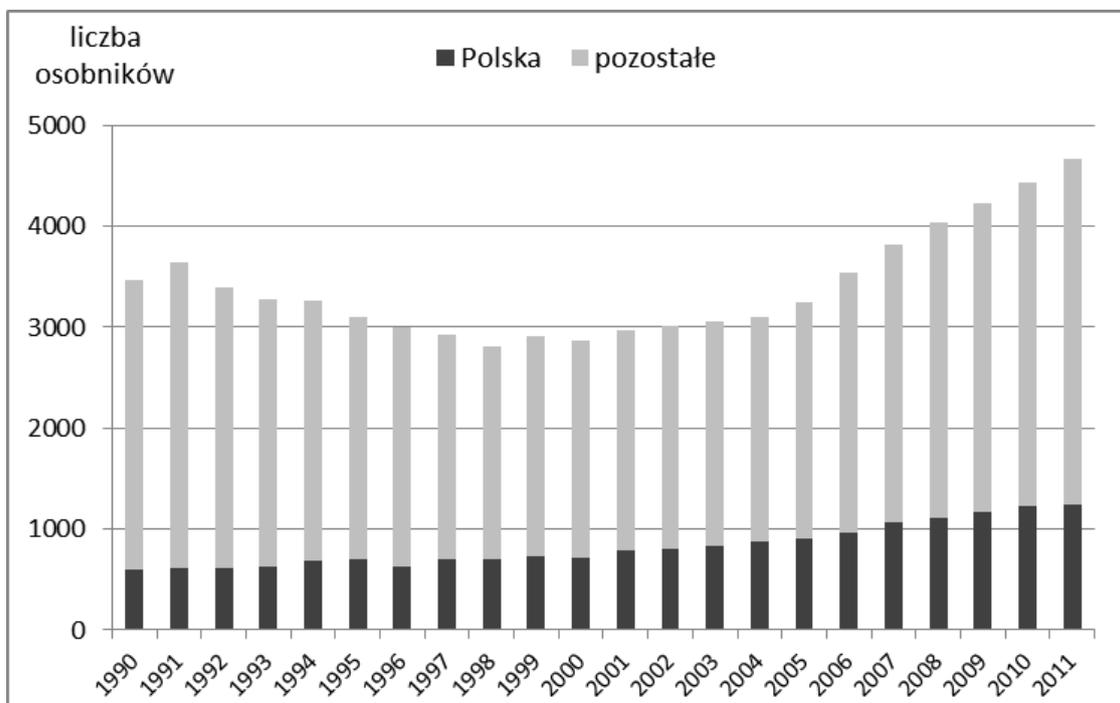
The vast majority of herds living in captivity concern groups with individual specimens or groups with 2-3 specimens (Table 2). These are merely used for presentation purposes. The most fundamental and important for the restitution process are herds with more than 8 animals (there are 62 such herds in Europe), which constitutes about 1/3 of all herds. There are four European bison Breeding Centres and, recently, a pen in Muczne that belong to more numerous herds in our country.

Table 2. The size of herds living in captivity (data from the end of 2011; the European bison Pedigree Book 2011)

The size of herds	The number of herds
1	24
2-3	68
4-7	74
8-11	28
12-19	20
20 and more	14
IN TOTAL	228

The number of European bison population has been rising in recent years due to an increased interest in the European bison and its protection as well as the work of European bison Specialist Group IUCN. The interest is focused not only on Eastern Europe, but the European bison population is growing very actively also in western countries such as Germany, Spain or Sweden. Diagram 1 presents the size of European bison population with the emphasis on the population in Poland in the years 1990-2011.





**Diagram 1.** The size of the whole European bison population in Europe in the years 1990-2011 with the emphasis on Poland (data from the European bison Pedigree Book)

*Legend:*

*liczba osobników - the number of specimens*

*Polska - Poland*

*pozostałe – other*

In the years 1990-1992, the European bison population in Poland constituted around 17% of the European population. This percentage has been around 27-28% in recent years which have also seen a clearly increasing trend- the population grows annually by approximately 200 specimens due to both the enlargement of existing herds and the emergence of new ones. The number of all herds living in captivity has increased by more than 30 since 2000. However, the number of free-living herds is not growing so fast. In 2000, there were 34 herds living in the wild, while presently their number amounts to 35. Some Ukrainian and Russian herds do not exist any longer, but there have appeared new European bison groups in countries such as Slovakia (in the National Park of Poloniny), Belarus or Rumania. The first semi-free herd has emerged in Germany (a numerous group in a large pen), as well as in France and Rumania.

In EU countries there are in total 2594 specimens, including 1122 ones living in the wild. The Polish European bison population constitutes 48% of the overall population in the EU and 93% of European bison living at large. In Poland, there are five European bison populations living in the wild that are described below.

### **Białowieża Forest (Puszcza Białowieska)**

An experiment carried out to restore European bison's full freedom by releasing first specimens onto the territory of Białowieża Forest began in 1952. The fact that the experiment was a success is reflected in the growing size of European bison population that lives in the wild.



Since its establishment, taking care of European bison is a responsibility of Białowieża National Park in cooperation both with the forest inspectorates in Białowieża, Browsk, and Hajnówka, as well as the Regional Directorate of State Forests in Białystok. Whereas Białowieża National Park plays the leading and substantive role in taking care of European bison, daily tasks that concern looking after these animals are divided among all units.

The population living in the Polish part of Białowieża Forest numbered 306 (130♂, 175♀) European bison at the end of 2000, and 504 (219♂, 285♀) European bison in 2004, thus it grew by 65%. Its size is growing slowly but steadily, despite animals' death and selective-reducing measures that are used to shoot them off. In the years 2001-2009, eighteen supernumerary males were released from the reserves in Białowieża (two specimens at the age of 4 and seventeen specimens at the age of 2-3).

The structure of the population did not change significantly in the years 2001-2012 in comparison with the initial years. Although the number of adult bulls and cows rose, that of the young and calves decreased. It is a deliberate effect resulting from the elimination rules followed in Białowieża Forest- during the reduction of the size of the population one selected late-born calves and the youth whose fitness made them stand out from their peers.

The European bison population in Białowieża Forest is being plagued by unique diseases. After 2000, necrotic inflammation of the foreskin (*zapalenie napletka*) (*posthithis*, *balanoposthithis*) was diagnosed in every fourth male at a different age that was eliminated. Another problem found in ten or more percent of eliminated males concerned parasitic diseases. The most dangerous diseases of this kind include the lungworms and liver fluke. In 2001, a bloodsucking nematode (*krwio pijny nicień*) (*Ashworthius sidemi*) that lives in the abomasums and causes, most probably, anaemia in infected animals was found in the herd in Białowieża for the first time.

The availability of natural prey in Białowieża Forest has been decreasing for many years, and only in spring the Forest environment abounds in rich undergrowth. As summer goes by, the undergrowth in wet-ground forests dries. European bison then begin to look for food in alder swamps, and, subsequently, on mown meadows as well as agricultural areas on the outskirts. The Forest area is free from complete logging, while bigger surfaces, where reforestation is being conducted, are usually enclosed with a fence.

There is a centuries-old tradition of feeding European bison in Białowieża Forest in winter. As early as the 17<sup>th</sup> century, local peasants who were privileged to mow the meadows belonging to the Forest had to leave some hay for animals. In the 19<sup>th</sup> century, there appeared first feeding racks. Nowadays, the number of feeding places in the Forest exceeds 30, which is conducive to the proliferation of the population.

In 2006, European bison came out of the Forest and formed a new winter refuge "Siemianówka" on meadows outside the border. The largest European bison group, around 70 specimens, stays there in winter.

## Borki Forest (Puszcza Borecka)

The Minister of Forestry and Timber Industry created the Rare Animals Breeding Centre in Borki on 31 August 1955. A year later, in April, first European bison of the Białowieża-Caucasus breeding line were transported from Niepołomice. Since 1962, a free-ranging breeding farm was run simultaneously with the European bison breeding reserve (run until 1985) in Borki Forest. In the years 1969-1972, the European bison of the Białowieża-Caucasian breeding line were exchanged for lowland ones. Currently, the herd of European



bison in Borki Forest numbers 100 specimens (57♂, 43♀) and has reached a target size.

According to the provisions of the European bison Protection Strategy in Poland, Borki Forest is a place of transferring supernumerary specimens from herds living in captivity. Some of these specimens are allowed to come back to the herd after being in quarantine. The possibility of shooting European bison was first introduced in Borki Forest in 1975. On average, between 10 and 14 European bison are eliminated in this way every year.

“The Programme for the European bison Population Management in Borki Forest” was developed in 2008. The most important recommendations pertained to the need to establish a monitoring system that would facilitate determining the size and structure of the herd as well as its proliferation and habitat preferences, the improvement of the feeding base in the Forest, the construction of a quarantine pen, and the enrichment of the educational base.

### **Knyszyn Forest (Puszcza Knyszyńska)**

The European bison’s population in Knyszyn Forest was originated in April 1973, when five specimens (2♂, 3♀) were released onto the forest area Sosnowik. At that time, the presence of one male European bison was already registered. The size of the herd was growing slowly, and there had been less than 25 animals until 2003. Later growth was so intensive that the population numbered 120 specimens at the end of 2012.

The European bison were not fed for many years, but due to the high level of damage in agriculture feeding was introduced. At present, apart from mowing and reclaiming meadows, there are conducted activities connected with building watering places and roads. The European bison’s population has been showing stable growth and a tendency to expand home range for 9 years. Thus, it should be acknowledged that methods used so far to protect and manage the population have proved to be right.

In winter, the current population lives on the area of approximately 16 000 ha (forest + field). It is assumed that the target size of the population living on the present area should amount to about 120 specimens. However, the aim is to disperse the herd, exploit the environment in a more even manner, and to reduce significantly the level of damage in the fields. There is a justified reason to expand the home range into the territory of the Forest District of Żednia, bordering on the Forest District of Browsk, which will create a bridge connecting the European bison populations in Białowieża and Knyszyn.

### **West-Pomeranian European bison**

The eight European bison transported into the acclimatization pen of 50.7 ha, situated near Ostrowiec in the Forest District of Wałcz on 29 February 1980, were released to the wild after about five months. About 10 years later, the herd moved onto the territory of the Forest District of Mirosławiec. Intensively exploited fields constitute now approximately 50% of the herd’s home range. There has not been any action of the active protection of the herd for twenty-five years. The size of this group was not large, consisting of merely 29 animals in 2004. There was an increase in an average age of specimens, and their reproduction capacity dramatically dropped.

In 2005, there was “the Programme of the European bison’s Protection in West Pomerania” developed, determining the urgent need to feed the West-Pomeranian population with other specimens in order to rise the genetic diversity of the herd. The first infusion of blood since the creation of the herd was carried out in 2006. The European bison’s group in the Forest



District of Mirosławiec has 80 specimens. Two new herds were created in 2008: one in the Forest District of Dobrzany, the other in the Forest District of Łobez. About 8 months later, both the herds moved onto the territory of the Forest District of Drawsko. In the ninth month after their creation, the herds formed one group, which now consists of 54 individuals and lives on the active military training ground.

In winter, West-Pomeranian European bison are fed mainly with oats and beetroots, which aims at reducing damage in farming and forestry. Reproduction capacity of this group is at the level of 80% of cows of reproductive age. The European bison are monitored via telemetry; approximately 20% of the animals are equipped with telemetric collars GPS/GSM/VHF. The continuity of measurements has been maintained since 2008. Very good cooperation with State Forests, local self-governments and the command of the military training ground has resulted in a high level of social acceptance for free-ranging European bison in the region. There is no upper limit of the size of the West-Pomeranian herd, which has great development potential. Both the location of the next free-ranging herd as well as the directions of European bison's proliferation in the region have been established.

The West-Pomeranian Nature Society takes care of the European bison's population in West Pomerania. It has been entrusted by the province governor, and later by the Regional Director for Environmental Protection, with a public task "Selected issues concerning the protection of free-ranging herd of West-Pomeranian European bison".

## Bieszczady Mountains

At the beginning of the 1960s, a decision was made to transport some of the lowland-Caucasian European bison from the breeding farmstead in Pszczyna and Niepołomice into Bieszczady Mountains. 19 specimens were transported to a newly-built pen in the Forest District of Stuposiany in the years 1963-1966. The second reintroduction was carried out in the western part of the Bieszczady Mountains, on the territory of the Forest District of Komańcza, near Wola Michowa. In the years 1976-1980, 16 European bison were transported from Niepołomice, the zoo in Kraków, and Pszczyna. The herd quickly grew in size and now occupies the area from the borderland between the Forest Districts of Komańcza and Baligród up to Lesko, in the north, and Cisna, in the south. The two populations in the Bieszczady Mountains, eastern and western, have not had contact with each other to date.

European bison are transported from abroad to pens in Wola Michowa, the second pen in Bieszczady National Park in the region of Bukowiec on the Upper San river, and in Muczne. The latter was created in 2012 on the territory of the Forest District of Stuposiany. In addition to providing the arriving European bison with the possibility of adaptation, it also plays an educational and informative role.

Unfortunately, bovine tuberculosis was found in the European bison living in the Bieszczady Mountains in 1996, for the first time in a herd occupying the then area of the Forest District of Brzegi Dolne (now Ustrzyki Dolne). The herd was eliminated, but not entirely, at the turn of the years 2000-2001. The risk of tuberculosis infection reappeared at the beginning of 2010, when a dead cow with the far advanced disease was found in the Forest District of Stuposiany, near the Ukrainian border. Later, further sick animals were discovered. A decision about the complete elimination of the herd that had then more than 20 specimens was taken in the autumn of 2012. The elimination process ended in March 2013.

According to the results of the inventory made at the beginning of 2013, the entire population in the Bieszczady Mountains consisted of 256 European bison which were divided almost



equally between two subpopulations. Based on many years of direct observation and its results, it has been estimated that an average annual realized growth, i.e. the proportion of calves in the population at the end of winter amounts to 6%. Currently, the area occupied by the European bison's herds in Bieszczady Mountains is approximately 650 km<sup>2</sup>.

## 2. Brief information on the European bison's closed breeding farms in Poland conducted by State Forests and other institutions - description and functions

At present, there are the majority of representatives of this species in our country- 1299 specimens which live mostly in the wild in five populations. At the end of 2012, 209 animals lived in captivity, in twenty-five herds, in the European bison Breeding Centres as well as zoological gardens and private pens (Table 3). These animals constitute a restitution breeding base for the European bison ex situ.

Table 3. The number of specimens in domestic herds living in captivity divided into sexes recorded at the end of 2012 (Editors of the European bison Pedigree Book)

The name of a breeding farm	The year of establishment	The number of specimens	male	female
Bałtów	2011	6	3	3
Białowieża	1929	31	10	21
Białystok	1956	2	1	1
Bydgoszcz	1978	3	0	3
Człuchów	2009	2	1	1
Gdańsk-Oliwa	1957	10	3	7
Gołuchów	1977	12	4	8
Karolew	2006	2	2	0
Kiermusy	2008	6	3	3
Leszno	1978	1	0	1
Łódź	1955	4	2	2
Międzyzdroje	1977	7	2	5
Muczne	2012	15	8	7
Niepołomice	1946	20	5	15
Poznań	1924	3	1	2
Pszczyna	1865	37	14	23
Pszczyna Park	2008	6	3	3
Smardzewice	1936/1952	17	7	10
Strzelinko	2011	4	1	3
Sycowice	2012	5	2	3
Toruń	1995	2	1	1
Ustroń	2005	5	4	1
Warszawa	1929	3	1	2



Wrocław	1949	3	1	2
Zagroda w Bukowcu	2011	3	1	2
In total		<b>209</b>	<b>80</b>	<b>129</b>

Contemporary European bison are divided into two genetic breeding lines: lowland (in Białowieża) and Białowieża-Caucasian. The former one is a pure lowland subspecies, while the latter one has the only male of Caucasian subspecies in the ranks of its founders, which is 100 KAUKASUS. Most herds living in captivity in our country consist of lowland animals which are the breeding core of this line in Europe. The pens in Muczne and Bukowiec (Bieszczady Mountains) keep animals of Białowieża-Caucasian breeding line. Their role is to participate in the programme of enriching the only herd of this line in the county genetically. The pen in Muczne, as a show, plays an educational role.

The lowland European bison's pens divide into bigger, longer-existing and, to a certain extent, elite European bison Breeding Centres (Niepołomice, Pszczyna, Białowieża and Smardzewice) and show pens with an over 30-year-long history (Gołuchów and Międzyzdroje). These six herds (a total of 124 specimens) are the most important part of the programme of the European bison's *ex situ* conservation. Other pens, smaller or lasting for a short time, play above all a show, educational, and breeding role, while the proportion of these tasks in European bison Breeding Centres is reverse.

Part of the herd in Pszczyna, Pszczyna-Park and Sycowice belongs to the breeding line from Pszczyna, descending from two founders and highly-inbred. These three breeding farms are designated to maintain the European bison's breeding line from Pszczyna, which is a very interesting example of inbreeding among mammals.

### 3. An influence of the European bison and its protection on the co-existence and protection of other species

#### A role in the ecosystem, interaction with other species

European bison belongs to species which are particularly demanding in terms of occupied area, both by individual specimens and groups characteristic of this species. This is primarily connected with the European bison's size. According to research done by Białowieża National Park, an adult specimen is able to consume even more than 30 kg of biomass per day which consists mainly of grass, sedge, herbs, low shrubs, sprouts, and bark. This means that one European bison takes over 10 tons of food every year. It is assumed that the biomass of plants per hectare which is available for the European bison in our forests does not exceed a few hundred kilograms. While feeding, herbivorous animals take food from abundant and easily accessible places. Therefore, it is necessary to assume that several dozen hectares of the forest should fall on one specimen in order to ensure European bison the possibility of consuming essential food rations in time unit and not to lead to the overexploitation of their food base.

Moreover, the European bison is a gregarious species. Although the most common group consisting of cows, calves and the young have from ten or so to twenty specimens, there are also periodical herds numbering more than thirty or even fifty European bison. Daily biomass consumption by such a herd should be estimated at over 1 ton.



Taking account of the above data, it should be stated that the European bison is an important consumer of the first order which may significantly influence the condition of vegetation cover. Only a small percentage of the European bison's natural food (approx. 20%) consists of sprouts, thus these animals feed on, first of all, the plants of undergrowth and monocotyledons growing on open areas within and close to forests. While pasturing, European bison also feed or damage the seedlings of trees and shrubs growing in grass. Therefore, if numerous, they may impede the succession processes and reforestation. On the other hand, by preventing the overgrowth of open areas, this species contributes to the maintenance of high biodiversity of forest ecosystems.

Due to its food habits, the European bison is in little competition with other indigenous species of large herbivores. The European bison is classified as a grazing herbivore, feeding rather indiscriminately, predominantly on monocotyledons and dicotyledons, preferably broadleaf. Hence, European bison only seldom consume food vital for species feeding strictly or mostly on shoots, tree leaves (such as moose or deer), or being highly selective in their diet – as roe deer are.

Considerable intake of food characterized by relatively low digestibility, means producing large amounts of feces. A European bison digests between 51,6% and 60,6% of dry mass of food, depending on season and the kind of food. Daily intake of as much as 30 kilograms of biomass involves producing 5 to 7 kilograms of feces, that constitute an important microhabitat for numerous coprophagous invertebrates. Due to their chemical composition, feces of European bison also play an important role in the so called localized fertilizing of the forest floor, since they contribute, as do droppings of other large mammals, to increasing the local diversity of trophic conditions for microorganisms and plants, and in turn enhance biodiversity in that plant stratum of a forest ecosystem.

Because of its size, the European bison is not vulnerable to predators, although historical reports from the Białowieża Forest, dating back to the XVIII<sup>th</sup> and the XIX<sup>th</sup> century, mention European bison that have fallen prey to wolves or bears. Contemporarily, we know of two confirmed successful attacks by wolves on calves that most likely got isolated from the herd, and of one by a bear on a juvenile cow. All these incidents occurred in Bieszczady Mountains. A European bison that died of age, injury or disease becomes a valuable source of nutrition for a number of predators and scavengers, ranging from the largest, i.e. bears, to small predators such as foxes or martens, as well as corvidae.

## Vulnerability to diseases and parasites

As a result of a particularly low genetic heterogeneity, European bison are prone to infectious diseases. Instances of epizootics were reported both among animals living in captivity (foot-and-mouth disease, bluetongue disease) and in free-ranging herds (tuberculosis). Due to migrations, often very far among males in particular, there is a possibility of pathogens being carried by such individuals over long distances. With parasites, this is also the case. Thus, free-ranging European bison herds may be either reservoirs or vectors carrying various pathogens.

A basic policy in preventing European bison from transmitting pathogens and protecting the animals themselves is routine monitoring of the population, which should include health checks, hence it should report and investigate every instance of a dead European bison. Decisions concerning measures taken in case of an infectious disease epizootic are made at ministerial level. Taking samples of feces periodically in order to assess the parasite load in the animals is recommended as well.



## The role of wisent protection for protection of other species

Habitat conditions required by the European bison are also favorable for numerous other species of mammals (herbivores and predators), as well as birds and invertebrates. For this reason, European bison may be considered an umbrella species, whose protection can simultaneously provide high quality environmental conditions for a range of other species having similar or lesser requirements concerning habitat areas. Territories designated for European bison conservation (such as sanctuaries and fauna reserves) can prove to be a significant factor supplementing or supporting other networks of conservation areas.

Dietary preferences and habitat use typical for European bison herds contribute to creating and sustaining microhabitats which increase general biodiversity and are indispensable for prevalence of a very wide range of fauna species.

## 4. Guiding principles on keeping the European bison Pedigree Book

In 1924 the International Association for the Protection of the European bison started the European bison Pedigree Book, the first individual record of this sort for a wild animal species. Before the war, the worldwide Book was kept in Germany, then in the post-war period in Poland, currently in the Białowieża National Park. The first Polish editor was Jan Żabiński, currently the position is held by Jan Raczyński.

The key function of the Pedigree Book is to ensure purity of the species, hence only European bison that come from centers cooperating and registered in the Book are eligible for conservation programmes. The Pedigree Book includes each purebred European bison, while for free-ranging herds only their numbers are registered. Each individual European bison has its own identification number and a name, the record also includes date and place of birth, names and identification numbers of parents and any information concerning the transport of the animal between different centers.

When the book was created, each breeding center was assigned identification letters that should become initials in the name of each European bison born in that center. The breeding center in Białowieża, and later all the Polish centers were assigned the initials 'PO' for purebred lowland European bison and 'PU' for European bison of the Białowieża-Caucasian line. European bison from Pszczyna, which back then was a German city, were identified by the initials 'PL'. European bison of 'unknown origin', i.e. coming from a free-ranging herd, for example, are given names beginning with the letters 'KA'.

Each European bison appears in the Book for the first time after being assigned a pedigree registration number, and it is listed in the table 'Official registry of purebred European bison born in the year...'. Transfers between breeding centers and to subsequent owners, as well as other events are documented in the table 'Changes in numbers of the European bison in the year...'. The table 'Index of all the European bison alive on December 31, year...' lists by name all the European bison living at the end of a calendar year in broken down by countries and breeding centers. The table 'The number of worldwide purebred European bison on December 31, year...', which opens every chapter of the Book, contains numerical data only – for herds in captivity, free-ranging herds (whose names are provided in capital letters) and breeding centers where solely lowland European bison are kept (written in bold).



## 5. Conservation status of the European bison in Poland and the European Union and legislative framework for conservation efforts

### European bison (*bonasus L.*)

Species of Community interest – the Berne Convention, appendix III (an index of wild fauna whose exploitation should be regulated so as to keep populations of those species out of danger), the Habitats Directive, Annex II (animal species of interest for the Community, conservation of which requires delimiting Special Areas of Conservation) and Annex IV (animal species of Community importance that must be under a strict protection regime, a priority species (species code: 2647),

- 🦌 legal protection in Poland: species protected by law for over 200 years, listed as one of the species in need of a strict protection (the nature conservation act) and a species for which any inflicted animal damage must be compensated by the State Treasury – compensating field damage, crop losses, farming produce or forestry damage,
- 🦌 Other EU member states – subject to legal protection in Lithuania, Slovakia, Romania – countries which have free-ranging European bison populations, the remaining countries do not have specific legislation for protecting the European bison, in some cases (Sweden, certain Länder of Germany) the species is treated as a subgroup of domestic cattle,
- 🦌 Conservation status according to *Polish red data book of animals. Vertebrates.* (Głowaciński et al., 2001): **EN**- endangered due to small population size.
- 🦌 Conservation status according to Red List (IUCN 2009): **VU** – vulnerable, wherein the status of the Białowieża-Caucasian line is **EN** – endangered due to small total population size, declining abruptly for some local groups.

## 6. Description of threats and protection methods

### Threats:

#### Small population sizes

Currently the total population of European bison in Europe is merely 4663 individuals, with free-ranging groups only accounting for 60% of the number. Such small population size cannot guarantee viability and safety of the species, which is the major reason for it being classified as endangered. Additionally, certain local European bison populations may be at risk of rapid decline due to various factors (poaching, accidents, epizootics). Hence, the future of the European bison as a species is uncertain, as it could become critically endangered or extinct over a very short period of time. Action Plan for the European bison is to reach a total population of about 6000 individuals in free-ranging herds, more or less half for each genetic line. This means at least doubling the current number.

Natura 2000 sanctuaries, where the European bison is under protection, conservation of the species was generally assessed as 'unsatisfactory' (U1). Populations existing in Poland do not have the capacity to grow by themselves (with the exceptions of those in Western Pomerania and Bieszczady Mountains) and with no measures taken to increase population sizes the conservation status will not improve.



## **No natural exchange of individuals between existing populations (isolation of existing herds)**

Individual herds are separated from each other as a result of a small total population and heavy fragmentation of suitable habitats. It is known that isolated populations are especially at risk of extinction due to progressive inbreeding and genetic drift. It is universally recommended to allow unrelated genotypes in when managing a small population. Hence, this effective isolation of European bison herds is an acknowledged threat, which in many cases was successfully prevented by transferring individuals between herds. This policy is used as part of conservation programmes for captive populations, but also for most free-ranging herds. In some cases, free-ranging European bison could potentially exchange spontaneously, for example between the Polish and the Belarussian populations in the Białowieża Forest, but there is an artificial barrier in the form of a fence. In other instances, there is a chance for forming a metapopulations within which subpopulations would naturally merge, as it was the case in East Carpathians or in the 'European bison Land' in Northeast Poland.

## **Habitat fragmentation – not enough room to establish new, large and viable populations**

It is estimated that a demographically stable European bison population should have above 100 individuals. Such a population needs an area of at least 200 to 300 square kilometres. In Europe, not many areas this large, free of discontinuities and interferences are left to use. One should bear in mind that smaller populations are unstable and require care and support, but are capable of functioning as a subpopulation which interacts freely with other European bison groups or is periodically supplemented by individuals coming from breeding centres or free-ranging herds. It would prove problematic to establish another population of over 100 European bison in Poland, whereas it is perfectly feasible to establish smaller herds inhabiting continuous areas, the West Pomeranian Voivodeship being one current example.

## **Very limited genetic heterogeneity**

After examining pedigrees of European bison it turned out that all the living individuals are decedents of 12 founders. One of the founders is 100 KAUKASUS, representing the Caucasian line, the remaining 4 males and 7 females are lowland European bison. Those European bison which originate from the Caucasian European bison represent the Białowieża-Caucasian line (LC). Purebred lowland European bison belong to the Białowieża or the lowland line (LB). Four female founders gave birth to solely crossbred calves, which is why the LC line originates from all 12 founders, while the lowland line only from 7 of them. One should also mention the Pszczyzna line which originates from only one couple of founders (42 PLANTA i 45 PLEBEJER) and is still sustained today.

This sort of bottleneck in the species history caused the gene pool to be extremely limited and in turn lowered its heterogeneity, particularly in the lowland line. Additionally, genetic contribution and importance of different founders is not equal, with genes of PLANTA and PLEBEJER being over-represented, making up for 90% of genes in the lowland line. As there are no male descendants of founders from the low and line, other males only have a copy of PLEBEJER'S Y chromosome, while European bison of the LC line also have genes of two other males.



As a result of small population and few founders, related animals engage in breeding. European bison are very highly inbred, particularly so in the lowland line. On average, over 40% of their genotype is homozygous. Yet, this is not correlated with inbreeding depression, as there are no reproductive disorders, mortality rate is low. It is possible, though, that the poor immunity to diseases and parasites results from inbreeding.

## Susceptibility to infectious diseases and parasitic infestations

The European bison is a species very susceptible to diseases. Infections leading to death of all or most herd members occurred on several occasions in the past (tuberculosis in Bieszczady, foot-and-mouth disease epizootic in Pszczyna, bluetongue disease in Germany). An outbreak is possible especially if European bison have come into direct or indirect contact with domestic cattle. As a rule, infectious diseases are more serious in European bison than in other species. Another aspect is acceptance of parasites and occasionally acute infections. European bison are known to have both parasitic fauna typical for cervidae and for cattle and sheep. Certain kinds of parasites propagate in European bison populations rapidly, for example *Astworthius sidemi* – a blood-sucking nematode, brought along with the Sika deer, for which 100% of the examined European bison in the Białowieża Forest now test positive.

## Locally low social acceptance

A major setback for European bison proliferation, necessary in the light of an overly small population, is a relatively low social acceptance for the species. It results from concerns about damage in forests and fields, occasionally also about personal safety. Surveys among inhabitants of regions where European bison lives demonstrate that its acceptance is higher in these regions, when compared to areas with no European bison occurrence. This phenomenon derives from the classic fear of the unknown. Social acceptance is also influenced by information provided to the public, oftentimes inaccurate or biased. This kind of broadcasts often describe situation in the Białowieża Forest, where conflicts occur as a result of insufficient capacity of habitats and intensified tourism in the forest.

## Poaching

Poaching is dangerous for the species, and it becomes especially harmful during social unrest. The European bison is a rather easy target for poachers, so its population size may plummet within a short period of time. One example is the population of 700 European bison that lived in the Białowieża Forest in 1915 and was practically extinguished in four years of being hunted by the army and poachers. Similarly, a population of about 250 European bison in the late 1980's, inhabiting Bukovina in the Ukrainian part of the Carpathians, has today reduced to 30 individuals. Fortunately, poaching in Poland is very limited in scope, and as such it is not dangerous, although European bison occasionally get trapped in snares set with intention of capturing other kinds of animals.



## **No conservation status in captive breeding in many West European countries (legal procedures relative to domestic cattle are applied)**

Despite being included in annexes to the Habitats Directive, the European bison did not occur in free-ranging herds in EU countries, except Poland, Lithuania, Slovakia and Romania, until recently. Only this year, the first small herd out of captivity was established in Germany. In countries where the species does not make part of fauna, it has no conservation status. In many of them, the European bison is treated as equal to domestic cattle. It needs to be labelled, provided with a passport, and in case the owner wishes to dissolve the herd, there is no legislation to prevent this. It is particularly dangerous if individuals in consideration are of significant genetic value. European bison in captivity are known to be a genetic reservoir for the species and must be optimally used as a resource. On the plus side, despite the lack of appropriate legislation, herd owners are now conscious enough to participate in conservation programmes voluntarily. With proper management of European bison migration and exchange, their populations should not suffer further losses.

### **Pressure from tourism**

As tourism becomes increasingly intense, it should be considered as one of the potentially harmful factors. European bison have undoubtedly become a matter of an ever growing interest for the general public, hence many seek to see the European bison in its natural environment in the wild. Unfortunately, this may be dangerous for the people attempting to come too close to the animals on the one hand, and on the other, it startles the European bison, which flee from their feeding grounds or sanctuaries, trying to evade humans, long before being spotted by them. In the Białowieża Forest, tourism is common enough to strongly disturb the European bison throughout the year, including in the rutting season and while rearing the young.

## **7. Applied and recommended methods of conservation**

### **In situ conservation – encompasses all kinds of protective activity within the existing free-ranging herds**

In situ conservation activity should be planned individually, according to actual and potential threats, specifically regarding the European bison population in question.

### **Managing low genetic heterogeneity**

Without a doubt, a threat to which all free-ranging herds currently in existence are exposed is a high inbreeding rate, resulting from the history of the species. As there is no method to improve this situation directly, what needs to be done is levelling up the genetic pools of the founders in currently isolated free-ranging European bison herds, especially those of the Białowieża-Caucasian line. As of today, the most efficient method of limiting the risk is supplementing the herds with individuals of a known pedigree, reintroduced from captivity and selected on the basis of pedigree analysis. This sort of activity has another advantage of allowing to manage any breeding surplus, a serious problem for many breeding centers, and increasing effective sizes of those herds. Additionally, reintroducing individuals from captivity helps rising the overall population size, which still remains critically low, despite growing quite steadily over the last decades.



If possible, natural exchange of individuals between free-ranging herds, occupying adjacent territories, should be encouraged by creating suitable conditions. This calls for a formally established conservation status and ensuring that natural trails permit migration. Such possibilities exist in Bieszczady Mountains, for example, where forest management plans currently account for corridors of seasonal migration for European bison, interconnecting areas they occupy in winter and summer. Also, in Polish part of the Carpathians, there is a possibility to designate migration corridors that would be compatible with those created on the Ukrainian side and connecting to conservation areas in Romania. Designating and managing such a corridor would not only help European bison populations to propagate, but also benefit all other species of large mammals. Another region in which conditions allow for functioning of such a corridor is the North-East part of Poland, where spontaneous migrations of European bison from the Białowieża Forest towards the Knyszyńska Forest, or from the Borecka Forest to the Augustów Forest already take place, and where a route for the corridor has been provisionally mapped out as part of the 'European bison Land' project. A region where such activity is successfully carried out is the territory of the West Pomeranian European bison population, where projects are conducted in order to disperse and divide herds. European bison can move freely over the area, not only from herd to herd, but over nearly a half of the West Pomeranian Voivodeship. Were the free migration inhibited in some way, several small and isolated groups of European bison would be formed.

### Parasitic disease prevention

Diseases caused by internal and external parasites are among the most common ones to develop in the European bison. Parasites inflict mechanical damage to tissues and organs and, through toxic byproducts of their metabolism, lead to poisoning. A liver fluke infestation, for example, causes mechanical damage to liver parenchyma, accompanied by connective tissue growth and calcifications in bile ducts. Lungworm infestation leads to pneumonia and pulmonary lesions. Recently, a blood-sucking nematode *Ashworthius sidemi*, originating from Asian cervidae, has become a major threat. Apart from the symptoms mentioned above, acute parasitic infestations universally lead to deterioration in animal health, debilitating their immune system and in case of ectoparasites, which inflict damage to outer tissue layers, also cause exposure to serious bacterial and fungal infections. Obviously, there is a feedback effect since individuals with health reduced due to injury or infectious disease may be at greater risk of a major parasitic infestation.

Since parasite treatment is difficult in wild animals, it is very important to undertake prevention inhibiting seasonal concentrations of European bison (such as supplementary feeding conducted simultaneously in many different locations). Organized supplementary feeding in wintertime should involve removing and composting excrements amassed in the vicinity of feeders, as well as disinfection with the use of Rapicide or by liming.

### Infectious diseases

The risk of infectious diseases in European bison is considered to be significant, given the fact that living in herds encourages proliferation of pathogens, combined with the species' high susceptibility to infections, likely resulting from the low genetic heterogeneity. Also, European bison usually do not come in contact with infectious agents, hence they fail to develop immunity to infections. For this reason, particularly viral infections spread easily in populations, even leading to a 100% mortality rate. In case of diseases such as tuberculosis, whose transmission is slow, all European bison in direct contact may become infected.

A source of infection may be other related species (such as domestic cattle) and transmission may occur via direct contact while grazing in the same area, or by blood-sucking insects.



While bred herds might be managed by either quarantining the remaining healthy animals or isolating the infected individuals, it is very difficult to spot the moment of infection or even its early symptoms in free-ranging herds. Thus it is vital to continuously monitor the herds by watching for visible signs of a change in animals' health (such as fatigue, separation from the herd, typical lesions on the fur and near the muzzle) and strictly adhering to the rule of epidemiologically investigating the carcass of every dead individual. Since European bison may be a potential reservoir of diseases such as foot-and-mouth disease, tuberculosis or brucellosis, oftentimes the only effective measure in case of an infection spreading in a herd is to terminate the herd.

## Decreasing rate of reproduction

In populations for which population structure is monitored for a number of years (populations of Białowieża, Bieszczady mountains) a decrease in the reproduction rate is observed as a result of the herd aging. The rate of reproduction might drop for a number of reasons, including animal health, physical condition or diet, but an undeniably essential factor is the age-sex structure. Cows may engage in reproduction at the age of 2, and beyond the age of ten odds of gestation drop significantly. For bulls, only the dominant and perfectly healthy males - normally aged between 4 or 5 and little over 10 years - gain the opportunity to reproduce, as a result of competing for females successfully.

For this reason, the age-sex structure of a herd should be monitored to ensure optimal reproduction rate in given natural conditions, and if out of balance, it should be corrected by either introducing new individuals or systematic elimination.

## Risk of traffic accidents

Wild European bison, which can roam freely may be a serious problem for local traffic. The risk depends on where a territory used by a given herd is located – it is very low in Bieszczady Mountains (where no accident ever happened over the 50 years of the free population living there) and relatively significant for the herd of West Pomerania, where over the 30 years following the first reintroductions several dozen collisions have been reported. If European bison are not accustomed to the presence of humans and vehicles by continuous supplementary feeding, they tend to stay away from busy roads. As research conducted in Bieszczady demonstrates, roads with traffic flow of about 150 vehicles per hour are impassable barriers for local European bison. Accidents involving European bison not only diminish their populations, but are potentially very dangerous for road users.

That is why, when selecting areas for reintroduction, one should exclude forest complexes divided by busy routes. Without question, places where animal road crossing often occurs should have a speed limit as well as special road signs warning against the possibility of collisions with European bison, as those already tested in the area of the West Pomeranian herd. If such a point of road crossing by European bison is in a spot with limited visibility (a turn, a hillock), one should consider permanently blocking such crossing in order to redirect the animals to more secure spots.

## Pressure from tourism

European bison have undoubtedly become a matter of an ever growing interest for the general public, hence many seek to see the European bison in its natural environment in the wild. Unfortunately, this may be dangerous for the people attempting to come too close to the animals on the one hand, and on the other, it startles the European bison, which flee from their feeding grounds or sanctuaries, trying to evade humans, long before being spotted by them.



In order to prevent such situations, European bison sanctuaries should ensure tranquillity for the animals by being delimited formally (and included in the SILP and LMN databases as protected areas, in accordance with § 14 point 8.2.c of the Forest management guide). Next, they should be marked clearly and provided with adequate 'no entry' signs. On the other hand, it is necessary to provide access for people willing to see or photograph the European bison in the wild, by organizing vantage points or building viewing platforms or towers from where European bison can be seen on an open space, grazing or drinking water. Such points should be easily reached by car or within walking distance from a parking lot, and should have signboards with information of educational value. Another aspect is preparing the European bison for the increasing pressure from tourism, so that human presence does not cause panic in the animals, as it is effectively put into practice in the West Pomeranian herd.

## Conflicts with agriculture

A serious problem in case of free-ranging European bison populations is that they may interfere with agriculture, that which might unambiguously alienate local communities from the species. The main reason why European bison feed outside of forests is scarcity of natural food sources in the forest, in terms of both quantity and quality. In habitats where plants of forest floor vegetation are not readily available, or sufficient only in some parts of the year, or where there is not enough grazing areas in the forests, such as clearings, glades or meadows, European bison will likely seek food out of the forest. Type of cultivations neighboring to the forest is also relevant. There will be virtually no damage on meadows, but crops attractive for European bison, such as winter oilseed rape may be expected to suffer some damage. The degree to which European bison are accustomed to human presence is important as well, one example being Białowieża, where European bison have been reported to enter farms and home gardens.

Measures that could ease these conflicts are for example setting barriers on paths leading out of forests, supplementary feeding with quality food in forests (including managing feed yards, recultivation or early mowing of forest meadows). A good practice is contracting hay from farmers who own meadows neighboring to the forest and leaving out haystacks for European bison in wintertime. Telemetry monitoring of European bison helps taking quick and effective action to prevent them from damaging crops. Initiative of this kind has been introduced for European bison in West Pomerania, particularly the herd in the forest district of Mirosławiec, as fields stand for about 50% of total area of the herd's territory.

## Poaching

Illegal hunting for European bison is either related to the desire to own a trophy or is motivated by trade. Prevalence of poaching differs significantly from region to region, and it is certainly related to local traditions and habits. Education seems to be of little relevance here, even though the importance of the European bison in nature conservation is promoted in Poland as early as in primary school. What certainly is needed, is a different legal approach to instances of poaching, which would help to render it unprofitable.

## Species restitution

In order to successfully reintroduce a once lost species back into its natural environment it is necessary to provide a suitable habitat. For the European bison, this means territories of at least several thousand hectares with mostly mixed forests, to a lesser extent exclusively deciduous or coniferous ones, and about 20% of the area taken by grazing lands such as clearings, glades and mid-forest meadows. Access to fresh water is of course also necessary throughout the year. The area should possibly have little or no fragmentation and no



anthropogenic barriers such as linear buildings or traffic routes. Proximity of agricultural lands is also undesirable.

Once a suitable area is available, one should assess its capacity (particularly in terms of food availability, but also taking social acceptance into account) so as to estimate target size of the population which would be sustainable without intense supplementary feeding. The next step is to plan the structure and size of an initial founder group which will become the basis for a future herd. One good idea is to assemble a group of 6 to 8 individuals, comprising one bull aged 3 to 4 (capable of breeding), young cows aged 2 to 4 and one older cow that could act as a leader of the herd. These individuals should bear as little genetic relatedness to each other as possible and belong to an adequate genetic line: Lowland (lowland part of Poland) or Lowland-Caucasian (the Carpathians).

Prior to introduction, basic infrastructure should be prepared, that is an acclimatization zone, feeders used for supplementary feeding in wintertime or keeping the European bison within the forest complex, and salt-licks. European bison may not be reintroduced directly after arrival, because stress they suffered during transportation will likely drive them far away from the original place of release. During the acclimatization period, human contact should be limited to strict minimum, although people involved in taking care of the herd should generally be frequent, as it facilitates later care and monitoring.

The length of acclimatization period and choosing the moment of release depends mainly on health and condition of the European bison, but possible presence of wild European bison in the area of reintroduction is also an important factor. If there is a stable herd already, the European bison in enclosure may be released earlier, since as herd animals, they will tend to join the herd and stay with it in the delimited area. To reinforce the bond that keeps European bison in the area of reintroduction, it is helpful to schedule opening the enclosure for winter, when the snow cover is deep. Creating an association of the enclosure with attractive food may be useful in future, in case capturing some of the European bison proves necessary. After reintroduction a herd monitoring system should be set, and the dominant stud bull should preferably be exchanged every 5 to 7 years.

## **Ex situ conservation – encompasses all protective activity carried out in captive breeding as supplementary to the in situ conservation**

Activity carried out as part of the ex situ conservation is concerned with methods of ensuring proper care of animals in captivity (i.e. maintaining their welfare), using their genetic resources optimally (by planning exchange and breeding), and educating the general public on every level.

These activities are aimed at sustaining a viable captive population that could supplement free-ranging herds, as well as at increasing awareness and acceptance for in situ conservation efforts.

### **Ensuring welfare - enclosure**

Animals living in captivity must be granted welfare i.e. conditions such that they ensure maintaining physical and psychological health in perfect harmony with the animal's natural state in its habitat. A European bison in such condition can cope with negative environmental factors. A lowered welfare leads not only to negative physiological changes but also to lesions and abnormal behavior (such as motor stereotypies or aggression) as an expression of frustration.



The European bison must be provided proper conditions that include size of the enclosure and its equipment. The kind of terrain which the enclosure is built on is also relevant. It is recommended to use partly wooded areas with quality permanent pasture as the primary grazing land.

It is known that in case of many zoological gardens European bison are kept in small enclosures and produce offspring regularly, that which is often taken as a criterion of satisfying their basic needs. However, in such limited runs European bison usually have access only to trodden ground, and possibly a single, fenced tree to provide some shade. Such conditions are not preferable and do not satisfy all needs of European bison, especially if one considers the fact that a European bison family group should be kept in the same enclosure, so as to satisfy basic social needs of the animals as well. Such basic family group should comprise between 6 and 8 individuals. In enclosures created specifically for European bison, available area per one individual should be at least 1,5 hectare and include woodland and good quality pasture. It is assumed that European bison will be fed throughout the year and that the fodder will partly consist of leaf meal, in case no shoots are available in the enclosure.

Enclosure equipment includes a feeding rack, a sheltered trough for fodder, a calving gate, a restraint module and a watering place. Fencing may vary (wire, rails, metal, a ditch, a moat, an electric fence), depending on many factors such as location of the enclosure, its intended use, expected number of visitors and budget. The only common rule is to use double fencing in order not to allow direct contact between visitors and animals. Animals are often deterred from approaching directly to the fence with the use of electric fencing installed inside of the enclosure, 0,5 to 1 meter away from the main fence. When constructing the fence, one should ensure that all the pillars are facing outwards, while the inner surface of the fence remains smooth. Similarly, no mounting components (i.e. screws, nails, bands), must not be protruding over the surface of the fence. It is particularly important in restraint modules, where the European bison touch walls directly as they pass through.

### Ensuring welfare - feeding

Another element crucial for providing European bison welfare is proper feeding. The European bison is a ruminant, and due to the anatomy of its digestive system and microorganisms existing in the rumen it is very well adapted to feeding on forage with high fiber content. The quantity of digested plant mass is very significant, as the volume of the rumen is between 118 and 166 liters. Mostly due to bacterial enzymes, digestion inside the rumen enables using hardly digestible elements such as cellulose, hemicellulose, lignin, cutin, suberin as well as non-protein nitrogenous compounds.

The European bison digests well the woody parts of plants – twigs of trees and shrubs or bark. Because of this, a proper diet of a European bison must be based on green plants and supplemented with shoots, while energy-dense starch feeds are not recommended feeds. Fodder such as hay, silage, soilage, leaf meals should be provided ad libitum, while cereal mixes should be limited to 1 to 2 kilograms per individual. Roots, such as fodder beet or carrot are a valuable supplement. Recently, also pumpkin has been used, as it is a good source of carotenoids.

If possible, it is also important to maintain a fixed composition of fodder provided to European bison, both roughage and concentrates. Microorganisms adapt very slowly to a new kind of fodder, hence any change in composition of the ration should necessarily occur very gradually over the course of 10 to 14 days. This applies to modifications exceeding 2 kilograms of dry mass or 15% of the ration.

A necessary addition is a salt lick with micro- and macronutrients.



## Prophylaxis and prevention of parasitic and infectious diseases

All the gates and gateways in the enclosure must be provided with disinfection mats impregnated with disinfectants to prevent transferring microbes from outside. The size of a mat must be such that it covers the entire width of a gate or gateway. It also must be long enough so as to ensure contact with the entire circumference of a vehicle wheel. The outer gates must be impregnated with a disinfectant on a permanent basis and the inner gates only in case of disease symptoms showing up in European bison.

The spot where fodder is provided should be on a terrain elevation, so that rainwater flows down from this place, and the ground around it should be hardened (for example by wooden block pavement or gravel), which will help remove accumulating excrements easily. Removal of the remainders of fodders and excrements in the vicinity of feed racks and watering places must be regular, i.e. at least once a day. It is necessary to disinfect the ground around feed racks once a week.

A potential threat to health of European bison is fodder contaminated with toxins of bacteria (*Salmonella*, *Shigella*, *Escherichia coli*) and fungi (such as *Fusarium*). For this reason, samples for bacteriological and microbiological tests should be taken from every batch of fodder delivered to the enclosure prior to purchase (especially if it comes from a new source). The fodder should also be stored properly, in order to protect it from moisture and contamination by rodents or insects

In case parasite eggs or larvae are detected, it is necessary to administer an albandazole-based preparation, with dosage of 10 mg/kg of body mass. The medicine fights infestations of nematodes, flatworms and trematodes, so one time administration may cure the European bison from parasites.

Apart from parasitic diseases, European bison are also threatened by infectious diseases that attack even-toed ungulates, especially by: bluetongue disease, hoof-and-mouth disease, of viral diarrhoea (BVDV, BDV), tuberculosis, paratuberculosis (Johne's disease), Contagious Bovine Pleuropneumonia (CBPP), vesicular stomatitis, anthrax.

If in the vicinity of European bison enclosure instances of infectious diseases occur, and the animals are kept in groups larger than 10 individuals, it is necessary to disperse the herds. To do this, it is recommended to create small groups whenever possible, and separate them from each other in different segments of the enclosure. The group should be managed by different people, so that if a disease shows up in one group of animals, the pathogens will not be transmitted to the other groups.

## Managing the gene pool optimally

This activity is aimed at merging many captive herds into a single viable population by a coordinated programme. The objective is to sustain genetic heterogeneity. Efficiency with which this plan is carried out depends on the size of the population in question. A single breeder, owning even over a dozen European bison, if left with no supply of new animals, will be forced very quickly to breed animals closely related to one another, for instance mother with son or father with daughter. Hence, every herd is in need of exchanging the male or females periodically.

A viable population i.e. one subjected to the programme, should encompass all breeding centres sustaining a given genetic line. The programme for the lowland line is largely carried out in Poland, since the majority of population in this line living in captivity is kept in Polish breeding centres (approximately 60%).



Key elements of the programme is selecting the animals for further captivity and mating them. In the first case it is necessary to decide which animals are to remain in the centre and which are redundant, in the second one must indicate where the selected European bison should be transported. The simplest scheme of managing a herd is to keep own-bred female offspring in the centre while transporting the males to other centres. The selection of best animals (females) requires assessment of the value of an animal in question in comparison with the rest of the herd.

Other criteria for selection may be different parameters or factors estimated on the basis of an animal's pedigree. The inbreeding rate of an individual (F) is a parameter informing about its homozygosity level, resulting from relatedness of its parents. The value of the rate is between 0 and 1. Individuals with lower values of this parameter are preferable. Another parameter is the degree of mean kinship (MK), that is, the average value of inbreeding rate of potential offspring after mating which each individual in the population, including itself. The value of this factor also ranges between 0 and 1, and the lower it is, the more valuable an individual.

An important element of pedigree analysis is the degree to which each animal's pedigree is known, expressed in parents. This value should preferably be as high as possible, as this directly influences values of the other parameters, which in case of any gaps in the pedigree will be underestimated.

A different method to assess the value of an individual is DNA analysis. As of today, polymorphism of 20 genetic markers has been determined (microsatellites, the MHC region). Such number of markers is not sufficient for full identification of an individual and currently hopes of obtaining more reliable results are with analysing individual mutations within the genome (the so called SNP) that involves polymorphism in approximately 1500 places in European bison. Analysis of markers in captive European bison is currently conducted.

## Education with the use of ex situ herds

In the majority of captive herds in Poland and abroad either all or most animals are exhibited to the public. Showing the European bison as it lives in captivity is an important factor in educating the public as it not only allows people to admire the animals, but also creates an opportunity to provide verbal or written information concerning threats and restitution of the European bison while discussing the importance of biological diversity and efforts towards ensuring its prevalence. Signboards often found near enclosures serve this goal, and sometimes even educational paths are created. In breeding centres

And forest districts where European bison live, many different events are organized for children, youth and adults, as part of Green Schools or other forms of popularizing knowledge, such as the „encounters with nature”. The European bison, as a species possessing a unique charisma about it, it draws attention of participants of such events, and many problems concerning nature conservation or protecting forest ecosystems can be discussed on the occasion of such meetings.

## Conservation efforts taken in Poland and Europe

### Establishing new free-ranging herds,

Over the recent years, new free-ranging herds have been created in Romania (2012), Slovakia (2004), the West Pomeranian Voivodeship (2008) and Germany (2013). New herds to follow



are planned in Germany, Czech Republic and Denmark, but mostly plans are made with Poland in mind. The number of potential new herds is not overly high, but there are preparations made to identify areas most suitable for the purpose. And so, for example in Germany, an analysis will be made of how suitable local territories are for European bison.

### Increasing the size and dispersing the existing free-ranging herds

In case of wild European bison populations existing in Poland, there are not much prospects to increase their size within the territories they currently use. Efforts are made in order to expand the territory available for European bison, or as it was mentioned above, establishing new herds in new locations is taken under consideration. A noticeable growth in the size of free-ranging herds is seen in Russia, where the number of European bison in free populations was 289 in 2007, while currently it grew to over 500 individuals

### Establishing captive breeds

Recently, new enclosures have been established in Poland, which satisfy the welfare criterion and are owned and managed by either private owners or state institutions (see table 4). There are 9 such enclosures in the country, which is a significant number in the European scale. Four of them meet the standard of a large enclosure, so it can potentially sustain a family group of 6 to 10 animals. The number of captive European bison in Poland has been growing due to establishment of new centres. New exhibition enclosures are planned in Mirosławiec, in the Knyszyń Primeval Forest and in Niepołomice.

Table 4. Enclosures in European bison breeding centres, created over the recent years in Poland and their status.

Name of the centre	Year of establishment	Main purpose	Status of the centre
Ustroń	2005	exhibition	Private zoological garden
Pszczyna Park	2008	exhibition /education	Zoological Garden supervised by the Agency for Regional Development and Promotion of Pszczyna
Kiermusy	2008	exhibition	Private enclosure
Człuchów	2009	exhibition	Private zoological garden
Bałtów	2011	exhibition /education	Zoological garden supervised by Delta Society
Strzelinko	2011	exhibition /education	Private zoological garden
Muczne	2012	exhibition/ acclimatization	Enclosure of Stuposiany Forest District
Enclosure in Bukowiec	2011	acclimatization	Enclosure for Bieszczady National Park
Sycowice	2012	exhibition /education	Enclosure supervised by the Institute of Applied Ecology



The main purpose for establishing the centres is to exhibit the European bison, while some are also stressing the educational role and two of them were created specifically for the purpose of acclimatization and rewilding.

The process of establishing new breeding centres is also seeing progress abroad, particularly so in Spain, Denmark and Hungary. In recent years, new, large enclosures have been established in those countries.

### **Improving the living conditions of animals in their natural environment and in captive breeding**

The basic issue concerning the problem of ensuring good living conditions for European bison in captivity is providing them with enough space. It is necessary to take into consideration the size of the group, vegetation cover and terrain profile. Enclosures should encompass woody areas, a natural grazing land and provide access to water throughout the entire year. The vegetation within enclosures should be protected from overgrazing. The area of grazing lands should be adequate to nutritional needs of the European bison inhabiting the territory. In order to ensure access to food base it is recommended to supplement it by planting trees and shrubs. As other ruminants, European European bison must be able to supplement their intake of micronutrients by having access to salt-licks.

### **Implementing unified conservation strategies – exchanging experience between breeding centres and applying the best and verified methods for keeping the European bison in captivity and in the wild**

Co-operation is crucial as far as European bison conservation is concerned, since in case of a species with such a small and dispersed population, a single herd owner or breeder cannot effectively work for its conservation on their own, hence only in co-operation it is possible to create a metapopulation. The first co-operative initiative for saving the European bison is marked by the establishment in 1924 of the International Society for Protection of the European bison, dedicated to the mission of rescuing the species. It was possible due to co-operation with several European bison owners, who combined had as little as 54 individual animals. The ISPEB was active until the end of 1940's, when Polish and Soviet teams took charge of the project, holding joint conferences periodically to work on guidelines for restitution and protection of European bison population in Eastern Europe. In the West of Europe breeders were dispersed at that time, and although several larger breeding centres did exist, no cooperation took place, not even within the borders of a single country. Beginning in the 1990's efforts have been made to co-ordinate and stimulate co-operation in this respect. Initially, this meant sending information from the Pedigree Book and starting the EEP programme for populations in zoological gardens, later on the creation of the EBAC (European bison Advisory Centre in Warsaw and in 2008, the EBCC (European bison Conservation Centre). It associated all the captive breeding centres interested in co-operation by establishing local structures, that is, selecting centres (the EBCC regional offices) which would represent regions in different countries. The offices are responsible for ensuring good



flow of information between the breeders and the Advisory Centre in Warsaw, which is in charge of genetic monitoring and pedigree analysis. Conferences, held annually since 2003 by the European bison Friends Society, are a key platform for exchanging experiences and ideas between the scientists and the practitioners.

### Protecting genetic resources (a gene resource bank, selection and exchange of individuals between herds)

Within the framework of the project 'The ex situ conservation of European bison *European bison bonasus* in Poland', the world's first European bison Gene Resource Bank was created. Its collection, stored at the temperature of -70°C, comprises tissues and isolated DNA samples of European bison from Poland as well as other countries. The bank also stores spermatozoa extracted *post mortem* from male European bison. Biological value of the sperm is tested by inseminating cattle on farms engaged in breeding żubroń – a hybrid of domestic cattle and European bison.

### Selection of individuals for breeding on the basis of pedigree analysis

Pedigree analysis is, as of today, the basis for selection and rating European bison held in captivity. The topic has been touched upon in the previous part (*ex situ* conservation). Table 5 presents the results of a pedigree rating for a herd in the European bison Breeding Centre in Białowieża. In the first column, the inbreeding rate is provided, of which the value should preferably be low. Low values may be caused by underestimation, resulting from an incomplete pedigree, hence high values in parents do not automatically translate into high values for the offspring. As such, it is rather an indicator of the effects of breeding efforts and a parameter that serves as a basis for coupling the animals. In the following seven columns the genetic contribution of each of the seven founders is provided, while individuals marked in grey are those, for which the genetic contribution of underrepresented founders (89, 87, 16, 15, 147) is high. Those marked individuals are more interesting as a choice for parents of the future generations, because in breeding the lowland line the objective is to increase the genetic pool of founders other than 42 PLANTA and 45 PLEBEJER. The choice will be particularly important for their peers, of which not all will stay in the herd. The following two lines represent male and female genetic lines. Males of the lowland European bison all share a copy of the same Y chromosome, since PLEBEJER is the only male that left offspring in the male line. There are three female genetic lines, of which that of 42 PLANTA is the most strongly represented, while the other two, of 89 BILMIA and 16 PLAVIA are less common, which renders females belonging to these genetic lines more valuable as mothers.

**Table 5.** Parameters of lineage evaluation of European bison picked from a herd in the European bison Breeding Centre in Białowieża

Number	Name	sex	Inbred coordinates	Initiator's contribution							Female line	Male line
				45	42	89	87	16	15	147		
9172	PODLASIANKA II	F	0,372	0,417	0,274	0,049	0,049	0,105	0,053	0,053	89	
9531	POSTÓJ	M	0,100	0,547	0,303	0,019	0,019	0,056	0,028	0,028		45
10163	PORWANKA	F	0,385	0,458	0,268	0,042	0,042	0,096	0,048	0,048	42	
10166	POWIKA	F	0,134	0,431	0,268	0,038	0,038	0,112	0,056	0,056	42	



10502	POLIMAR	M	0,101	0,517	0,294	0,022	0,022	0,073	0,036	0,036		45
10768	POWERONIKA	F	0,388	0,460	0,275	0,043	0,043	0,09	0,045	0,045	16	
11008	POSADKA	F	0,244	0,530	0,269	0,025	0,025	0,076	0,038	0,038	42	
11009	PODERA	F	0,134	0,431	0,268	0,038	0,038	0,112	0,056	0,056	42	
11051	POTAN	M	0,089	0,651	0,307	0,012	0,012	0,009	0,005	0,005		45
11188	PODOFILINA II	F	0,138	0,419	0,279	0,044	0,044	0,107	0,053	0,053	89	
11190	POLTAWA	F	0,198	0,510	0,278	0,029	0,029	0,077	0,038	0,038	42	
11726	PONORA	F	0,275	0,448	0,271	0,041	0,041	0,099	0,05	0,05	42	
11729	PODOLANIEC	M	0,142	0,385	0,276	0,047	0,047	0,122	0,061	0,061		45
11731	PODBIEG	M	0,138	0,419	0,279	0,044	0,044	0,107	0,053	0,053		45
11732	POKUTNY	M	0,134	0,431	0,268	0,038	0,038	0,112	0,056	0,056		45
11734	POTEELKA	F	0,202	0,512	0,286	0,031	0,031	0,070	0,035	0,035	16	
11989	POLANIN	M	0,197	0,506	0,276	0,029	0,029	0,079	0,04	0,04		45

This kind of information is given to the breeder and a worth of every individual is suggested. Other aspects are genealogical lines, number of offspring in the immediate family and the condition of an animal. All these information are helpful in decisions concerning breeding. In order to pair the given animals, a table of relation is created and based on its values it is possible to choose a less related male for a given female (Table 6).

**Table 6.** Table of kinship of European bison picked from a herd in the European bison Breeding Centre in Białowieża (OHŻ Białowieża)

		9531	10502	11051	11724	11729	11731	11732	11989
		POSTÓJ	POLIMAR	POTAN	POWIK	PODOLANIEC	PODBIEG	POKUTNY	POLANIN
9172	PODLASIANKAI	0,0895	0,0548	0,1843	0,2184	0,4139	0,2916	0,2535	0,2654
10163	PORWANKA	0,0918	0,0548	0,1999	0,2434	0,2862	0,2877	0,2954	0,2831
10166	POWIKA	0,1590	0,0548	0,1418	0,3805	0,3099	0,3130	0,3886	0,2280
10768	POWERONIKA	0,0862	0,1343	0,2012	0,2374	0,2875	0,2891	0,2814	0,2835
11008	POSADKA	0,0548	0,0548	0,2067	0,2372	0,2264	0,2314	0,2733	0,2628
11009	PODERA	0,0548	0,0548	0,1418	0,2913	0,3099	0,3130	0,3886	0,2280
11188	PODOFILINA II	0,0749	0,1305	0,1385	0,2529	0,3300	0,3876	0,3130	0,2187
11190	POLTAWA	0,1049	0,1234	0,1856	0,3177	0,2181	0,2252	0,2613	0,3336
11726	PONORA	0,0899	0,1803	0,1717	0,2628	0,2934	0,3071	0,3317	0,2607
11734	POTEELKA	0,0822	0,1249	0,1869	0,3117	0,2193	0,2267	0,2474	0,3341

## The exchange of individuals between the Breeding Centres and free-range herds – „fresh blood”

Such rules of selection of individuals are not essentially applied within one herd, unless there is a possibility of a temporary isolation of selected males for the rutting period. Instead, it is the way of exchanging the individuals between herds. Generally a male individual is moved to a new herd. On the basis of the same parameters one individual, the least related and distant in the genealogical lines, is chosen. At the same time he is available, i.e. he is marked by the



breeder as redundant for the herd. The exchange is quite expensive and requires a professional transport equipment. If it is an international carriage the whole operation is logistically difficult, but, for example, the European bison Friends Society, along with a specialized firms, has been organizing such transports for many years. The goal is the exchange of males and enriching the free-roam herds, especially the LC line. Such activity has been led in Karpaty Mountains for a few years now.

## Improvement of general awareness

### Education about the need of protection of every level of biological diversity on the example of European bison.

The European bison is a symbol of the wildlife conservation and can be used to explain and present the problems of losing the biological diversity, the influence of outside species, the protection of species variability and the ecosystem protection. The education process is led in every facility in the country; only the area, intensity and content are different. By using the pens with the European bison, some facilities, such as Forestry Management in Kobiór, are organizing the meetings with the youth and children in substitution to biology lessons. During such meetings there are information presented not only about the European bison, but also about his natural habitat, how the foresters influence it, and many more issues. Next to other pens there are lessons for school kids and preschoolers, for example as a project „Following European bison’s trail” (Tropem żubra). Other facilities organize meetings for the residents, while visitors can become acquainted with information presented on boards and in folders given or sold at information desks. One particular folder receives a lot of attention „*ex situ* protection of *European bison bonasus* in Poland”.

Another form of education, the one contemporarily important, is presenting wide and up-to-date information on the internet. In basically every institution the European bison’s caretakers have their websites and last „European bison on-line” stream from feeding site in Forestry Management Browsk was very popular.

### Taking actions to prevent damage

A social acceptance of the European bison, like with many other species of big animals (i.e. wolves or elephants), depends on the fact that a given community has direct contact with the animal. People living in the city generally have positive attitude towards the European bison, for them it represents a symbol of wildlife and an important protected species. On the other hand in rural areas, where because of direct contact with European bison people sometimes have serious damages like losses in crops or direct danger, presence of these animals is treated negatively.

Another argument for keeping the European bison in the area of forest (if it is possible) is presence of busy streets and railways near their habitats. It can be done by making natural feeding grounds inside forests more attractive for European bison and by securing their habitats. Thanks to constant telemetric control it is possible to response quickly to situations when European bison cross the allowable boundary of their herd’s area. If those reactions are immediate and consistent, it is possible to create conditions from the Forestry Management in Drawsko located in Drawsko Pomorskie Army Training Area. When local herds try to enter the crop fields, they are turned back and thanks to this during the year they spend a few hours cumulatively on the fields.

Still, sometimes the only way is to build an enclosure on the roadsides or on European bison’s migration trails.



## Using European bison as a marketing symbol enhancing area's attractiveness.

Raising social acceptance of the species should avail of the power of positive connotations connected with the animal. There are not many species in Poland's wildlife that connote with power, dignified look and natural beauty like European bison. Giving the possibility to observe European bison always raises interest and touristic movement in the area. European bison's marketing power is also helpful in creating a demand for gadgets and souvenirs. Thanks to his charismatic influence on people's minds, European bison is a very useful educational element helping to understand the ideas of wildlife conservation.

## Monitoring of space, health and genes as a basis for taking protective actions.

### Spatial monitoring

The necessity for multidirectional monitoring of free range European bison populations is a result of a need of knowledge about their condition and it is essential to prevent possible threats these animals can pose in urban areas.

The first thing which needs to be monitored is the spatial dynamics of herd's distribution. On this ground we can estimate the area that the herd occupies and it is possible to assess the target amount of a given population. Such data is also helpful in order to single out the most probable places where conflicts can occur, i.e. destruction of tree stands, damages in agriculture or places, where migrating European bison can pose a threat to vehicular traffic.

Nowadays it is possible to control particular individuals or herds to which they belong, but it is relatively expensive, since it requires using GPS telemetry – a cost of 7-12 thousand zlotys for one transmitter. Of course, this means that it is possible to monitor only selected individuals, (i.e. a leading cow), but it sometimes happens that young migrants (usually bulls) wander alone and show up unexpectedly in undesired places.

A good cooperation with the administration of State Forests and local hunting clubs is necessary. From there we can get current data from observations or stalking actions and quickly find a European bison that moved away from the monitored herd. To that end it is enough to distribute default observation cards to local hunting clubs and forestries; the cards are received from these places on a regular basis (figure 2).

Figure 2. An example of an animal's presence in the area registration card, it is used to monitor European European bison population in Bieszczady Mountains.



## Karta rejestracji obecności żubrów

<b>Data:</b>			
<b>Nadleśnictwo:</b>			
<b>Leśnictwo:</b>			
<b>Nr oddziału:</b>	<b>Ew. lokalizacja GPS</b>		
<b>OBSERWACJA (zakreślić):</b>			
<b>BEZPOŚREDNIA ZWIERZĄT</b>	<b>TROPY</b>	<b>ODCHODY</b>	<b>ŚLADY ŻEROWANIA</b>
<b>Dodatkowe informacje (np. liczba obserwowanych żubrów, wiek, płeć, warunki pogodowe, pora dnia, las, teren otwarty, inne uwagi) :</b>			

*Legend:*

*Karta rejestracji obecności żubrów – European bison's presence registration card*

*Data, nadleśnictwo, nr oddziału – Date, Forest inspectorate, Division number*

*Obserwacja: bezpośrednia zwierząt, tropy, odchody, ślady żerowania – Observation: direct, tracks, feces, scavenging marks*

*Dodatkowe informacje (np. Liczba obserwowanych żubrów, wiek, płeć, warunki pogodowe, pora dnia, las, teren otwarty, inne uwagi) – Additional information (i.e. the number of observed European bison, age, sex, weather conditions, time of day, forest, open area, other comments)*

On the grounds of this data it is possible to determine i.e. the number of individuals in European bison's groups, their age and sex structure, reproduction rate and even to work out European bison's habitat preferences.

### Health monitoring

Current knowledge of European bison's health status allows not only to introduce pre-emptive actions in case of epidemiologic hazard, but also it makes it possible to evaluate to what extent are parasite infections or afflictions dangerous to other game species or farming animals living near European bison's habitats. In this aspect, monitoring of European bison is observing their look (i.e. shape, condition of their hair) as well as behavioral qualities different than usual. It is absolutely necessary to perform a veterinary autopsy of every deceased individual, whether of natural causes or eliminated for any reason.

Since some infections, i.e. *Mycobacterium bovis* (tubercle bacillus) can be found out only through laboratory analysis, it should be obligatory to take and send samples from animals suspected of having been ill to referential laboratories.

Parasite infections can be monitored in non-invasive way by analyzing samples of excrements from spring and autumn – parasite's increased hatching period and during autopsies by reviewing organs like lungs or liver.

### Genetic monitoring

Amongst European bison living in captivity, pairing of individuals is under strict control, so there is a full knowledge of calf's provenance from mother's and father's side. Such individuals have to be registered in bloodline book, so determination of their relation with other European bison is a routine action. Getting such knowledge about animals living in free-range herds is of course impossible, here only molecular genetics techniques can help. Thanks



to such analyses we can i.e. determine the level of genetic fluctuation in a given population. It is possible to use almost every kind of tissue for this research, so test tissues (blood, liver, muscles) should be taken from every deceased or temporarily anesthetized European bison. This way we can monitor only a small part of the population, but constant monitoring can be made using so called “hair research” found in the field.

### **Improvement of free-range herds' habitat condition**

Habitat condition has to be defined on the basis of each species needs. When it comes to European bison, this evaluation should be based on parameters of the habitat which are key to providing living conditions for this species. So called habitat suitability index is usually used to evaluate the condition of a habitat. By putting it on the map it is possible to identify habitat areas suitable for specific species and by knowing their acreage to evaluate feeding or social capacity. Such analysis should be performed before the European bison will take up residence and whole infrastructure (assimilation pen, feeders) should be built within the preordained area. Verification of this action will be the identification of places where European bison gather; it is done through field observations and verification of animals' presence (tracks, excrements and signs of feeding). It should be made after freeing the animals and after certain amount of time (usually about 1 year), when animals can familiarize themselves with the area and choose their favorite part of the habitat. Such areas of concentration are usually determined as Kernel 50% areas, which means that there is a 50% chance of European bison's presence there. Typically they are very small parts of the whole area (Figure 3).



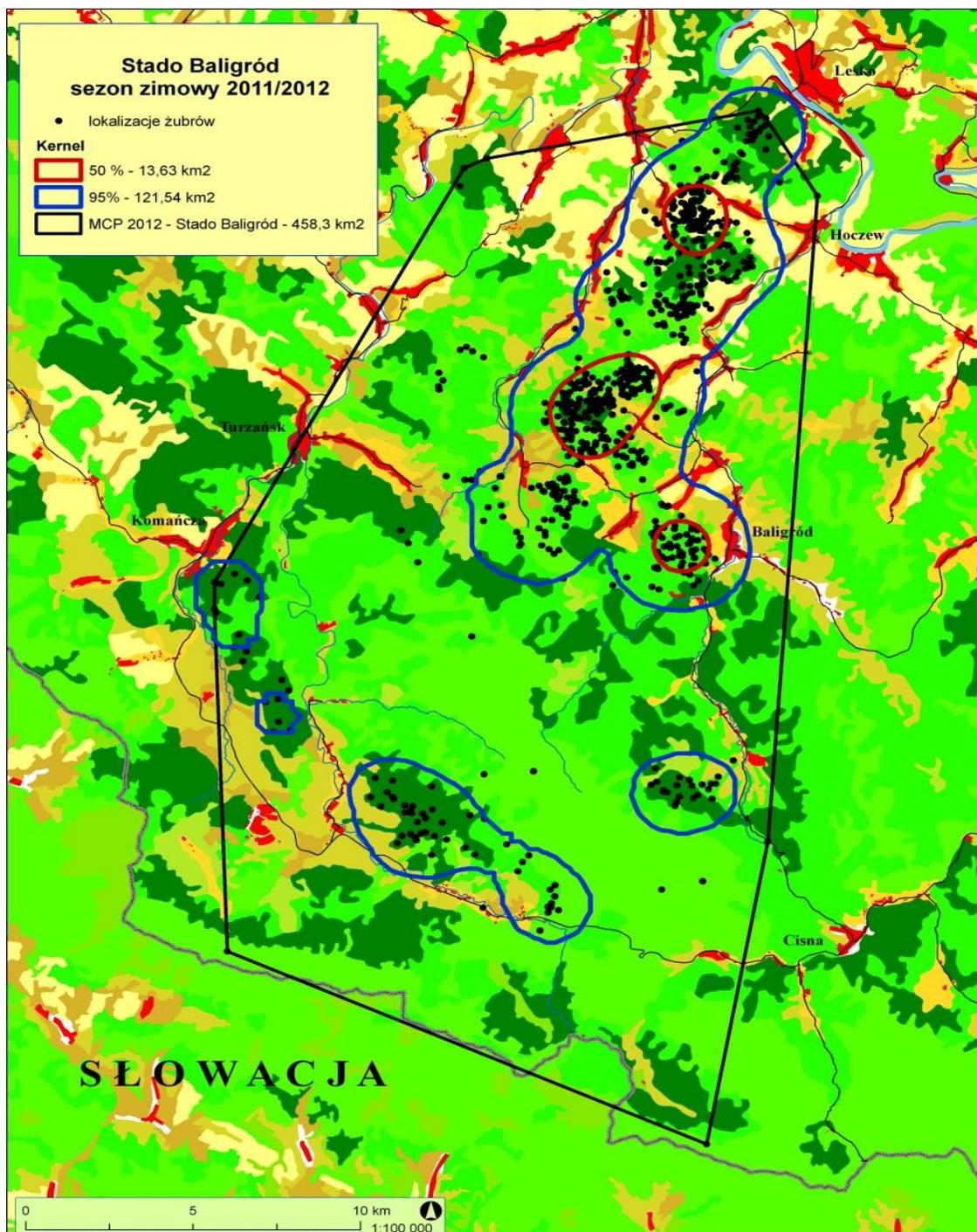


Fig.3. Habitat area of „the Baligród herd” (stado Baligród) in winter season of 2011/2012 and locations of European bison’s regions of concentration, marked as areas of 95 and 50% chance of animals’ presence.

*Legend:*

*Stado Baligród-The Baligród herd*

*Sezon zimowy 2011/2012- Winter season 2011/2012*

*Lokalizacje żubrów-Locations of European bison*

*Kernel-kernel*

*Km<sup>2</sup>-sq. km*

*Słowacja-Slovakia*



Once European bison familiarize with their new habitat, an assessment of damages in the tree stands should be made. Another important thing is an ongoing registration of damages in the agriculture, collisions and possible aggressive interactions between European bison and people or farm animals. All data should be put on numeric maps in GIS system. It allows for identifying areas of living where an intervention is needed to prevent such conflicts

### **Evaluation of population's condition**

Parameters which allow assessing the population's condition are: sex and age structure, reproduction and mortality rate. Another important thing is so called amount trend analysis. It is a parameter required i.e. in the evaluation of the condition of population in Nature 2000 system (Natura 2000). The same approach is used to assess the range of population and it needs to be determined whether this range increases, decreases or is on the same level. In order to be correct on the basis of such analysis it is necessary to have access to longstanding research (minimal 10 years), because of already known fluctuations in numbers of herds and acreage of habitats.

## **8. The best practice**

### **Upkeep, ongoing veterinary care and health prophylaxis of existing free-range and captive herds.**

In previous chapters some general rules of prophylaxis in closed centers were presented. In this chapter, on the basis of a case study, a scenario of procedures in free-range and captive herds will be determined.

First of all, each European bison's heard has to be under the veterinarian's care. It is a condition required for every newly created herd and one which should be fulfilled by already existing ones. Vet's role is different in pens and on the outside, but the spectrum of his actions can be put together and presented in an organized way.

### **Herd's inspection – more frequent in captivity (at least once a month) than on the outside (most convenient time is the winter season)**

It is a visual familiarization with the animal's condition and an assessment of their behavior. On this basis, especially in herds, animals which need isolation, the ones that don't fit, need special feeding or even medical treatment, are selected. It is important that the veterinarian's assistance taking care of a herd should be permanent, as he or she needs to know the animals and their behavior on an ongoing basis. During the inspection there is a person taking care of the herd and noticing changes, especially in behavior and habits of the animals

### **Protection against contagious diseases and parasite invasions**

An action of regular disinfection of people and vehicles entering the pen's area by placing disinfected mats in gates and doorways. This action should be a routine procedure, but in a situation of higher threat (i.e. information about an outbreak of a contagious disease) it must be strictly obeyed. When it comes to free-range herds, it is not possible to act in that way, but in the face of danger occurrence a veterinarian can limit access to places of European bison's presence by placing signs of "no entry". Another protective action is a quality control of the feed and of the water given to the European bison. A veterinarian has to pay attention to the quality of feed, its possible pollution by molds or parasites. The quality of drinking water is especially important when watering place is artificial or with still water. Samples of water



should be periodically sent for microbiological examination (*Escherichia coli* bacteria) and an evaluation of chemical contamination (i.e. by pesticides used in agriculture).

The doctor should also supervise cleaning feeding places. In the pens that means troughs, water holes, area around feeders and in the free-range herds – areas around haystacks and feeders used by the European bison in the winter. Elements of their constructions have to be cleaned; excrements and remains of the food have to be removed. After the feeding period the area should be disinfected with a proper method, i.e. by using calcium or by removing a part of the ground. Such actions decrease the development of parasites and their transmission to the European bison. It is important that excrements and wastes are carried to proper dumping place so they are not dangerous to other animals.

In captivated herds procedures of deworming take place twice a year unless, on the basis of monitoring, directives are different. In free-range herds such actions are not possible and there is no point performing them. In situations of exceptional threat of parasite invasion in free-range herds, the usual procedure is to make animals scatter and to disinfect feeding places with the use of any possible means. It is also possible to distribute some deworming medicines with dry or granulated feed; the situation is similar with deer.

### Monitoring (ongoing control) of health conditions

Monitoring is usually performed in two ways. First one is a coproscopic examination of a sample randomly picked from the researched area. Such research is conducted by Witold Stefański Institute of Parasitology of the Polish Academy of Science in Warsaw for virtually all European bison's herds, which allows for reciprocal comparisons and an evaluation of given population's condition. There are three methods used flotation diagnosis, decanting and Baermann's method. As a result, for given excrement sample an amount and type of roundworm and coccidian's larva is determined, i.e. for one selected sample: "5 *Dictyocaulus viviparus* larva, 42 roundworm's eggs of Trichostrongylidae family, 3 *Eimeria bovis* oocysts, 1 *E. auburnensis* oocyst, 3 *E. zuernii* oocysts and 3 *E. Pellita* oocysts"

The team from the Institute of Parasitology informs whether found extensiveness and intensiveness of the invasion is dangerous for a herd.

Another important aspect of health monitoring is a detailed selection of deceased and eliminated animals along with necessary histopathologic and microbiological analyses. An example of an autopsy protocol template is presented in table 6. The results of a section and the results of additional research are analyzed by a team of specialists from the Faculty of Veterinary Medicine on Warsaw University of Life Sciences and, if it's necessary, suggestions for particular herds are prepared.

Figure 7. Autopsy protocol template

EUROPEAN BISON'S AUTOPSY PROTOCOL (PROTOKÓŁ SEKCJI ŻUBRA)
Place of an autopsy conduct
Date of an autopsy
Time of an autopsy
Date of death
Place and cause of death
Sex



Age

Body weight

Number, name of an individual

### **Autopsy description**

1. Skin and derivatives
2. Subcutaneous tissue
3. Muscles
4. Musculoskeletal system (bones, tendons, ligaments, articular surfaces)
5. Endocrine glands
  - a. thyroid
  - b. adrenals
6. Serous membranes (pleura, peritoneum)
7. Heart and blood vessels
8. Larynx
9. Trachea
10. Lungs
11. Tongue and throat
12. Przewłok: - esophagus
13. Stomach (rumen, reticulum, omasum, abomasum)
14. Bowels
15. Liver
17. Pancreas
18. Urinary tract (kidneys, bladder, urine tube)
19. Female genital organs (ovaries, Fallopian tubes, uterus, vagina, vulva)
20. Male genital organs (testicles, deferent ducts, follicular cells, Cowper's gland, prostate, prostatic utricle, penis, foreskin)

Histopathological examination and additional examination

### **Certificate**

Pathologist

First name and surname (signature)

During the autopsy, samples for genetic monitoring are taken as well as for other research, i.e. evaluation of European bison's need for -micro and macronutrient.

### **European bison's immobilization**

Immobilization is an action of subduing of an animal in case of a direct contact. It should be safe for European bison and performed only when necessary. Every immobilization should be attended by a specialized veterinarian.

There are two types of immobilization: physical and chemical. Physical immobilization is catching an animal (i.e. with net, tether or special catching pen). Mechanical immobilization of big and strong ruminants like European bison is dangerous for the animal as well as for the man, which is why various cages and tethers should be just a support. To subdue European bison a pharmacological (chemical) immobilization is used with the help of pharmacological preparations. Immobilization is necessary to perform veterinary treatment (like local and general treatment, dressing wounds, help with labor, blood drawing i.e. before transporting) and for marking, putting on telemetric collars for scientific research and when an animal



needs to be caught. It is important to remember that transportation of an anesthetized animal is very dangerous because of the possibility of bloatedness, choking with food or problems with breathing.

Various levels of immobilization can be attained accordingly to the needs: latency (anesthesia) or pharmacological sedation. Immobilization can be done in the open space or in small catching room with peace, quiet and no outside people present during the procedure. Preparations in a form of a liquid are administrated as intramuscular injections made from a distance with i.e. a pneumatic weapon adjusted for such injections.

Immobilization should be carefully prepared, time should be used to maximum extent and the immobilization itself should be performed quickly and efficiently. Each treatment of such type can bring many unexpected events which should be treated properly. A reaction for those problems should be taken into consideration while planning:

- ☛ There is no possibility to approach a European bison for an effective distance necessary to administrate a pharmacological sedation (if, for example, only one individual is being immobilized and he is surrounded by his herd, which usually happens with individuals showing symptoms of weakness),
- ☛ Ineffective injection because of a weak contact of the needle with an animal's skin, syringe's unsealing, hitting a bone which results in bending or breaking of a needle, freezing of a sedation because of a temperature,
- ☛ Inaccurately assessed weight of the animal,
- ☛ Animal's condition during immobilization – unnecessary agitation,
- ☛ Individual reaction to a pharmacological sedation

Preparations used for immobilization should have analgesic and subanesthetic effect as well as they should make good flaccidity of the skeletal muscles and decrease consciousness while being safe for the animal. Pharmacological preparations and doses presented in table 8 are referential.

For European bison, the most useful are syringe shots with the capacity of 3 ml (if used sedations are on the basis of etorphine, otherwise the capacity has to be bigger) and needles without collars (2 x 40 mm). Such syringes fall off immediately after the shot or after some time. They can be used multiple times if they are not damaged by an animal. It is easy to find the syringe thanks to a stabilizer with a red bobble that is put on a rear valve.

Table 8. Pharmacological preparations used to immobilize European bison

sing	Name and quantity of the anesthetic agent for 1 kg of body weight	Name and quantity of the antidote for 1 kg of body weight
1	1,5 mg carfentanil / 35 mg xylazine*	100 mg naltrexone (or naloxone) for 1mg carfentanil + 0,125 mg yohimbine
2	0,01 mg etorphine **/ 0,5 mg xylazine	2 mg diprenorphine for 1mg etorphine + 0,125 mg yohimbine
3	2,5 mg ketamine / 0,08 mg/ medetomidine	0,4 mg antipemazol
4	0,18 mg detomidine / 10 mg ketamine	0,4 mg atipemazol

\* If a European bison does not lie down within 20 minutes it is advised to re-inject a full dose of the preparation

\*\* Etorphine is very toxic for a human. It is easily absorbed by skin and mucous membrane, so an extreme caution is advised while injecting the preparation into the syringe. Personal protection should be secured (goggles, masks, latex gloves). All actions should take place in front of people able to help in case of poisoning with the medicine. Furthermore, a



consultation with a medicine doctor is necessary. Regardless of a danger for human, etorphine is used because of its small doses needed to immobilize an animal and quick effect of flaccidity.

An effective dose makes external stimuli gone, especially reaction to a touch, with right clinical parameters of the heart rate (100-120/min) and breathing (10-18/min). When the animal does not react, it is advised to put the body on side while having in mind that the head should always be higher than the rest of the body. It is necessary to use sun protection and to cover the animal's eyes.

After finishing actions for which the European bison was immobilized, an antidote is given and the animal is placed on a sternum. Bending of thoracic limbs at wrist joints and pelvic limbs in stand-under position which will make it easier for the European bison to raise one it gains consciousness. After the wake up an observation of the animal is advised until it is fully functional.

All aspects of protection of herds in captivity are currently (until the end of 2013) realized in the project „*ex situ* protection of *European bison bonasus* in Poland”. A leading beneficiary in this project is WULS, partners are forest inspectorates Kobiór and Niepołomice, The Forest Culture Centre in Gołuchów and the European bison Friends Society. The project in 85% is financed from the European Regional Development Fund and in 15% from National Fund for Environmental Protection and Water Management as the V part of the Infrastructure and Environment Operational Program.

## **Counteractions against basic risk factors determined for local European bison populations – scatter of the population, area enhancement, diminishment of winter groups**

European bison is classified as a grazing species, so the most important element while deciding whether an area is attractive or not, is a good quality of a pasture. It can be a glade or meadow inside a forest, eventually a meadow on the edge of forest. Just like pastures for farming animals, pastures for European bison should be kept in a good condition, limed if necessary and under sown with proper composition in case of poor species variety.

Meadows and pastures kept in a good culture allow harvesting hay, which is both a feed for a winter time and a maintenance treatment necessary for keeping their quality, as well as for grazing animals.

In many cases it is necessary to feed with a fodder provided by men, whether because of winters with heavy snow cover in lowlands, or as an additional factor for keeping European bison in the forest. The feeding should not be centralized, it should run concurrently in a few or a dozen or so feeders, at least few hundred meters apart from each other, accordingly to the amount of the population. The feeders should be positioned in a place that can provide a shelter from the wind and from people.

If the feeding is necessary, then European bison can be fed with: hay, haylage, mangold, carrot, forage kale, mashed oats, corn or a granular worked out in a Forest Research Institute with an addition of a rind (composition: corn grit, forage flour, cereal bran, white grit, lucerne, bark of broadleaves trees, treacle, fodder salt, fodder chalk, monocalcium phosphate, vitamin and mineral premixture).

Other necessary elements are salt licks. They should be set at least 0,5 m high to make sure that animals will be able to reach them regardless of an amount of snow. It is best to put them



on rootstocks or crotched stumps, so animals can use the salt and also chew the tree saturated with it. Standard cubes made for cattle or blocks of rock salt can be used here.

Preparation of a new winter feeding place requires building a haystack of an appropriate construction which prevents quick deterioration. Figure 4 shows a construction scheme of a feeder used by Zachodniopomorskie Environmental Association. What is worth noticing is the stability of the construction, so important when used by animals which weigh over 500 kg.

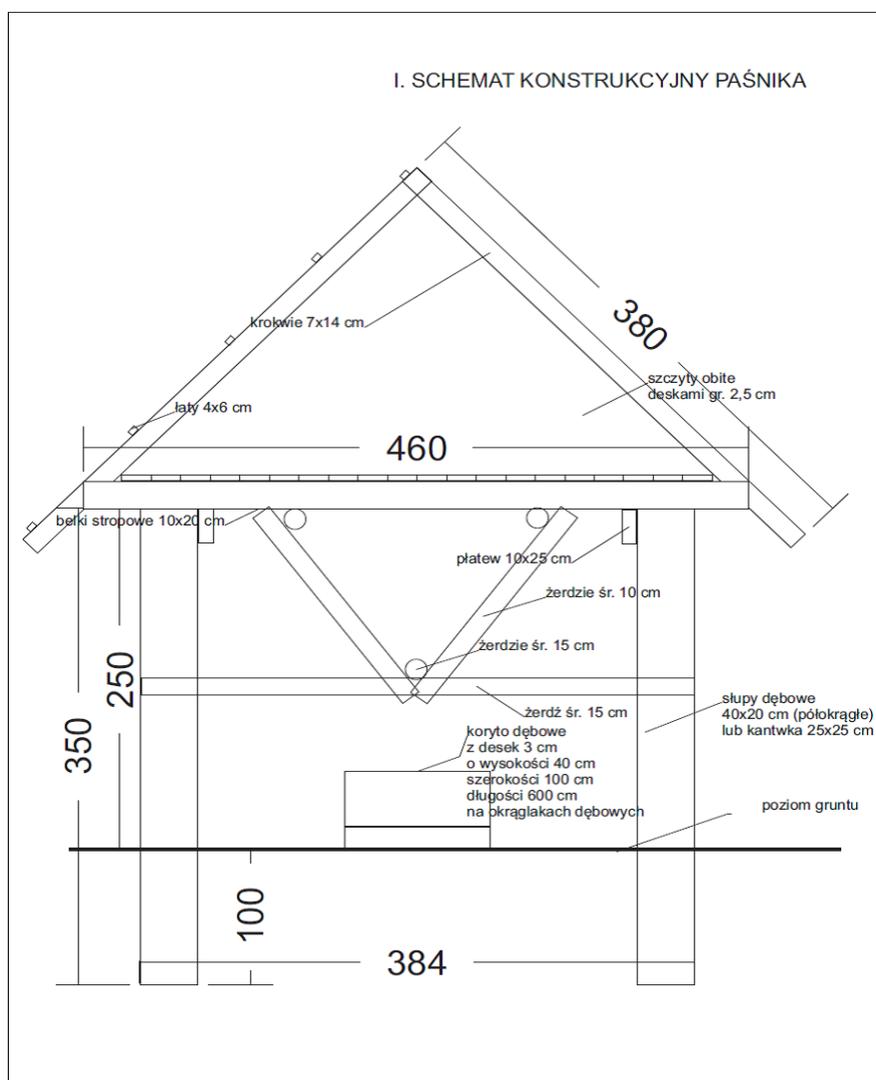


Fig. 4. Exemplary construction of a feeder – project “żubry zachodniopomorskie”

*Legend:*

*schemat konstrukcyjny paśnika – feeder’s construction scheme*

*szczyty obite deskami – boarded tops*

*łaty, krokwie – battens, rafters*

*belki stropowe – ceiling joists*

*platew – purlin*

*żerdzie – poles*

*słupy dębowe (półokrągłe) lub kantówka – oaken stanchions (half-round) or scantling*

*koryto dębowe z desek o wysokości/szerokości/długości/na okrągłakach dębowych – oaken trough made of boards, height/width/length/on oaken logs*



Another example of this construction is a feeder built in a preserve „Żubrowisko” in Pszczyna Jankowice (Fig. 5) different mostly in length, which makes it possible to be used by more animals simultaneously and to store more hay under the roof. This type of feeder is mostly used to hold hay, basic winter food.

### Przykładowa konstrukcja paśnika

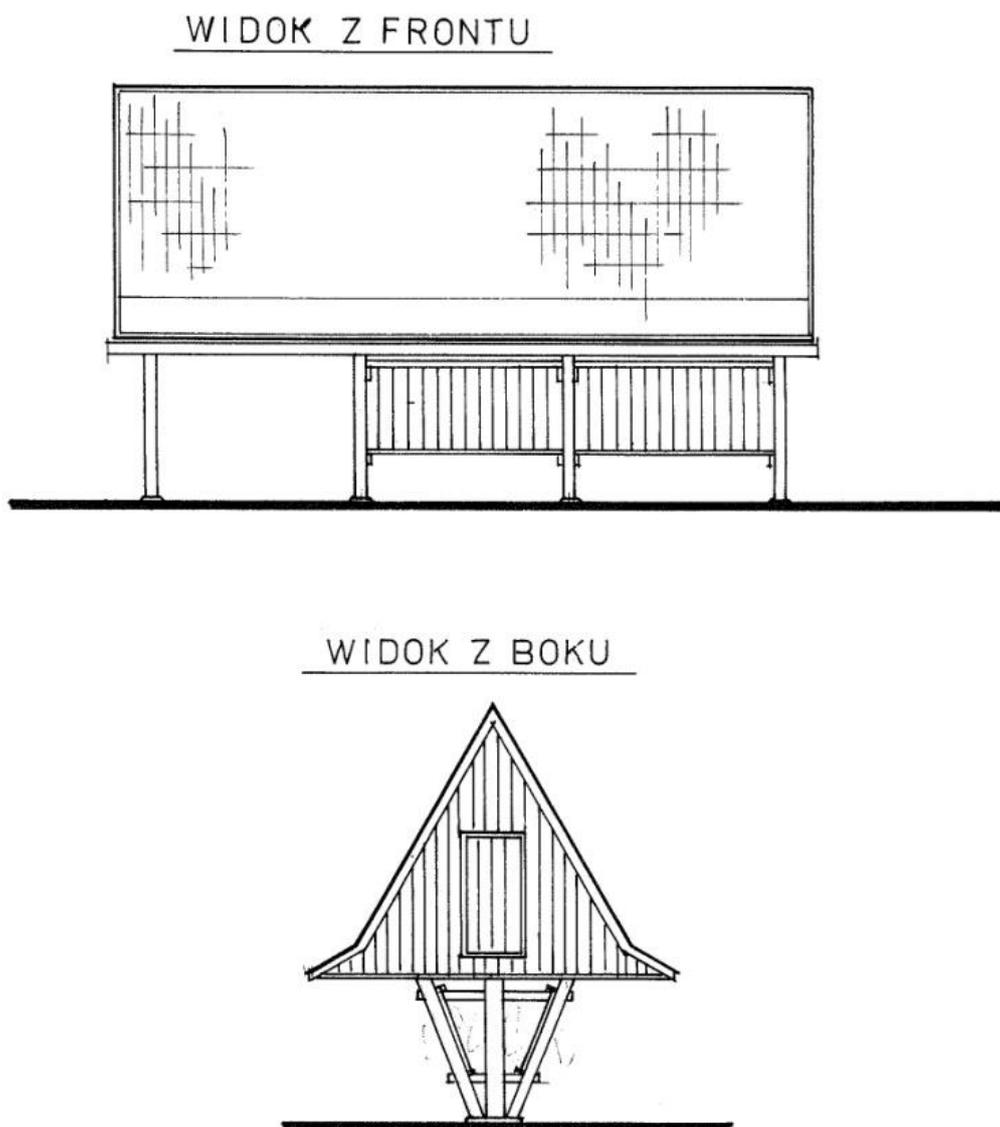


Fig. 5. Exemplary construction of a feeder – preserve “Żubrowisko”

*Legend:*

*Przykładowa konstrukcja paśnika - Sample construction of a pasturage*

*Widok z frontu – Front view*

*Widok z boku – Side view*



## Monitoring of population's distribution and usage of the environment in free-range herds; genetic monitoring, health monitoring

### Spatial monitoring

It is necessary to monitor free-range herds for their own sake as well as because of possible threats connected with their presence.

If it is possible to buy and put on a collar (immobilization) then GPS telemetry is a very important tool of overseeing herds; it works well in West-Pomeranian Voivodship. It allows to:

- 🦘 Gather knowledge of areas of living and behavior of herds with methods unavailable in other ways,
- 🦘 Enhancement of methods of population protection – knowledge about areas of animals' presence gathered systematically in real time helps to prevent road accidents, accidental shootings, poaching and allows to counter damages done by the European bison in the crops.

It is imperative to see that there are specific technical requirements of a collar for European bison – one necessary container with electronics and batteries hanged on a solid belt.



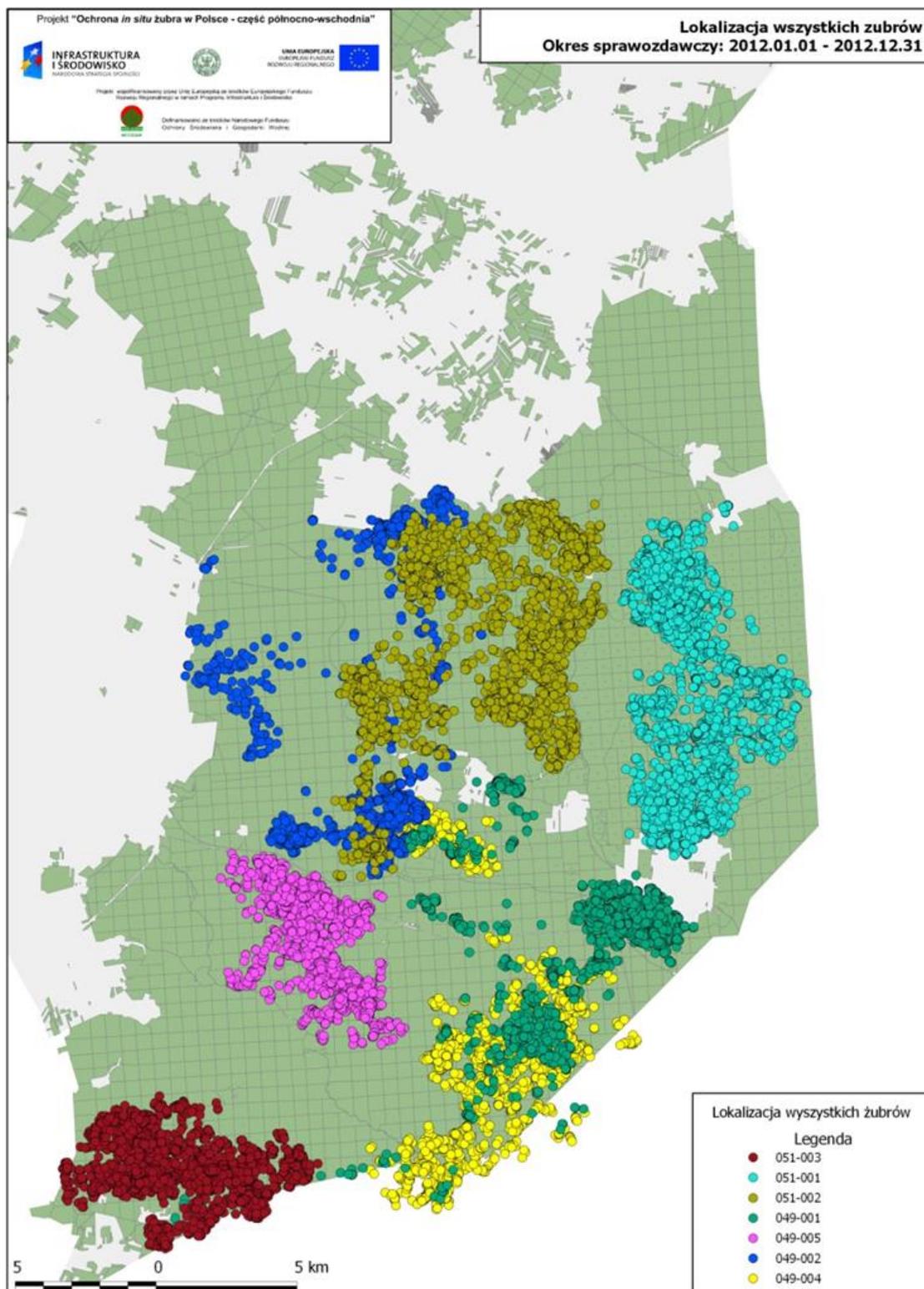


Fig. 6. Results of a telemetric monitoring of European bison in 2012 in Białowieża Forest (Puszcza Białowieńska)

*Legend:*

*lokalizacja wszystkich żubrów – Location of all European bison*

*okres sprawozdawczy – reporting period*



Collected data can also provide some valuable data about size of herds, age and sex structure, reproduction rate. It can also be a basis of evaluation of European bison's preferred habitats (Fig. 6)

Monitoring with the use of telemetry (classic or satellite) should be complemented with routine observations performed by people, who often work in the field. Here cooperation with personnel of the State Forests can be priceless. A forester is not only in the field regardless of the weather and season, but also has an ability of observation or evaluation of tracks and trails left by various types of animals. Results of such observations should be registered on simple observation cards which can be later taken back from the administration facilities of State Forests, national parks etc. An example of such observation card is the card itself along with an instruction, used in Białowieża Forest during different projects (Fig. 7). The ongoing project is called „European bison's in situ protection – south-eastern area” in which the WULS is a leading beneficiary and eight forest districts are partners, i.e. district of Białowieża Forest, Borecka Forest, Knyszyń Forest and the Białowieża National Park. The project is financed by the ERDF in 85% and by the National Fund for Environmental Protection and Water Management in 15% as a part of the Infrastructure and Environment Operational Program.





Monitoring realizowany w ramach projektu pt. „Ochrona żubra in situ - część północno-wschodnia” w 85% dofinansowanego przez Unię Europejską ze środków Europejskiego Funduszu Regionalnego w ramach Programu Infrastruktura i Środowisko w ramach obszaru 5 i projektu w oparciu o umowę o dofinansowanie nr POK.01.01.01-00-2009-01 oraz w 15% ze środków Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej zgodnie z umową o współfinansowanie wydatków kwalifikowanych Projektu realizowanego w ramach V osi priorytetu POK nr 14020109a-01OP/WK/P10

Nadleśnictwo/Gmina ..... tel kontaktowy.....

Nazwisko obserwatora.....

Data Godzina	Miejsce obserwacji (oddział, pododdział, miejscowość)	Liczba żubrów	Skład stada jeśli rozpoznany*				Uwagi (np. osobnik z obrozą, środowisko- starodrzew, młodnik, uprawa, zrąb, polana, łąka, pole)
			Liczba byków	Liczba krów	Liczba młodzieży	Liczba cieląt	

\* Wskazówki na odwrocie karty



Monitoring realizowany w ramach projektu pt. „Ochrona żubra in situ - część północno-wschodnia” w 85% dofinansowanego przez Unię Europejską ze środków Europejskiego Funduszu Regionalnego w ramach Programu Infrastruktura i Środowisko w ramach obszaru 5 i projektu w oparciu o umowę o dofinansowanie nr POK.01.01.01-00-2009-01 oraz w 15% ze środków Narodowego Funduszu Ochrony Środowiska i Gospodarki Wodnej zgodnie z umową o współfinansowanie wydatków kwalifikowanych Projektu realizowanego w ramach V osi priorytetu POK nr 14020109a-01OP/WK/P10

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			Liczba byków	Liczba krów	Liczba młodzieży	Liczba cieląt	

\* Wskazówki na odwrocie karty

Fig. 7. European bison observation card used in „European bison’s in situ protection – south-eastern area” project.

**Legend:**

*Data, Godzina*-Date, Time

*Miejsce obserwacji*-Place of obervation

*Liczba żubrów*-Number of European bisons

*Liczba byków*-Number of bulls

*Liczba krów*-Number of cows

*Liczba młodzieży*- Number of the young

*Liczba cieląt*- Number of calves

*Uwagi (...)*-Remarks (individual with collar, environment-old trees, young forest, crops, trunk, glade, meadow, field)

*Tel kontaktowy*-Contact number

*Nazwisko obserwatora*- Surname of the observer

*Nadleśnictwo/Gmina*-Superintendency/Commune

*Wskazówki na odwrocie karty*-Tips on reverse of card



An important effect of direct observations is the annual stocktaking of herds. In Białowieża Forest this has been performed for many years and the main idea is to keep a record of every individual. Calves born in a given year are registered accordingly to their sex, i.e. if 30 females were born, they are registered under positions from 1891 to 1920. After eliminating and selecting of an individual his age is accurately evaluated and one number (accordingly to age and sex) is crossed out from the register. This way a precise age and sex structure of a population is known. To keep such records properly it is necessary to precisely evaluate the age of an animal, but in Białowieża National Park it is mastered. It is also important to get all the information about every fall. Although this might be quite difficult, it is possible to assess age and sex with just a skull.

## Health Monitoring

Health monitoring is very important not only because of disease prevention, but also because of evaluation of possibilities of various infections, infectious and parasite diseases, also within other species (like cervids) and farming animals using the same pastures as European bison. This monitoring includes a direct observation of individuals to evaluate their behavior, shape, condition of hair, and also an autopsy of deceased or eliminated individuals. It is necessary that the autopsy is performed by a veterinarian who takes care of the herd. When certain diseases have to be diagnosed (i.e. tuberculosis), proper samples of tissues or organs should be sent for analyses in specialized laboratories. In free-range populations it is necessary to monitor health through intervention cull (few individuals from a population). European bison selected for the cull should include not only those individuals showing visual symptoms of an illness or injury (broken leg) or the old ones, but also individuals visibly healthy, when there is a higher risk of an illness. Decisions to perform such health monitoring should be automatically released by the General Directorate for Environmental Protection at the beginning of each year (until January 31st of every year). The amount of such culls should be determined for all herds by the national coordinator for the European bison along with each individual herd's caretakers and veterinaries working in the area. Absence of such culls makes knowledge about health conditions incomplete and, in case of a threat, veterinarian's reaction can be delayed.

## Genetic monitoring



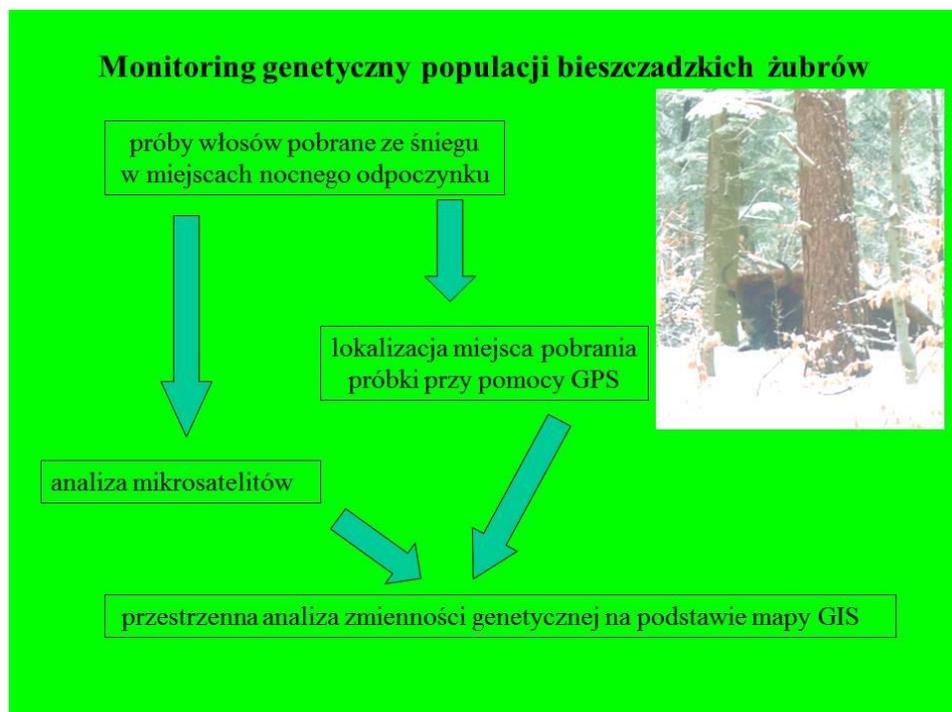


Fig. 8. System of taking and registering samples for a genetic monitoring used in Bieszczady Mountains

*Legend:*

*Monitoring genetyczny populacji bieszczadzskich żubrów – genetic monitoring of European bison from Bieszczady Mountains*

*próby włosów pobrane ze śniegu w miejscach nocnego odpoczynku - hair samples taken from the snow in a place of night rest*

*analiza mikrosatelitów – microsatellites analysis*

*Przestrzenna analiza zmienności genetycznej na podstawie mapy GIS – spatial analysis of genetic variability on the basis of GIS map*

It is possible to control the reproduction and determine both parents of a newly born calf in a breeding reserve, so a genetic structure of the herd is possible to be tracked. In case of a free ranging herd it is impossible. The assessment of the genetic structure and the key factor for European bison - the level of heterozygosity - is therefore possible only with the aid of molecular genetic methods. The material for analysis can be collected from almost all kinds of tissue, so it is recommended to collect samples when having access to a dead or anaesthetised animal. A routine assessment that needs non-invasive methods is based on the samples from hair roots. In addition, GPS identification of the place where the hair samples were collected enables the evaluation of the spatial distribution of related animals (Fig. 8).

Genetic monitoring is carried out by the Department of Animal Genetics and Breeding at WULS-SGGW using the same methods for all herds, both free ranging and living in enclosures. Material can be collected not only using above mentioned method developed in the Bieszczady Mountains (clumps of hair with roots from winter lairs), but also using darts (skin biopsies collected with the use of pneumatic guns), taking blood samples from anaesthetised animals and taking tissue samples from dead or eliminated animals. A skin sample collected with the use of a syringe mounted in a dart can be dried under a lamp or stored in 40% alcohol. Tissue samples can be frozen at  $-20^{\circ}\text{C}$  or stored in 40% alcohol. All the above mentioned sample sources allow to get the DNA and to associate a studied sample



with the origin of the animal (breeding reserve) or with a specific location (even very precise one).

DNA is isolated from the samples and evaluation of microsatellite polymorphism is made. Selected microsatellite markers are shown in the Table 9.

**Table 9.** Microsatellite markers in the European bison population used by the Department of Animal Genetics and Breeding at WULS-SGGW

Previously used markers				New markers
<b>BM1824</b>	<b>AGLA293</b>	<b>TGLA126</b>	<b>TGLA325</b>	<b>MM012</b>
<b>BM2113</b>	<b>ETH225</b>	<b>TGLA122</b>	<b>INRA329</b>	<b>INRA035</b>
<b>URB042</b>	<b>TGLA53</b>	<b>UWCA1</b>	<b>INRA189</b>	<b>HEL009</b>
<b>SPS115</b>	<b>TGLA227</b>	<b>EBMS44</b>	<b>INRA126</b>	<b>ILSTS034</b>
<b>ETH10</b>	<b>ETH3</b>	<b>MGTG4B</b>	<b>INRA023</b>	<b>BM1818</b>
<b>INRA123</b>				

For each *loci* and population the frequency of found alleles and basic parameters of variability like observed heterozygosity ( $H_o$ ) and expected heterozygosity ( $H_e$ ), or actual and effective number of alleles are counted. On this basis a herd or single animal is then evaluated.

Specimens from a particular population are presented compared to other examined animals from the same line, what enables the evaluation of similarity of a specimen to a particular line. On Fig. 9 an example of such analysis for a few specimens from line LB is shown. The height of the coloured area shows the similarity to the lowland line, hence two of the specimens marked on the scale are more than 90% similar to the lowland line, while the other two are less similar. Such data can help the breeder to decide which animals in the herd should be chosen.

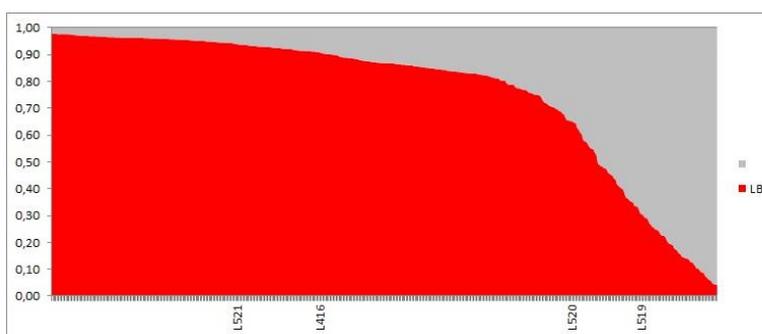
EUROPEAN BISON CONSERVATION CENTER



**GENETIC MONITORING OUTCOMES**

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**Fig. 9.** An example of genetic monitoring analysis results delivered to the breeder (explanation in the text).

Another element of genetic monitoring is the origin analysis, but it only refers to the animals held in captivity and their principles are explained in another chapter of this guide.



## Evaluation of the condition of habitats

There is a number of published studies on evaluation of European bison habitats' quality both on lowland and mountain areas. This index value enables to identify the most favourable areas for European bison on the basis of a detailed habitat map. Such actions should be taken up mainly on the stage of reintroduction planning, when the place favoured by the animals is not yet known. An adaptive-acclimation pen, where European bison are kept before release, should be located in areas of such potentially optimal habitat patches.

It often happens, however, that after release the animals migrate a certain distance to a place that from unknown reasons suits them better. In such cases it is necessary to recognise the animal concentration areas on the basis of long-term observation and notices of animal presence in these areas. (Fig. 10)

After some time when the free ranging herd is forming it is advised to evaluate the European bison's' impact on the tree stand (especially restocking). The best way would be to evaluate the damages with special attention paid to the types of damages caused by the European bison. Also important are information on reported crop damages in the nearby areas and direct conflict situation involving European bison (e.g. traffic accidents or cases of aggression towards farm animals or humans). It is then possible to evaluate if the land area intended for the European bison provides enough food and is a suitable habitat, or if the European bison will need to relocate in search for better living conditions. On this basis possible counteractions can be proposed.



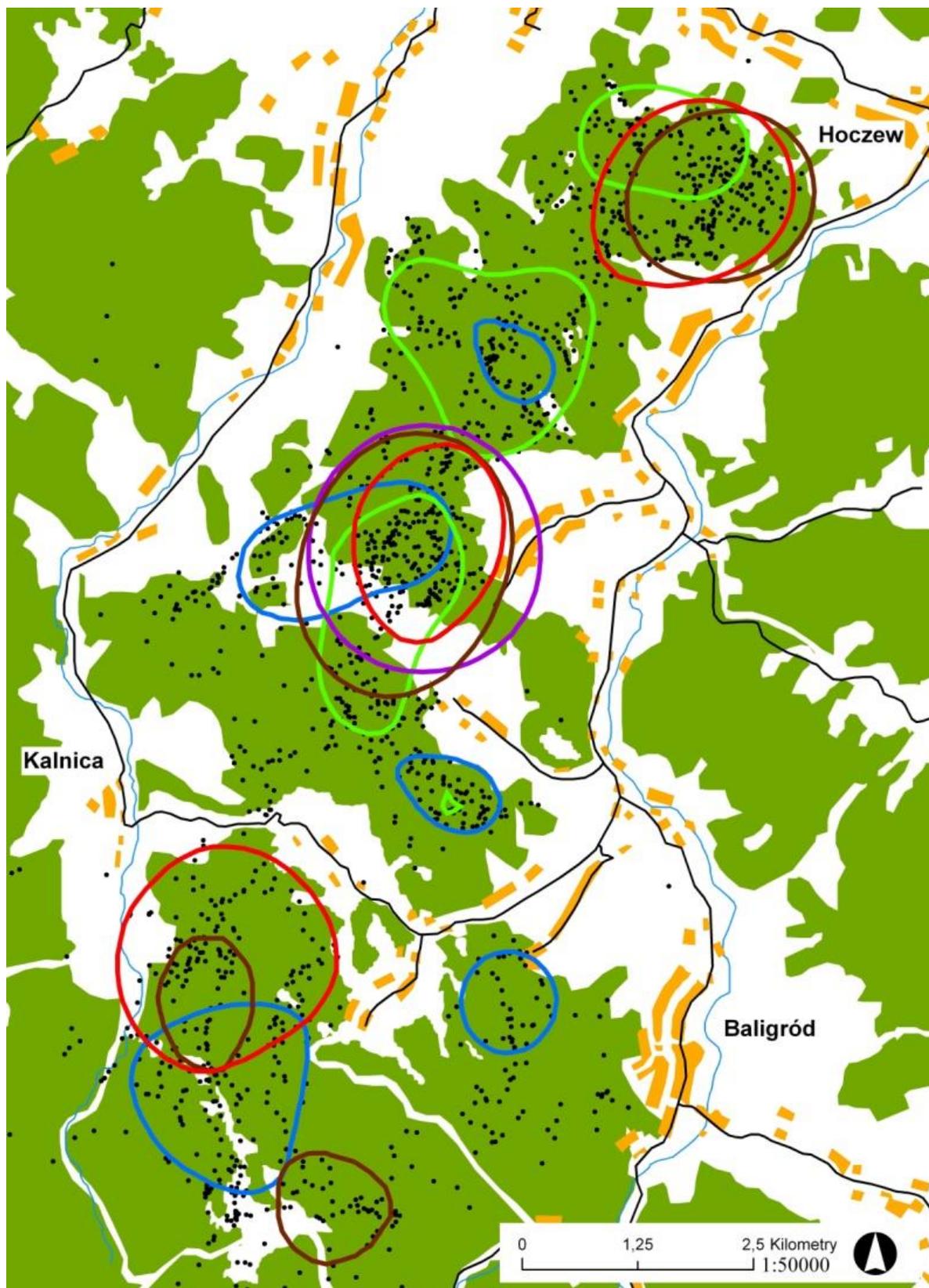


Fig. 10. Variability of European bison concentration areas from western subpopulation from the Bieszczady Mountains in certain years and seasons between 2001 - 2007.

*Legend:*

*Kilometry – Kilometers*



## Evaluation of the condition of populations

To evaluate if the population condition is good, not only such parameters as age and sex structure or reproduction and mortality levels, that are easily comparable with other data, are used. Analysis of population size trend is also useful. If this trend is negative it shows that the population condition is getting worse. If it's stable it suggests that the habitat carrying capacity has reached its maximum. If the trend is positive it means that the population is in the growth phase. An analysis of the population range can be used alternatively - it would show if the population reduces the range, keeps it on the same level or gradually increases the range. For such analyses an access to long-term data series (from 10 or more years) is necessary. For example in the Bieszczady Mountains population number fluctuations are observed in a 5-6-year cycle, so a short-term analysis may lead to false conclusions.

## Limitation of damages in forests and fields by feeding the European bison, contracting meadows and protecting corps

Feeding should take place between December and March, but intense feeding starts only when the snow cover thickness reaches over 70-50 cm. Until that time the European bison feed on natural food (e.g. in the Bieszczady Mountains they feed mainly on blackberry as it to be found in their habitat), sometimes debarking or bud chewing takes place (Fig. 11).



Fig. 11. European bison feeding on blackberry in winter



Fig. 12. An example of hay laid out

**Hay and haylage** - is laid out in bales, directly on the ground not in the feeding racks - the animals have free access from all sides, so when they feed intensively, there is no danger that the haylage would rot. (Fig. 12, 13).



Fig. 13. An example of haylage laid out



Fig. 14. An example of sugar beets laid out for deer which were frequently collected by European bison. Kołonicze Forest District, Baligród Forest Inspectorate.

Only sugar beets are used, as they are more frequently collected, are more nutritious, and far and foremost they keep exceptionally well, remaining good quality even in March (Fig. 14, 15). Storage in closed and covered storehouses. As part of the project “*In situ* European bison conservation in Poland - southern part” 2 storehouses has been built with a very convenient location in the middle of a forest.



Fig. 15. Three bulls leaving the feeding area in Kołonicze Forest District, Baligród Forest Inspectorate.



Fig. 16. Feeder with storage room in Kołonicze Forest District, Baligród Forest Inspectorate.

Feeder with storage room in Kołonicze Forest District, located inside the catching area. In the first plan covered part for hay is visible, on the side there are troughs for corn and salt-licks. Inside sugar beets, salt and corn are stored. The storage room is insulated. The attic can be used as observation post - the two gable windows can be opened. In the picture we can see that almost all of the hay has been eaten by animals: partially by European bison, partially by deer. The picture was taken in March (Fig. 16, 17). These facilities were built within the Priority Axis V of the Infrastructure and Environment Operation Programme financed in 85% by the European Regional Development Fund (EFRR) and in 15% by the National Fund for Environmental Protection and Water Management (NFOŚiGW) The beneficiary of the project "In situ European bison conservation in Poland - southern part" is the Regional Directorate of State Forests in Krosno and four forest inspectorates from the Bieszczady area: Baligród, Komańcza, Lutowiska and Stuposiany.



Fig. 17. Identical feeder with storage room in Czarne Forest District, Baligród Forest Inspectorate. Beginning of winter.

European bison often visited the forest meadows that had been mowed and where bushes were removed within the project. Other animals, deer and roe mainly, also use these areas. In areas with dense forest cover, like in Bieszczady Mountains, it's one of the best solutions - meadows serve as feeding and resting areas in the growing season, so the animals' attention is diverted from the crops and young stands. Meadows are located even at 900 masl. Near the meadows there also are salt-licks laid out, mainly in salt boxes (Fig. 18).





Fig. 18. Forest meadows are often visited by European bison (Bieszczady Mountains).

Additional feeding of free ranging European bison in Western Poland is based on cereals and beets rather than hay (in the north-west Poland European bison don't eat it as there is plenty of dry grass available). A system of special European bison feeders with strengthened construction is built there. The feeders are used every second season, so it enables disinfection of feeding areas (health prevention). It is also important to keep the hay meadows mowed for the European bison's needs.

### Feeding by meadow contracting (leasing)

Contracting of the hay from private meadows in the area where European bison stay began within the project "European bison Land" ("Kraina Żubra") co-financed from the EU funds as a part of a financing instrument LIFE+, where the main beneficiary was the Mammal Research Institute of the Polish Academy of Sciences and the partners were the Regional Directorate of State Forests in Białystok, Białowieża National Park and the Green Lungs of Poland Foundation, and was continued within the project "*In situ* European bison conservation in Poland - southern part". The owner of the meadow was to prepare the meadow in an appropriate way (levelling, fertilizing), collect the hay and leave it in a Dutch barn/haystack at the edge of his meadow. Additionally the construction of the Dutch barn was also financed. Thanks to these practices the amount of hay for European bison and the number of feeding areas were higher. At the same time the meadow was mowed at the turn of June and July, what allowed the European bison to use it in summer, autumn and winter.

In case of both projects the Białowieża National Park (BNP) was (is) responsible for their realisation. There was a procedure developed for those farmers who wanted to participate in the project of European bison food amount increase. The procedure is as follows:

BNP (with MRI PAS or later with WULS-SGGW) informs the farmers (through commune offices) that they can submit an application for a subsidy of a European bison meadow. The condition to submit an application is the location on the meadow in the areas where the European bison live. The applications are collected in March-April.

After they are collected, the BNP workers verify the proposals with regard to the presence of



European bison, distance from the Białowieża Forest and quality of the grassland. After the applications have been verified, those farmers who met the criteria are chosen and they sign contracts in which they oblige to mow the grass, prepare the hay and leave the hay on the edge of the meadow while the MRI PAS (or now the WULS-SGGW) obliges to collect the hay and finance these services.

The aims of these projects were consistent and the contracting supports achieving these aims: dispersion of the population, lowering the winter concentration of European bison in the feeding areas, improvement of living conditions of the population as well as increase of social acceptance of the species. The interest of farmers grows each year (Table 10.)

**Table 10.** The acreage of meadows from which the hay was contracted

Year	number of farmers	acreage [ha]
2006	2	4
2007	9	25
2008	21	52
2009	26	61
2010	20	50
2011	29	72
2012	44	107
2013	58	156

For this region the estimated amount of hay from 1 hectare of extensively used meadows is slightly above 5 tons, so when the hay is contracted there are several hundred tons of it and thus, there is no need to bring the hay from distant places. What is even more important, it minimises the conflicts between local inhabitants and increases the level of social acceptance. There are attempts to develop a farming-environment package for permanent grasslands to support the European bison population, but it is only at initial stage of planning. So far it was possible to get a subsidy for this purpose.

What also increases the social acceptance in the area around the Białowieża Forest is the protection of the crops by installing an electric fence or an enclosure of other type around the endangered field (Fig. 19).





Fig. 19. Fencing crops in the area of Białowieża Forest is a preventive measure to protect against damages caused by European bison.

Actions are taken up also in the Knyszyn Forest as part of the project “*In situ* European bison conservation in Poland - southern part”. A big problem in that area are damages caused on private fields, with rapeseed mainly. For two years now food is laid out in forest areas to divert the European bison’ attention from the fields. Looking at the two-year experience it may be stated that the number of animals stopping in the feeding areas is increasing but it is still a slight percent of the whole herd. At the edges of the forest enclosing fence is being build which should force the European bison to change their marching routes and maybe more interest in the provided food. The effects will be visible in the 2013/14 winter. European bison are very conservative and change of habits of a herd led by the same cow for a number of years is very difficult. Despite the difficulties it is necessary to take action but is it also important to patiently wait for effects.

### **Promotional and educational campaigns to increase understanding of the European bison’ needs and to increase acceptance of their presence in the environment**

As part of the project Life European bison Land, a series of meetings was organised for local communities of the communes participating in the project. The main purpose was to inform about the European bison, the project itself and new possibilities to make use of the presence of the species (e.g. in touristic or region promotion). The meetings comprised presentations, discussions and field trips to the Białowieża Forest and BNP museum. The meetings had a key role, as the social support is an essential condition for effective long-term European bison conservation and necessary to achieve the project’s aims. They were organised in 11 commune offices and district governor’s offices and the Białystok province governor’s office. In the surveys evaluating these actions the participants provided positive feedback and



assessed the value and quality of the meetings very high. The presented topics raised interest and the participants declared a positive attitude towards European bison conservation, and for those who had such positive attitude before the meetings it was even more fixed. According to the participants, the best form of topic presentation was the field trip to the forest and the possibility to directly observe the European bison's behaviours in natural environment.

Parallel to the meetings for commune representatives there were educational classes held in primary and lower secondary schools in the 11 communes, with 1660 pupils participating in total. The pupils were very enthusiastic about the classes and noticed the usefulness of knowledge gained at school, during classes and all kinds presentations and competitions.

Additionally, within the "European bison Land" projects, information materials have been prepared. They were targeted at adults and children and had various forms: information posters, maps, brochures, comic strips and calendars. The most important and well received part, however, was the website which was widely appreciated for its factual contents and aesthetic valour ([www.krainazubra.pl](http://www.krainazubra.pl)). What is more, markings similar to road signs were prepared and placed in the area covered by the project. (Fig. 20)



Fig. 20. Sign prepared as part of the project "European bison' Land"

*Legend:*

*Uwaga! Kraina Żubra – Watch out! European bison' Land"*

In the framework of projects on *in situ* European bison conservation various workshops are organised. They are devoted to European bison as a species, their living conditions, population and areas that might be suitable for future European bison introduction. The number of workshops in each project differs, but the way they are conducted is similar. The workshops are one day long and present topics related to European bison, their situation and actions that need to be taken for their conservation. Ongoing activities are also presented. Every meeting is announced at least 1 month ahead in the region where it's going to take place. Information is sent out to institutions that might be interested in the presented topics: Regional Directorates for Environmental Protection (RDEP), national parks, landscape parks, State Forests institutions, communes, districts, secondary schools, higher education schools, non-governmental organisations. Private individuals take part in the meetings as well. Information on the planned meeting is also available on websites. Various information



materials are prepared as part of the projects, mainly brochures about European bison and ongoing activities, but also calendars and materials for children. One of the most popular materials is a brochure prepared as part of the “*Ex situ* European bison conservation *European bison bonasus* in Poland” presenting the breeding reserves in our country in a very comprehensive way.

## **Cooperation of NGOs, scientists, State Forests administration and public environment protection services, national parks, Regional Directorates for Environmental Protection, General Directorate for Environmental Protection**

European bison is a charismatic species and because of its unique features it is an object of interest of scientists. Unfortunately there are very few studies on natural populations before the European bison became extinct, among them there is a monograph on Białowieża Forest by Karcov (1903), or a study by Wróblewski (1927). In the restoration period studies were always conducted while taking preventive measures, and their results were the basis of further decisions. In Poland a special attention needs to be given to the long-term research conducted in the Białowieża Forest by the Mammal Research Institute of the Polish Academy of Sciences and Białowieża National Park together with the WULS-SGGW. In the 1950s and .60s research teams, representatives of ministries and other institutions responsible for European bison conservation programme met regularly during so called Polish-Soviet conferences. The aim of those meetings was to evaluate the effects of practical measures and to become acquainted with the research results on various aspects of the species’ biology. Also further plans for the European bison restoration were made. In the 1970s and 80s regular meetings didn’t take place any longer - it was a loss for the advance of research on the species, but the research teams in Białowieża (MRI PAS and BNP) as well as at WULS-SGGW studied various aspects of European bison, the population in Białowieża Forest being the central focus. The effect of intensified interest of researchers in European bison in the 21st century is the geometric growth of the number of publications on this topic. Naturally in the conservation programmes the research results are widely used, as in the current century the cooperation of research and practice has developed thanks to the regular conferences in which many practitioners take part. Conferences are organised annually by the European bison Friends Society and NGO concentrating on this species and associating over 130 people. Once a year a bulletin is published (European European bison Conservation Newsletter) including research papers, reports and conference materials summarising the presented lectures. During the conference around 50 papers, lectures and report are presented. Due to its cyclical nature the conference brings the research and practice together. The researchers are members of teams or commissions that take care of particular herds and populations.

The visible effects of cooperation are projects involving research institutes, national parks, NGOs and organisational units of State Forests. Such scheme connecting competences and abilities gives great effects for European bison conservation. Cooperation with local authorities and regional directorates for environmental protection - all of whom are eager to help with environment protection programmes and support activities- aim at minimising conflicts. Some even engage in the actions and feed the herds, like the directorate in Białystok. The local authorities in Mirosławiec actively engage in projects supporting the West-Pomeranian herd. They are also interested in education and possibilities to use the European bison as an element of the region’s promotion.

It is worth to mention the case of local population management by an NGO (The West-Pomeranian Nature Society - in cooperation with environment protection services, local



authorities and forest inspectorates under a fiduciary agreement between the Regional Directorate for Environment Protection in Szczecin and the West-Pomeranian Nature Society on the basis of the act on public benefit activity and volunteerism. Projects for the European bison protection were financed by the Provincial Environmental Protection and Water Management Fund in Szczecin and EcoFund. The projects were the following: “Protection and admixture of new blood”, “Development and protection of the West-Pomeranian herd”, later continued within the Priority Axis V of the Infrastructure and Environment Operation Programme project “Protection of West-Pomeranian European bison”. All these projects are performed by The West-Pomeranian Nature Society in cooperation with organisational units of State Forests.

It is typical that the activities concerning European bison and cooperation between institutions are undertaken by the institutions themselves and are not formally imposed upon them. In the document “European bison conservation strategy in Poland” approved by the Ministry of the Environment there was a postulate that an institution/ person has to be established to coordinate the protective measures for European bison conservation, which hasn’t been implemented yet. So there is a need to formally establish a national coordinator for European bison protection, who will control the performance of the general strategy for European bison breeding and population protection. The coordinator would also be assisted by a supporting board consisting of the representatives of the institutions protecting the European bison. At present coordination is performed by the European European bison Friends Society as part of the project of European European bison Conservation Centre concerning European bison populations in captivity.

There has to be a formal guardian appointed for each free-range population. A formal guardian of the herd from Bieszczady Mountains is the Regional Directorate of National Forests in Krosno, but there is none for the herds in Knyszyn and Borecka Forest. The West-Pomeranian herd’s guardian in the Regional Directorate for Environment Protection in Szczecin entrusted the tasks to the Nature Society. In Białowieża Forest the protection is provided by the Białowieża National Park. The guardian bears the responsibility of coordinating all the activities concerning the protected herd, submitting applications to the environmental organisations, implementing the information policy and organizing meetings, trainings and council sessions. The guardian has to be appointed by the formal decision of the General Directorate for Environment Protection/Ministry of the Environment to be able to have an influence on all the institutions that work in the field. All the activities concerning European bison, especially reintroduction of animals, construction of adaptation pens and others, should be within competences of the formal guardian. Each herd guardian establishes an opinion-providing body comprising researchers, practitioners that perform the actual protection in the field, veterinary services, regional directorates on environment protection. The responsibility of such body, often called a Committee, is to give an opinion on protective measures and to indicate them.

On the basis of experience from Bieszczady Mountains, where tuberculosis prevention activities must have been postponed because of protests of researchers that were not specialists on ecology, zoology, veterinary and public health, it seems to be necessary to establish new criteria of decision taking in particular cases, based on experts’ opinions.

### **Establishing new herds of European bison - a complete database of good practices for use in other locations (number, admixture of new blood)**

Establishing new, satellite herds of European bison as a tool for development of small, isolated populations. Effects achieved after establishing herds in Drawsko Forest Inspectorate



in 2008:

-  increased number of population
-  broadened acreage
-  increase of genetic variety
-  development of the herd within the borders of a military ground - the best scenario for a local population, possibility of great increase of the population number in optimal habitats without any concern of crop damages.

As a result of the project “European bison conservation programme in Poland: Development and protection of the West-Pomeranian herd” The West-Pomeranian Nature Society established two new European bison herds in 2008. There were two 4-hectar adaptation pens located in the area of Łobez and Dobrzany Forest Inspectorate (14 km away from each other and 38 km away from the area of Mirosławiec herd), where the animals were brought in March and April 2008 - 6 cows and 2 bulls to each of them. All of the cows came from Białowieża and bulls from the facilities in Niepołomice and Pszczyna. In the Dobrzany herd the cows were 1 year (1), 2 years (2), 3 years (1), 8 years (1) and 9 years (1) old and the bulls were 3 years and 1 year old. In the Łobez herd the cows were 2 years (2), 3 years (2), 5 years (1) and 6 years (1) old and the bulls were 3 years and 1 year old. In June 2008, after 3 months of adaptation, the animals were released from the pens.

Till September 2008 the Dobrzany herd occupied an area of 3000 ha around the adaptation herd, while the Łobez herd migrated to the neighbouring areas of Drawsko Forest Inspectorate, to the military grounds, occupying a much larger area (around 10 thousand ha).

During the first 3 months after release it seemed that the areas of Dobrzany Forest Inspectorate are more suitable for European bison reintroduction - area with nutrient-rich moraine soil, deciduous and mixed forests with large amount of rich and mesotrophic beech. The European bison stayed in a relatively small area of 2000 ha and did not leave the forest. At the same time the eastern area of the Łobez Forest Inspectorate, where the adaptation pen was located, and the western area of Drawsko Forest Inspectorate, where the herd migrated, are poor, innutritious sandurs with dominance of pine woods. The behaviour of the herds initially seemed to confirm the preferences of the European bison from the Polish part of Białowieża Forest, where the animals prefer deciduous and mixed forest habitats.

The situation reversed in autumn and winter. The Drawsko herd still stayed in the same area as in late summer using the feeders, while the Dobrzany herd started to migrate and fed on the farmlands, occupying a three-times larger area than in late summer. The Dobrzany herd visibly avoided the feeders and the food laid out was collected by other game animals. Only in January the European bison started to feed on the laid out oats and beets. They started to visit the feeding area regularly, but at the same time they also fed on the farmlands.

In January 2009 the Dobrzany herd started to migrate eastwards and entered the area of the other herd two times. On the basis of GPS data analysis it seemed that after running into the fresh tracks of the other group, the herd moved back to their own area. The third time the Dobrzany herd entered that area it joined the other herd. The stamping grounds that the European bison chose were the poor woodlands on the Drawa river sandurs, and they never tried to migrate to the rich forests in the Dobrzany Forest Inspectorate area.

During the adaptation period in the pens, telemetric GPS collars were put on 3 animals from each pen: 2 adult cows and 1 adult bull. A Plus Vectronic Aerospace collar should be kept on an animal for at least 700 days. Unfortunately the collars put on the animals worked for a shorter period of time and the first one that stopped transmitting the data broke down even before the release from the adaptation pen, and it wasn't damaged by the animals. Despite the



low quality of the telemetric devices the continuity of the measures was maintained and is still ongoing. At present Polish collars of much better quality are used.

Two herds established in 2008 in the Łobez and Dobrzany Forest Inspectorates located 14 km apart from each other (Fig. 21), 10 months after release joined and formed one herd. Their stamping area was located in the poor woodland area on the Drawa river sandurs, and the rich forest habitat in the Ińskie Lake District was abandoned. 7 females ready for reproduction gave birth to 5 calves, at least 3 of which survived the first 3 months. The herd monitoring is impeded by the unreliability of the GPS telemetric collars Vectronic Aerospace, which work for approximately 4 months while they should operate for 2 years. At present the herd consists of 54 animals.

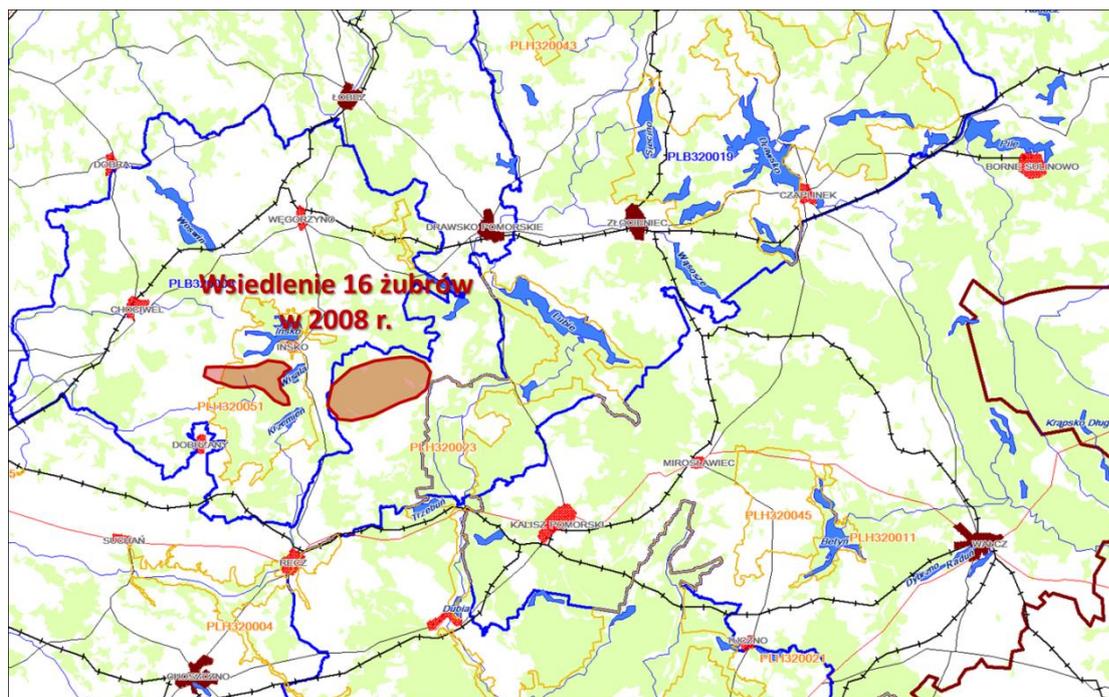


Fig. 21 The place of reintroduction of the European bison now inhabiting the Drawsko military ground.

Legend:

*Wsiedlenie 16 żubrów w 2008 r. – Reintroduction of 16 European bison in 2008.*

## Establishing a free ranging herd in the Bieszczady Mountains

The foundations of the Bieszczady free ranging herd are the result of a decision made in the early 1960s to separate animals from the mixed lowland-Caucasian line from the breeding reserves in Przczyna and Niepołomice and to reintroduce them in the area of Bieszczady Mountains. Baligród Forest Inspectorate was the initial location of the adaptation pen, but in 1963 it was decided that the European bison breeding facility is going to be located in the Stuposiany Forest Inspectorate in the eastern part of Bieszczady Mountains. Finally, on 31 May 1963 a committee established by the State Forest Administration in Przemyśl made an inspection of the proposed area of the forest and indicated a detailed location of the quarantine pen in the Ustrzyki Górne forest district, in the divisions 33a,d,c, 34a, 36c with the area of approx. 5 ha. The area of the pen included beech and fir stands of different classes and age, a



glade and a part of a stream.

The technical project and cost estimate was prepared by the office of the State Forest Administration in Przemyśl. The enclosure fencing comprised wooden posts and perches obtained on site and was 1100 m long. In the pen a feeder was built that was 9 meters long and served also as a storehouse for hay and fodder. The total area of the pen was 5.68 ha.

The construction was finished on 6 October 1963, and after the fodder was gathered, the first European bison from Przyczyna (2 animals) and Niepołomice (3 animals) arrived on 30 October 1963 (Tab. 11).

**Table 11.** Identification data of the first group of animals reintroduced in the Bieszczady Mountains.

No	Sex/Name	number	Year of birth, origin
1.	Bull "PULON"	1128	1958 (Pszczyzna)
2.	Bull "PULPIT"	1287	1960 (Pszczyzna)
3.	Cow "PULEŚNA"	973	1955 (Niepołomice)
4.	Bull "PUSZCZAR"	1462	1962 (Niepołomice)
5.	Bull "PUJAR"	1471	1962 (Niepołomice)

Soon, two more European bison joined the group: bull named "Purus" and cow named "Pujonka" coming from Niepołomice.

European bison acclimation to the mountain conditions occurred during winter, which is usually heavy in the Bieszczady Mountains. It was similar in 1963, when the snow depth reached five feet, temperatures were below minus 20 degrees of Celcius and persisted for several weeks. European bison were fed with hay without restriction and they received 4 kilos of acorns per animal per day. During severe frosts they were also fed with oats and beech seeds. Some problems were caused by the dominant bull "Pulon" which drove away smaller individuals and even wounded them with its horns. So it became necessary to build a croft for new-born calves to separate young animals from the aggressive bull, who only tolerated cows in his environment. During the whole winter, animals' behaviours were observed and it was discovered that they coped well with such deep snow cover.

Since all European bison staying in the quarantine farm were in excellent condition, with the coming of spring it was decided that they would be released into the wild. Enclosure was opened on the 4th May 1964, however, it turned out that the animals at the beginning did not want to leave the croft and they did not come out until the night between 4th and 5<sup>th</sup> of May. In the early days in the wild, herd penetrated the area moving from the Kiczutki top to the edge of the forest and further to mountain pastures of Bukowy Berd, then they went for the woodsman house in Widelki and there they entered the yard, from which they were managed to be convinced to return to the forest.

In late May, the herd broke into two groups: cows with young remained in the area of farms and two bulls took the journey towards the Roztoki creek and Halicz at the level of Krzemień, i.e. about 15 kilometres from the exit area. On 17th of July 3 next European bison were brought to the quarantine farm: bull "Pulon II" from Pszczyzna, cow "Puczaja" and bull "Puston" from Niepołomice. A few days later "Punina", "Puri", "Punek" from Pszczyzny and "Pucela" with "Pucnota" from Niepołomice joined them. On 24th of July the herd numbered



15 animals. Around the middle of December 1964, 16th individual arrived - young European bison was born by a cow "Pujanka". Despite the severe frosts at the time the calf was healthy and busy. The whole herd kept together with the cow which had given birth for some time. In the end of October 1964, the bull "Pulpit" was driven away from the herd by stronger "Pulon" and took a lonely journey to the north. It was not found until November, when it was discovered in the area of non-existent village of Sokole more than 60 kilometres from the farm. He wintered there until the spring and at the end of April 1965 he was caught and transported back to the herd. But after a few months, in August, he made his longest journey wandering through almost the entire Sub Carpathian region. Within the period of almost 28 days he walked a distance of 400 km and he was only captured as far away as in the village of Żabno upon Danube (near Tarnow) from where he was also transported back to the farm in Niepołomice.

In autumn of 1965 another individual separated from the herd. In his journey to north he arrived in the vicinity of the Jarosław near to Pruchnik. Inventory checking of animals on 1 January 1966 showed that there were 21 European bison in the wild in the Bieszczady Mountains of which 4 cows were expecting an offspring in the spring.

In 1976, the settling in of the European bison was carried out but in another part of the Bieszczady Mountains, in the Forest Inspectorate of Komańcza near Wola Michowa where the second acclimatization farm was build. In the autumn 1976 were brought here 5 European bison named "Kestrel", "Puga II", "Puna", "Pustolnia" and "Puha" from Niepołomice and bull "Pulasa" from the Cracovian Zoo. In 1980 10 more animals from Pszczyna were picked up here. Upon release the troop expanded to approx. 140 individuals in 2012 and its area now extends from the forest districts of Baligród and Komańcza to Lesko to the north and Cisna in the Southeast. So far, there was no contact between the two populations of European bison in Bieszczady Mountains. Bieszczady European bison feeding is kept to a minimum. They use several places with hay and silage hay and they often visit feeding points provided for the deer. The main management problem of this herd is its continuously expanding living area to the north where more densely populated areas begins, which in the near future can produce undesirable conflicts with the local people.

European bison in the Bieszczady Mountains show clearly seasonal reactions by changing the areas of herds' concentration. Their movements are related to at the beginning of winter-periods of the first significant snowfall and in the spring-to a temperature increase (monthly average) - up to approx. 10 degrees of Celsius. The distance of such migration usually does not exceed 20 km, along the north - south axis. Generally Bieszczady European bison spend winter at lower altitudes in areas with lesser snow accumulation. During this period, their main food is leafy shoots of evergreen blackberries. However, from the beginning of spring, European bison migrate slowly towards the higher altitude areas following the development of the young vegetation. It is estimated that within the year-round areas of herds habitats over 90% of their surface is in the range between 500 - 1000 m above sea level. The preferred habitats during the vegetation season are natural pastures (mid-forest and meadows bordering the forest, clearings, and glades). In contrast, the importance of these kinds of habitats clearly drops in the winter season. Important parameters for the forest habitat preferences are value of



shielding coverage and abundance of natural feeding base. In vegetation season density treetops determine forest habitat preferences, but regardless of the season - most preferable usage by European bison are the stands of interrupted density of upper branches of a tree. Another important factor is the dominant tree species in the stand. In the summer it is the dominance of fir and in the winter-of pine and alder dominated stands. This makes mass occurrence of evergreen blackberries in the undergrowth, which is the most important winter food in Carpathian Mountains for all large herbivores. The most optimal conditions for European bison in the Bieszczady Mountains are created by mosaic of forest patches of different species composition of trees and natural pastures.

A specific feature of European bison population in the Bieszczady Mountains is its small dependence on man in a winter feeding issues which makes the local European bison maintain a much greater distance from the man then, for example, in case of European bison in Bialowieza. Bieszczady Mountains are also the only place in Poland where European bison interact with large predators (wolf, bear). For many years, there were no cases of predation on European bison, but in 2010 there were already a few such accidents. Bieszczady population is assumed to be the core for the Carpathian metapopulation extending from the Polish Republic and Slovakia via Ukraine and Romania. These days regular contacts are already observed of Polish European bison with a herd established in 2003 in the Slovak Połoniny National Park, as well as there occurs frequent crossing of the Polish-Ukrainian border in the Bieszczady Mountains by European bison.

### **Improving the living conditions of European bison in closed farms conditions, construction or modernization of the breeding infrastructure**

The main issue in creating good living conditions in closed breeding of European bison is to give them a sufficiently large space. This need results both from the nutritional requirements of this species, which are estimated at 30-45 kilos of biomass per day for an adult and with a herd of European bison lifestyle as well as the fact that the animals should be given the opportunity to both grazing and access to sheltering, preferably in the form of woody vegetation, providing protection from wind, rain, excessive sun exposure and the necessary peace.

The size of land intended for rearing a European bison farm is dependent on many factors. First of all it is determined by the size of the group, but also the nature of the vegetation cover and topography. It is difficult to determine the minimum area necessary for the maintenance of European bison farms. Undoubtedly, even in small areas (e.g. in ZOOS) European bison reproduce and survive to old age, with full care assured by man. On the other hand, the corresponding area of farms is essential to ensure the comfort of living for these animals. Relation between the size of farms and the proportion of the surface area per one European bison is important. This is a crucial parameter for the degree of utilization of grass and other plants as herbaceous, shrubs and trees. At farms with very limited space, European bison quickly eat up and tread herbaceous vegetation available on the European bison run as well as destroying through the gnawing and beating any unprotected trees and shrubs. As a result in a short time the animals lose access to their natural pasture and become entirely dependent on the feed supplied by guardians. For this reason the area reserved for closed breeding herd of European bison should be selected with great care to meet as much as possible the demands



for natural food and have sufficient shielding conditions. Ideally, the farms would be created in areas of forest (deciduous or mixed) with access to natural watercourses and pastures rich in grass.

It should be remembered that in the closed farming conditions we will never be able to provide such an area as European bison could have in the wild and in consequence the full potential of rotational use of their food base. So, we always have to reckon with the greater destruction of the plants within the farms than it is in the areas of herds living in the wild. For this reason, it is necessary to take measures protecting primarily forest plants, which requires the longest time for regeneration. Thus, the trees growing within farms should be protected against gnawing of bark and root collar area by European bison, the best solution is to wire mesh around the trunks up to 2 m. Alternatively, we can use more aesthetically pleasing wooden cladding strips or halved rod. Root zone can be protected by placing large stones around the trunk. You can wrap clumps of bushes with low fences from poles, not allowing the animals to eat side shoots and also preventing the destruction of whole plants through breaking them.

It is very important to ensure that animals have the possibility of grazing, which is an essential means of feeding for European bison. Although there are no official standards for surface designed for European bison farms, in the case of demonstration farms its minimum surface should be in the range of 1.5 - 2.0 hectares (including approximately 0.5 ha of pasture clearing) for each European bison, while at least 30% of the surface must be covered with trees. The larger the area of farms, the easier it is to introduce the area division and by its rotating use cause rational use of pasture plants in different parts of the farm allowing for its natural regeneration. In Polish European bison Breeding Centres area per one animal is usually much higher, ranging from approx. 3 ha up to several acres in the reserve "Żubrowisko" in Pszczyna. Depending on the grading habitat within which a breeding farm is assumed to be held, sometimes it is necessary to enrich the existing vegetation in woody species eagerly gnawed and beaten by European bison, such as: goat willow, aspen, hornbeam, ash and spruce and oak. Enriching natural grazing place consisting of the plantings of trees and shrubs (especially deciduous in the form of clumps in the gaps and under the copula of trees) requires full fence seedlings in order to secure their growth for at least several years.

Food base of the forest origin consists of species of trees, bushes and shrubs that are the source of the shoot and bark pasture. If a stand also includes heavy seed species, their seeds (acorns, chestnuts, beech seeds) are also an excellent food for the European bison.

An essential element of the farm prepared for the European bison breeding is feeding clearing (pasture) with an area of approx. 0.5 ha/ animal, rich in grass plants. In these open areas, the European bison should have access to the widest possible range of grasses and legumes with high nutritional value and taste. If the existing grazing areas are characterized by poor composition of meadow vegetation species, it is necessary to conduct full land rehabilitation or the grasses seeding in order to vary the species composition and ensure adequate productivity of such a surface. For seeding grass or reclaimed surfaces a mix of hay and grazing is recommended with the following composition: meadow fescue and perennial ryegrass (20%), red fescue, orchard grass, Italian ryegrass, timothy grass, smooth meadow-grass and red clover (10%). Well managed meadows and pastures or planted forests located within the farms are the nutritional basis for European bison who live there. Meadows and pastures maintained in complete agrarian culture allow for both hay harvesting, which, beside bringing food for winter period is a care treatment which is necessary in order to preserve their quality and for the grazing of animals.



It is extremely important both in farming conditions and in the wild to provide year-round European bison unlimited access to clean water, preferably in the running form (natural watercourses). Access site should have hardened edges (e.g. gravelled, or paved with stone) so that there will be no danger of collapse of the animal drinkers in the mud.

Another essential element of both breeding farms and developed habitats for European bison are salt licks. They should be fixed at a height of at least 0.5 m above the ground, in order to ensure access to them, regardless of the snow cover, preferably placed on butt (lowest part of the trunk) or forked trunks, in order to allow the animals for both a direct use of salt as well as chewing wood supersaturated with it. Here one can either apply the standard cube made for cattle or rock salt in lumps.

The activities are carried out within the project OPIE (Operational Programme for Infrastructure and Environment) "Ex situ conservation of European bison *bonasus* in Poland" and before that, in the framework of a set of projects, "Protection and maintenance of European bison fauna reserve "Żubrowisko" funded in 2002-2010" with the use of national funds and own resources of NF (National Forests).

### **The procedure for obtaining permits to conduct a breeding farm**

European bison as a species being under protection in Poland cannot be kept in captivity without obtaining permission of the General Director of Environmental Protection. The document "Strategy for the protection of European bison in Poland" clearly indicates that the creation of new herds, both in the wild and in captivity, aims at increasing the number and diversity of the national population. At the same time, the document clearly states the need for meeting appropriate conditions of living in the farm. An important element is the issue of ownership of animals as a protected species because they remain the property of State Treasury, which may be difficult to accept by individuals, potential owners of farms. European bison will be a subject to the principles of the national program for the protection and exchange, identical with the EBCC program (European bison Conservation Centre), so the future breeder must be aware of the obligation of full submission to the choice and selection of animals for breeding and production.

The process of obtaining permission should include the following steps:

- 🐾 request to GDEP containing information about planned project of closed breeding for European bison, the name and address of the applicant, the purpose of the planned breeding (exposure or not), the location and intended area of farms (with a map and a simplified technical project) in applicant's own land or a leased one (lease agreement), land development manner, the opinion of Voivodeship Nature Conservator and the district veterinarian and a declaration that the conditions relating to the coordination of restitution breeding in the country are fulfilled,
- 🐾 the opinions of the experts indicated by GDEP in cooperation with EBFS (European bison Friends Society) (possibly national members of European bison Specialist Group of IUCN) in the field of breeding and welfare of European bison in order to assess the relevance and quality of the planned area,
- 🐾 preparation of the farm including all necessary equipment,
- 🐾 commission handover protocol of prepared object (acceptance of technical conditions of enclosure and equipment) by the committee indicated in the permit GDEP,
- 🐾 constant medical-veterinary care and breeding for the created herd is ensured by the breeder
- 🐾 written acceptance by the breeder founding herd selection breeding conditions (including bans from independent import and export individuals and participation in a



national breeding program of restitution and communication requirements to the Editors of the European bison Pedigree Book and the EBCC,

- Request to GDEP / RCPN (Regional Council for the Protection of Nature) for transfer of European bison and for an authorization of their breeding and maintaining post the positive acceptance of the investment by the commission.

After obtaining the permission from GDEP farm is under the direct care of EBFS and EBCC, which recommends the transfers of animals and, at least once a year, controls the compliance of the breeding conditions of the permit.

### **Comments and insights into how to create farms and other facilities construction for European bison on the basis of the experience gained in the Bieszczady Mountains in recent years as an example of good practices**

The basis is a good location of the farm, taking into account the diversity of the area for stall exposure (creek or place with many smaller water sources, meadow, trees), near the paved road (easy access for tourists and for performance of mechanical works in the farm). It is better if the farm is divided into quarters; the appropriate amount of them is at least three or more. This division allows for the use of alternate pastures, greater and easier reproduction control e.g. the separation of the bulls from cows or calves after rising by their mother. An important element of the farm is a small room set aside for quarantine, treatment but also for the capture for transport. Such catching place should be equipped in a so called sleeve (awl) directing the animal to transportation crate (Fig. 22, 23). The farm must also be equipped with a croft for new-born calves, which is the place where fodder is given, and to which calves may come but adult animals are not able to.



Figure 22. An (sleeve) awl to harvest European bison (Bialowieza National Park).



Figure 23. Catching pen from outside (Białowieża National Park).

Next to the pen there should be an agricultural infrastructure for a storage and preparation of fodder, the number of rooms ought to be adapted to the type of stored food (hay, grain, succulent feed) and other needs (social and storage space). The building should be located so as to allow for the support of two quarters. What is important is a food over hay rack at the height adjusted to the easy downloading of food by European bison and mechanical cleaning work as well as drainage and drainage of nearby outbuilding.

Farm must be protected against access by other animals (e.g. large predators and due to health risk) by additional protection e.g. net if pen fence is made of perches or metal. An ongoing monitoring should be used also with the help of cameras. It is important to prevent direct contact between humans and animals through an appropriate location of fences (slope) and warning signs. Trees, which are inside the pen, can be secured from European bison by nets, stones around or bands of wood from being accessed.

### Methods of catching and transport of animals

Other infrastructure serving European bison in free herds, apart from places of feeding, involves also catching places (Fig. 24, 25). Catching European bison alive is an important practice for populations in the Białowieża Forest, from which annually a dozen or so animals are exported to other breeding farms in the country and abroad. On one hand, catching alive allows for the formation of new herds and on the other hand-it is a good way of limiting the quantitative growth of the population in the Białowieża Forest.



Fig. 24. "Fresh" built catching place for European European bison at the forest administration region Kołonicze, forest district Baligród.



Fig. 25. Catching place for European bison at the forest administration region Kołonicze, forest district Baligród.

An issue of the transport of European bison is directly connected with the subject of catching place,. These animals after being caught alive, while providing the minimum amount of stress, should be put in transport boxes about the appropriate volume adjusted to the body size of individual so that they are not too tight, but simultaneously so that their width makes it impossible to turn around for a European bison. They have to be high enough so that the



animal can stand freely in their interior (Table. 12; Fig. 26). The bottom of the box should be made in the way which facilitates its cleaning and disinfection after the transport. The structure of the box must ensure the access to the animal in order to distribute fodder, water as well as enabling possible veterinary treatments as e.g. performing the injection. From both sides of the box there should be installed lowered door providing free access for the animal, as well as, after arrival to the destination point giving possibility to leave the transport box easily. The inside of the box should be smooth, without elements sticking out like nails, screws and others. Ideally the box would be made from wooden elements or wood based (plywood, OSB board). The box should also be provided with handles enabling the manipulation, protecting and immobilization of it during the transport. Long-term experiences of centers in Białowieża and Pszczyna show that this is an optimal method of the transport of European bison, enabling individual treatment of each animal and ensuring maximum safety for service as well.

During transport, the European bison should be accompanied by guardian who takes care of refilling water and feeding as well as controls every few hours the behavior and state of the animals.

**Table 12.** The transport boxes' dimensions depending on the age and sex of the animals [cm]

Age and gender	Height*	Width*	Length*
bulls > 4 years	175-195	70-85	270-290
cows > 4 years	160-175	60-70	250-270
3-year-old youth	145-160	55 -65	220-240
2-year-old youth	130-145	50-60	195-215
1-year-old youth	115-130	40-50	160-180

\*Dimensions refer to internal box dimension



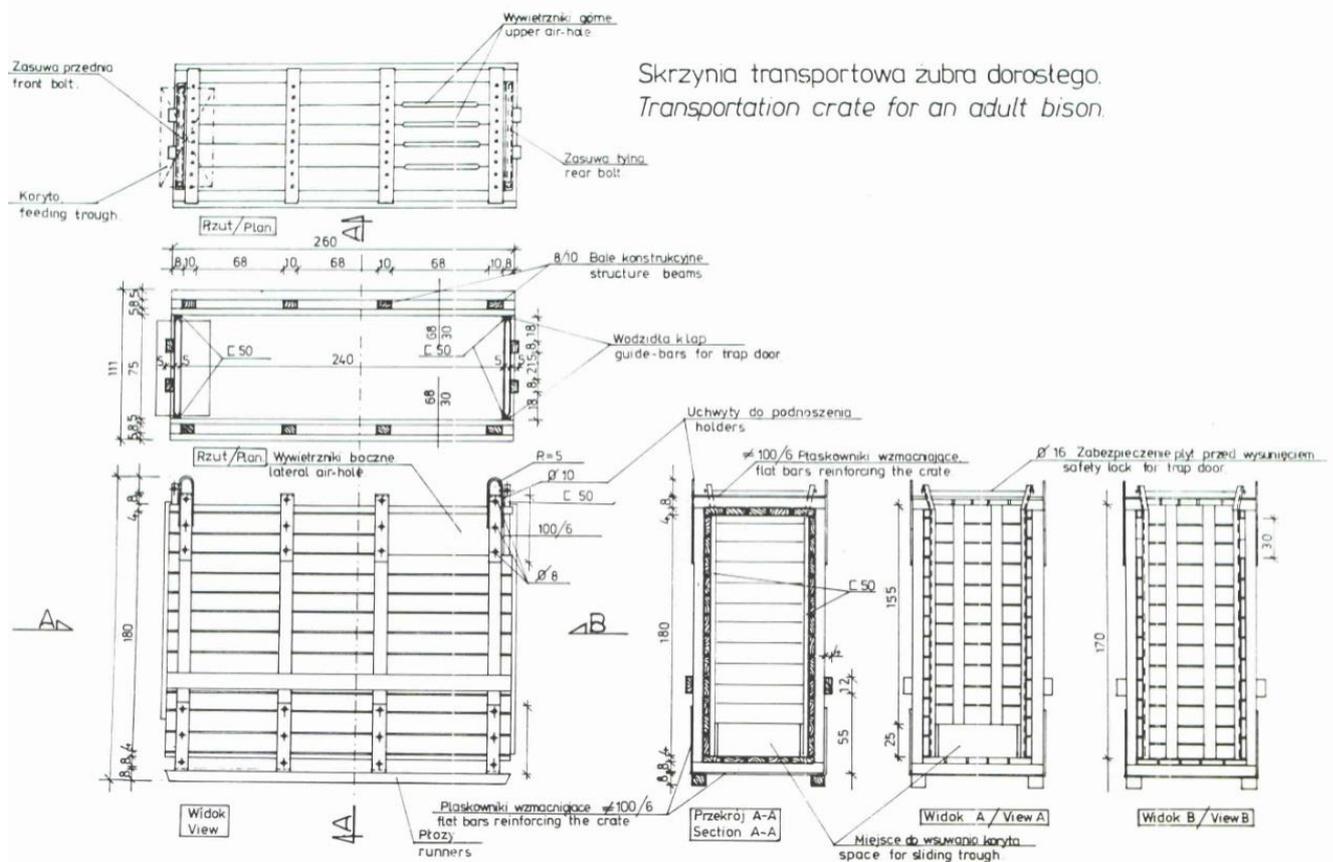


Figure 26. The construction plan for the transportation crate for the European bison

## 9. Increasing social acceptance through the establishment of educational and promotion base

European bison is a unique species of Polish fauna because, like the eagle, it has particularly strong positive associations. As early as in the Middle Ages, its image was used in heraldry as a symbol of wisdom, dignity, grandeur and beauty. Today European bison silhouette is part of the name or logo of a number of products (e.g. drinks, trucks, and soap brands) and even institutions (e.g. bank, national park, the League of Nature Conservation). This means that the direct use of the species name of this animal or its image in the project name is a powerful symbol in marketing. For example, this is in the case of "Land of European bison" conducted by the Mammal Research Institute of Polish Academy of Sciences (PAS) or European bison Days organized annually by the municipality Lutowska in Bieszczady Mountains. Also, e.g. in Romania, the action entitled "European bisonland" and events associated with the reintroduction of European bison to Vanatori - Neamt Natural Park, met with great interest and a very positive reception of the community.

In all places where European bison was introduced or where breeding and demonstration farms were established, an immediate interest in this fact and the rapid increase in tourist traffic were obtained. The best example would be a demonstration farm established at the beginning of the year 2012 in the Stuposiany Forest District, in the Bieszczady Mountains, which until now has been visited by over 40 thousand people. A European bison breeding farm is also a very important element attracting tourists to the leisure complex in Kiermusy



near Białystok. Built in the surroundings of Białowieża National Park towers and observation platforms, where you can watch grazing European bison, from the very beginning the facility enjoyed great interest. Free-living European bison are also a very important tourist attraction in the Knyszyńska and Boreckia forests and even within the Drawski polygon where the part of West-Pomerania herd moved.

Not without significance for the impact of European bison on the attractiveness of an area for tourists is also the opportunity to buy all kinds of gifts and gadgets related to this species. A model example here can be Białowieża where the wooden statues production of European bison itself is a source of income for many families, while T-shirts, mugs, key chains, etc. with the image of a European bison are available almost everywhere. Similarly, a significant part of the population of Białowieża has ensured employment in connection with the population of European bison inhabiting the area as guides, coachmen, tractor drivers, conservators of tourist facilities, and the person leading rental accommodation or employed in gastronomy.

The appearance of the European bison in the new environment is also an opportunity to carry out educational campaigns among both school age and adult population, who often do not have reliable knowledge about this species and see it through the prism of various, often false stereotypes.

With this aspect the issue of social acceptance of European bison in the communities for which the presence of these animals may be associated with measurable costs or losses is also related. While city dwellers generally perceived European bison very positively as a symbol of wildlife and important protected species - in agricultural environments which are in direct contact with European bison, especially when they occur in relatively high numbers, the presence of these animals is not necessarily seen as desirable.

It is obvious that nobody can be positively perceive a cause of partially eaten or trampled crops and damaged fences, but largely negative attitude of farmers to European bison is associated with a lack of knowledge of the procedures necessary to receive compensation or a general aversion to bureaucracy. However, as the experience from Białowieża shows, if the farmer has a pre-contracted some hay meadows area for the purpose of obtaining hay for European bison and thus a reliable and steady income, his attitude to this species changes dramatically to a very positive one. This system turns out to be competitive in comparison to the payment of compensation both in terms of cost and efficiency. For this reason, where it is profitable, the option of contracting meadows and pastures directly adjacent to the forest should be taken into consideration. Undoubtedly, this solution is not always possible. Sometimes the market value of the crop simply decides. Sometimes the presence of European bison is not desirable because of the possibility of direct conflict either with home livestock or people, as well as in the case when European bison enter the field and cross busy routes.

In such case, treatments raising the attractiveness of grazing areas within forests ought to be initiated as a first step. They should primarily rely on the creation of new or rehabilitation of existing open spaces - like natural pastures, mid-forest meadows, glades. Activities that may be mentioned here include regular mowing, liming, sowing with attractive species and even drainage. In this case it is beneficial to introduce prolonged (2-3 years) cellared clear-cutting, where, thanks to the lack of restrictions in the access to light, European bison have access to an attractive natural food in the form of undergrowth monocots, raspberries or blackberries. On clear-cuts it is profitable to leave for a while branches or crests trees from which European bison love to gnaw the bark. Recommended solution is a creation of feeding plots within a forest, which are available throughout the year for European bison, constituting an attractive feed in the form of e.g. Jerusalem artichokes or stubble turnips. Pastures of good quality, early



harvested hay, trench or crushed oats or corn may also be a good supplement. A very important element increasing the attractiveness of the habitat is also presence of salt licks and easy access to good quality watering places.

In extreme cases, e.g. a significant risk of road traffic collisions or very high burdensome damages of crops creating barriers for passages through which herds roam the fields or fragments of fencing of particularly dangerous routes may also be considered.

A very important aspect, often decisive for the possibility of maintaining the European bison within the forest complexes, is to ensure permanent peace in their refuges. In these areas, which should be clearly marked, no entry bystanders (tourists, mushroom pickers, collectors antlers) must be strictly followed and any conducts of forestry works or other necessary procedures associated with the presence of human and mechanical equipment operation during periods of European bison stay must be prohibited.

Information and promotion of activities conducive to the protection of European bison is an integral part of all projects. As part of the project "In situ conservation of European bison in Poland - the north-eastern part" signs indicating the European bison presence were set in Knyszyńska Forest (Fig. 27),



Fig. 27 Information board. The Knyszyńska Forest

as in the Białowieża Forest in the framework of Life project. Optimal places suitable for installing the panels are educational paths or the farms. Then the content contained on these boards has a chance of being studied by visitors while visiting the track. At the same time, the right markings should persuade people to try to stay on the paths and not to penetrate the European bison refuge, which is a significant problem in the Białowieża Forest. WPWS (West Pomeranian Wildlife Society) in cooperation with the municipality of Mirosławiec is realizing a project funded by the IaEP called "Releasing the European bison population in the north-



western part of Poland from the pressure of tourism". The element of preventing tourists from penetrating animal refuges is a project funded by WND-RPZP "Building of demonstration European bison farms in the municipality of Mirosławiec". This farm will be an element and a continuation of good practices of the "Program for the protection of European bison in Poland: the development and protection of the West Pomeranian herd."

Exposure farms are a very good form of education and protection against the pressure of tourism, but access to them requires additional infrastructure, without which the object does not fulfill its function. These are: good directions marking, parking for cars and for buses, information boards about the European bison also in English, covered viewing platforms with tables, benches and toilets. One can also watch the European bison by video cameras and the image may be presented for example in the covered part of the shelter. It is important for the access to the farm to be linked with the educational path.

## 10. Creation of educational base for potential European bison breeders

Environmental Education Centre in Pszczyna-Jankowice is an object prepared to fulfill a very important role - the education of future guardians of European bison. The resort is located right next to an exposure pen covering 10 hectares and surrounded by educational path. Classes can be held in the building of the old forester adapted to the organization of even small conferences. The third element which is necessary is essentially the personnel prepared to conduct the training. These three elements with some support of WAU and EBFS are located in Pszczyna-Jankowice and it is there where trainings for future breeders are conducted. The scheme of training consists of 2-3 hours of lectures on the biology of European bison (Fig. 28), threats to species, protection methods and methods for maintaining animals in captivity, including nutrition, prevention etc. One of the elements of the training is also information about the role of Pedigree Book for this species.



Fig. 28. Workshops concerning the European bison

The largest part of the training concerns practical classes in the pen and reserve. They rely on the possibility of working together with the European bison guardian, becoming familiar with fundamental principles of safety, pan procedure, the ability to observe and recognize individual animals, determining their age.

What is very important during the training is to preserve the safety rules. European bison are large and strong ruminants. They look sluggish, but can move with amazing speed and agility, but they are not tenacious runners and they tend to quickly get tired (after running up few tens of meters they stop and gasp heavily). European bison are resistant to attempts of domestication and so far man has not been able to fully tame adult European bison. European bison, kept in a closed culture are more dangerous than those living in the wild, as they largely lost their fear of man. European bison don't tolerate direct contact with people, for example. Stroking, patting, etc. emotional reactions are in fact innate, unconditional reactions. Intense stimuli can trigger emotional states such as fear or aggression. Emotions are accompanied by motor and internal reactions, involving the sympathetic nervous system and the endocrine glands. It is accompanied by fast heart rate, breathing, sweating, muscle tremor. Whole body movements indicate the nature of emotions and are revealed by a sharp wagging of the tail, burying in the ground with the front limbs, gasping. The release of emotional tension often manifests itself in the form of an attack on other animals, wallowing and even sudden interest in food. The basic action in dealing with European bison is patience and remaining calm. Scaring, chasing attempts are generally not effective.

Training courses in Pszczyna-Jankowice are implemented according to the needs and- in practice- at order and they last 2-3 days minimum, obtaining a very high rating.

## 11. Summary

This guide, is intended to be a source of basic knowledge about European bison, so for those involved in the implementation of restitution programs covering both the creation of new herds or the care and management of existing populations in the wild as well as the personnel of breeding centers and zoos maintaining European bison in captivity.

Therefore, historical stench and characteristics of the species act here as an introduction, being the basis for understanding of the current situation and a proper assessment of the risks for the European bison whether those in captivity or those staying in the wild. Gathered here most important information on the biology of the species and its requirements in relation to environmental conditions, are intended to facilitate the assessment of the condition of individuals or whole herds and of the planned breeding procedures. Knowledge of the interactions of European bison with other species and their role in the ecosystem is essential in planning the reintroduction programs. The description of the principles of European bison Pedigree Book will allow for understanding the criteria for the selection of animals for breeding and breeding quality assessments of individuals. On the other hand knowledge of the legal status and protection of European bison in the member states of the European Union is necessary to organize the exchange of individuals between breeding's and for the organization of international transport. The description of the risks both at the population level and in terms of epidemiological or anthropogenic pressure was presented in great detail, which should facilitate the rapid and precise identification and quantification of risks in specific environmental conditions. Analogously extensive characteristics of the applied and recommended methods of protection aims at bringing treatments already used to practice, but also the most effective methods according to the authors for the protection of this species.



Thus, in order for this guidebook to have as wide as possible scope of use in everyday practice and for it to be conventionally used for breeding and conservation measures, a description of best practices was posted here: examples of the selected by the authors best and most optimal methods of conduct both in terms of ex situ and in situ conservation and in terms of genetic principles, methods of monitoring, prevention and sick animals treatment, primary prevention of risk factors and reduction of damage to crops and forest stands.

In the end, finally, the issue of raising social acceptance for this species, education on the importance of European bison both for the functioning of natural ecosystems and for the protection of natural heritage, as well as the training of European bison breeders was widely discussed.

Currently, it is the only one in the world so broadly and specifically addressed compendium of knowledge on this species, as well as practical recommendations for the management and breeding of herds in the wild.

It is worth recalling that conservation actions with regards to European bison are funded from various sources. The project which was realized was funded by the European Union under the LIFE + funded mechanism; several projects were financed by EcoFundusz, many projects obtained funds from the National Fund for Environmental Protection and Water Management, together with provincial funds. Last funding is from the European Regional Development Fund under the Operational Program V Infrastructure and Environment. All of these projects are implemented by direct guardians of European bison herds, or units of State Forests and National Parks, as well as by research institutions and NGOs.

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