

Formation of Borisov-Berezinsky European bison population and its present state

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Abstract: A review of the history of creation of European bison population (*Bison bonasus bonasus*) in the vicinity of the Berezinsky Biosphere Reserve is presented. Described are the population dynamics, birth and death rates. Presented are data on the formation of the spatial structure of this population and seasonal migrations of the bison. The prospects for further existence of Borisov population, and measures necessary for its maintenance are evaluated.

Key words: *Bison bonasus bonasus*, population dynamics, spatial structure, Berezinsky Biosphere Reserve

Introduction

The European bison (*Bison bonasus bonasus* L., 1758) until XVI – XVII century was quite a common species for the northern part of Belarus. That is confirmed by the findings of its bone remains during archeological excavations in the north of Belarus in location of medieval Vitebsk settlements. According to Alexandrovich (1999), in Upper Castle of Vitebsk the share of bison in hunting bag was 21,5%, and its maximal population number was registered during XV–XVI centuries. However the question, whether in historical times E. bison inhabited the territory of present Berezinsky Reserve, is still unclear.

Geographically the reserve is located at the watershed of two large river basins: the Western Dvina which flows into the Baltic Sea, and the Dnepr, flowing to the Black Sea. Characteristic for this territory is high percentage of wetlands. Marshlands occupying the place of a big water body, which was formed at the end of the last Wurm glaciation, cover about 60% of the protected area (Geltman 1983). Dominating there sod-podzol sandy-sabulous soils of low natural fertility determine a high percentage of forests in this region. At present, forests mainly coniferous (56,2%) and marshlands (33,4%), occupy 83,3% of the total area of the reserve (Stavrovsky 1996). Deciduous forests, consisting of oak and ash, located in the flood plain of River Berezina, occur at only 0,9% of the protected area. Such forest structure has been formed about 2,5–3 thousand years ago (Luchkov 2000). For the E. bison which requires an access to a deciduous browse (Flerov 1979), and tends to avoid vast mires, such range is of little use. Nevertheless, in the first half of 1970s there

was an attempt to introduce a herd of Białowieża bison to the reserve, which initiated free-roaming Borisov-Berezinsky subpopulation of E. bison, currently numbers 35 individuals. The way of its creation and following 30-years of its existence demonstrate that human influence and agricultural activity are key factors, that determine formation of E. bison herds, as well as their spatio-temporal and behavioral characteristics. Although the E. bison is quite adaptative to various habitat conditions, the analysis of level of human influence and related risks are necessary to avoid possible catastrophic consequences. Application of such approach becomes the most urgent since at the territory of Belarus a number of free-roaming herds of E. bison was established in the 1990s, without a proper scientific background and analysis of range characteristics.

Study area

Borisov-Berezinsky free-roaming bison population lives within Borisov and Logoisk administrative districts of Minsk region. Its home range includes the territory of Borisov forestry, adjacent to the southern borders of the Berezinsky Biosphere Reserve, south-eastern part of the Reserve in the neighborhood of Lake Palik, and also a small part of the Logoisk sylvicultural hunting ground at the border of Borisov district.

Bison observations within the herd's summer habitat were performed at the territory of Palik forestry of the Berezinsky Biosphere Reserve, and at the Reserve's subordinated hunting ground "Berezina". At winter period the study was carried out at the territory of Ikon and Zembin forestries of the Borisov forestry enterprise, and also at a part of Logoisk forestry enterprise territory situated at the border between Borisov and Logoisk administrative districts reclaimed flood plain of the Cna river, and adjacent to its agricultural lands and fragmented forest tracts.

Materials and Methods

Data for Borisov-Berezinsky bison population were gathered during regular surveys of winter and summer habitats. A questionnaire on encounters with bison was distributed among the forest guards of the reserve and inhabitants of neighboring villages.

Data analysis of number, reproduction rate, herd, sex and age structure, habitat distribution and migration routes for the period 2003–2009 are based on observations of the author. For earlier period used were archive materials containing correspondence, certificates etc., that are kept in the science department of the Reserve and in Borisov forestry enterprise, as well as the books of Nature Chronicle of the Berezinsky Biosphere Reserve, and scientific publications.

The census was made on the basis of visual observations of the main herd and separate groups of animals, and also the results of snow tracking in winter. Evaluation of sex and age structure of the herd was based on direct observations. For population reproduction analysis, the birth rate was calculated as the ratio of calves born during a given year to the total population number.

Results and Discussion

History. In February-March 1974, according to the decision of Nature Protection Chief Management for reserves and hunting grounds of the Ministry of Agriculture of the USSR, to the Berezinsky Reserve transferred was the group of 5 pure blood Lowland bison, consisting of one male and four females. The aim of this introduction was the creation of free ranging herd. The animals were taken from the bison breeding station at Prioksko-Terrasny Reserve, which allowed to follow their genealogy according to the pedigree book (Table 1).

Table 1. Pedigree data of E. bison, released at the Berezinsky reserve in 1974.

Name	Sex	EBPB N°	Date of birth	Parents
Moment	♂	2448	5 June 1969 r.	Barhat (N° 913) Motovka (N° 1322)
Monista	♀	2582	13 May 1970 r.	Motylek (N° 1092) Moshka (N° 877)
Motyzhka	♀	2723	22 May 1971 r.	Motylek (N° 1092) Motorka (N° 1390)
Monna	♀	2583	23 May 1970 r.	Barhat (N° 913) Moskovka (N° 1046)
Monsta	♀	2581	12 May 1970 r.	Motylek (N° 1092) Motorka (N° 1390)

After a short stay in the enclosure, in April 1974 animals broke the fence and went to the forest. Until the autumn the herd stayed at the Reserve's territory, mainly in the neighbourhood of settlements, near agricultural fields and in flood plains of small forest streams. Later the animals crossed Berezina river and migrated towards the south-eastern border of the Reserve, from where, when winter came, moved to agricultural fields, adjacent to the protected area. In spring 1975 the herd ceased to visit the Reserve's territory and moved 20 km away from its borders to the Zembin forestry at Borisov. The mosaic structure of this area, consisting of small forest tracts with a large number of clearcuts and forest plantations intermixed with agricultural fields and meadows, provided optimal habitat for the bison.

Since all animals were born and raised in captivity, they were not afraid of people and not avoided encounters with humans. At the very beginning of its existence, the Borisov-Berezinsky population was provided with sufficient amount of supplemental food, but animals were ignoring feeding places organized for this purpose, and preferred to stay in the neighborhood of farms, eating hay and silage right from storehouses.

Despite the failures connected with the first release of the bison, the delivery of animals to the Berezinsky Reserve was continued. During 1976 from the bison breeding station at Prioksko-Terrasny Reserve, three pairs of E. bison were brought there, which were released without former acclimatisation in the central part of the reserve, when the main herd already left the reserve's borders long time ago. However, those animals did not participate in the formation of Borisov-Berezinsky population. Some of them died, and some were later removed for captive breeding. The lack of success in the second attempt to release E. bison in the Reserve caused, that their delivery there was terminated. Thus, the ancestors of present Borisov-Berezinsky population are five animals, released in 1974.

At the beginning the herd living in the territory of Borisov forestry grew up quickly. By autumn 1976 it counted ten animals, and by 1982 their number reached 20 individuals there.

Since the herd remained at the distance of 15–25 km from the Reserve's borders, regular observations, protective measures and logistics of supplemental feeding were difficult. Actually, the Reserve's administration totally lost control over the herd. Frequently they received cable messages like: "There is a herd of bison at the territory of the Ikon village, which stays without supervision and feeding, causing substantial damage to the sovkhos Zamosh'e and people. Ten ha of orchard and haystacks were destroyed. Take quick measures. Soviet of the village Ikon and sovkhos directorate". Subsequently, in November 1976, not far from agricultural fields two females were killed by poachers.

Because the situation required immediate solutions, by the end of 1976 the Chief Management for nature protection, reserves and hunting grounds of the USSR, the supervisor of the program for E. bison recovery in the USSR – M.A. Zablotsky, and the Director of the Berezinsky Reserve – U.N. Chichikin made an attempt to analyse the mistakes made in creation of a free-roaming herd at Berezinsky Reserve. However no constructive conclusions were achieved, and the Borisov population was left on its own for a long time.

According to observations done in four years after the release, the herd formed its territorial preferences, and routes of seasonal migrations resulting from foraging conditions at the Reserve. When a younger generation appeared, the resources of natural food became not sufficient for the herd, and since then regular supply of supplemental food were necessary. Thus, the crop in the fields and fodder stocks in the neighboring farms were the factors contributing to the selection of permanent home range of Borisov bison population.

A question about the future of this bison herd was brought up repeatedly at sessions of Academic council of the Reserve. Finally according to a decision of Ministry of forestry of BSSR and Chief Management of nature protection, reserves and hunting grounds of the USSR in 1982, the herd went under the supervision of Borisov forestry, with its home range occupied since autumn

1974. The forestry was obliged to compensate for the damages caused by the bison. The area penetrated by the herd was estimated at this time for about 40 000 ha. In 1987 a 6 000 ha of this area was declared as excluded from hunting. However, this prohibition was frequently broken, and a control over the herd was still badly established.

In January 1990, at the meeting with deputy chairman of the State Committee for Nature of the BSSR, was decided the establishment of a biological reserve at the territory of Borisov district for the protection of this bison herd. Due to the collapse of USSR in the following year, this decision was not implemented. On 31 January 1996, the Executive Committee of Borisov District made a decree "About establishing a reserve of local importance to breed Byelovezha bison" at the territory of the Zemin forestry, with the area of 8 325 ha. In September 1999, at the meeting with chairman of Executive Committee of Borisov District, a decision about passing this territory to the Berezinsky Reserve was undertaken. In the following year however, the hunting ground "Berezina" under the authority of the Reserve was established, and the declared protected area ceased its existence. At the same time cancelled were, existing since 1982 positions of "bison rangers", taking care about the herd and its observations.

Hunts for foreign hunters in Belarus, went into practice in the mid 90-s, and negatively influenced the Borisov population. In winters of 1994 and 1995, 3 adult animals – 2 males and a female were culled upon the pretext of selection. The quality of selective criteria can be judged by the fact that bagged cow was pregnant. The same situation took place also in winters 2001 and 2002, when foreign hunters shot five more bison, again including a pregnant female.

"State program of preservation, settling and use of E. bison in Belarus" implemented in the country at the end of 1990s also had no influence on the condition of the Borisov population. Plans to connect the home range of the herd to the Reserve's territory failed, and even a decrease the inbreeding level (a value of its coefficient according to Kashtalian *et al.* 2006 reached 0,335) was not taken into consideration.

Nevertheless, some positive changes for the Borisov population were achieved, including an introduction of regular winter feeding, financed by the Borisov forestry, Ministry of Natural Resources and the Berezinsky Reserve. As a result a number of bison visits to forage stores for cattle and private farmlands in surrounding villages decreased significantly. There was no incident of death due to emaciation recorded between 1988 – 2003.

Since 1999, the administration of the hunting ground "Berezina" became responsible for the herd protection and its routine survey, however only to a certain degree. Needs of hunts for foreigners prevailed over preservation measures established for the Borisov population. The level of disturbance has increased. Animals often escape winter feeding stations even when they are

stocked with forage. Migrations of the herd to the territory of nearby Logoisk district and the hunting ground of BSHF (Belarusian Society of Hunters and Fishermen) became common. In 2005, the area of winter home range of the bison was included into a newly formed hunting ground of a Sport Club of Trade Unions Federation of Belarus. Its administration refused to share responsibility for the bison condition with the reserve. And although in the beginning of 2008, a protected area with a status of a local reserve has been reactivated at this territory, there was no improvement in the state of winter ranges of Borisov-Berezinskaya population in last two years. Implementation of protective measures and delivery of winter food for the herd is complicated because of the distance between winter ranges of the herd and the Reserve. Hunts organised at the hunting ground scared away bison from feeding areas. Activities foreseen for the reserve remain only on the paper.

Population dynamics, birth and death rate. A number of authors (Karcov 1903; Dinnik 1910; Severcov 1940; Geptner *et al.* 1961) maintain that in free ranging bison populations a birth of calves takes place only once in two – three years. As the reason they mistakenly give a long lactation period (Wróblewski 1927) or being more realistic – the availability of food (Karcov 1903).

Data on Borisov population show that during first years of its existence (1974 – 1980) (Table 2) females had young not every year. There were periods when calves were born every year, and periods when they were born every second year. The proportion between the number of females and males among newborn calves was almost 1:1 (5 males and 7 females were born during this period).

By the autumn of 1981 a total number of animals in this population reached 15 individuals including 2 adult males and 5 females. Annual growth rate was at the level of 10–18 %. Mortality was low – two females were killed by poachers and one orphaned calf died.

During those first years of the herd existence calves were born by the founder females, and only in 1979–1980 by females born in freedom, which reached the puberty. The birth rate expressed as a ratio of females in reproductive age, reached then 50–75 %. This high figure can be explained by rather stable foraging conditions in first winters, when the animals were not afraid of people, and regularly visited forage stocks and farms in local villages. Gradually they became more careful, and avoid close contacts with a man. At this time the reproduction rate of the herd decreased, and calves were born in 2–3 years intervals.

During the period between 1981 – 1988 the number of bison almost did not change. With 7–8 reproductively active females, birth rate did not exceed 2–3 calves. Death rate however significantly increased. During 8 years recorded were 12 confirmed cases of bison death. The destiny of other animals that disappeared from the herd is unknown.

The creation in 1987 an area excluded from hunting within herd home

Table 2. Population changes of the Borisov population of E. bison between 1974–2008

Year	Total number (for December of the given year)	Change in %	Newborn animals	Confirmed case of death	Birth rate (% of the total number of herd)
1974	5				
1975	7	+40,0	2		40,0
1976	10	+42,9	3	3	42,9
1977	8	-20,0	1		10,0
1978	11	+37,5	3		37,5
1979	13	+18,2	2		18,2
1980	15	+15,4	2		15,4
1981	17	+13,3	2		13,3
1982	20	+17,6	3	1	17,6
1983	18	-10,0	0	2	0
1984	18	0	3	1	16,7
1985	17	-5,6	2		11,1
1986	19	+11,8	3	3	17,6
1987	18	-5,3	2	2	10,5
1988	20	+11,1	5	3	27,8
1989	22	+10,0	5		25,0
1990	25	+13,6	3		13,6
1991	31	+24,0	6	1	24,0
1992	34	+9,7	4	1	12,9
1993	34	0	3		8,8
1994	34	0	3	3	8,8
1995	33	-2,9	2	2	5,9
1996	35	+6,1	4	3	12,1
1997	37	+5,7	5	1	14,3
1998	36	-2,7	0	1	0
1999	37	+2,8	2	3	5,6
2000	36	-2,7	2	1	5,4
2001	35	-2,8	0	4	0
2002	35	0	4	2	11,4
2003	35	0	2	2	5,7
2004	37	+5,5	4	1	11,4
2005	37	0	1	1	2,7
2006	37	0	1	0	2,7
2007	39	+5,3	2	1	5,4
2008	38	-2,6	0	3	0
01.01.2009	35				

range, has positively affected its number. A main factor was the regular feeding at winter ranges of the herd. During the period 1988 – 1992 a number of animals increased almost twice – from 19 to 34 individuals. Apart from appearance of young animals, decreased the mortality. In winter ranges between 3 – 6 yearlings were annually recorded, and most of them successfully reached the puberty.

Situation of the Borisov population in the 90. reflects economic and social troubles, following the breakdown of the USSR. Weakening protective measures, administrative-territorial changes, problems with organization of winter feeding, introduction of bison hunts for foreigners, decreased the growth rate of the herd which numbers stabilized at the level of 34–37 individuals. Although a birth rate remained slightly higher than natural death rate, the growth rate of the herd was affected by commercial hunts. This situation also negatively affected the sex ratio. Until May 1st of 2003 the Borisov population counted 27 sexually mature animals, including 20 females and only 7 males. Among them only two bulls at the age of 7–12 years took part in reproduction. Younger and older males were absolutely excluded from reproduction by them, and as a rule stayed alone or in small bachelor groups. Among the young up to 4 years old were 6 females and 1 male. Such sex ratio remains until now – 25 females, and 5 males in reproductive age.

During the 90s despite a large number of potentially fertile females, usually less than 4–5 yearlings were recorded, sometimes only 2–3. There were no calves recorded during winters of 1998, 2001 and 2009. Since the birth of bison calves usually takes place at inaccessible areas, the estimation of total birth rate is impossible. The first data on the number of calves in a given year can be obtained not earlier than in late autumn when animals appear in their winter ranges. Therefore a number of newborns could be higher, however not all of them survive the first months due to predators' pressure, genetic problems connected with a high level of inbreeding in the population, and poaching.

A number of authors (Karcov 1903; Geptner *et al.* 1961; Kalugin 1968; Bobyr' 1992) indicated an ability of adult bison to protect successfully themselves and young animals from large predators. The bison from the Borisov population have to confront predators, the bear and the wolf, only at summer ranges. During the survey in July –September 2003, within the southern parts of the Reserve, where the most part of the herd was concentrated, we repeatedly noticed intersection of bison tracks with tracks of bears. However the bison did not leave the selected territory when a predator appeared there, neither changed the routes of their regular migrations. During the existence of the Borisov population we were aware of only one case of three-years-old calf death, being attacked by wolves. The animal was killed by a pack of wolves in September 1999 in the forest track near the borders of the Berezinsky Reserve.

During the Borisov population existence the total number of documented cases of the bison mortality is 44, out of which 22 to a certain extent were connected with human activity (Table 3). The reason of another 8 cases was not determined.

Table 3. Mortality rate and reasons of death for the Borisov population of E. bison for the period 1975–2008

Reason of death	Number of dead animals	Adults	From 1 to 4 years old	Calves
Poaching	7	6		1
Poisoning	3	1		2
Dead during the transport	2	1		1
Selective shooting (including foreign hunters)	10 (8)	10 (8)		
Killed by predators	1		1	
Diseases	3	1		2
Injuries	1	1		
Exhaustion	3			3
Stillbirth	1			1
Natural mortality	4	4		
Drowned	1	1		
Unknown	8	4		4
Total:	44	29	1	14

Of 80 bison calves born in this population (the birth of which was exactly determined) 14 died in the first year of life. Among animals at the age of 1–3 years, only one case of death was noticed. However while defining the age of animals observers often made mistakes, and dead young bison could be counted as adult animals. This category counted 29 individuals in the Borisov population.

Lavov, Voronova (1982) and Kozlo *et al.* (1996) report on the duration of calving season in the Borisov population. Similar tendency was frequently observed in other free or semi free bison herds. The latest calving recorded in the Belovezha Puscha are mentioned by Kulagin (1919) and Korochkina (1971). Zablotsky (1939) wrote about the duration of the rut for bison from Askania-Nova, and about the bison from the Caucasian reserve – Kalugin (1958). Information, that almost one third of bison calves in the Borisov population are born from September to November (Kozlo *et al.* 1996) seem to us not to represent the facts. However calves much smaller than other typical for this age group are frequently noticed at wintering ranges. There are records of: a calf born at the end of August 1980 (Lavov, Voronova 1982), two calves – at the beginning of autumn 1990. In winter 2003 we noticed a calf much smaller than other animals younger than a year. Obviously mortality among such late-born bison calves is high, and death of most of them happens during the first weeks of their life. However some records indicate that part of them have reached adulthood.

Late birth is an effect of a prolonged rutting season in the Borisov population. It begins at the first half of August when the majority of animals inhabit forest tracks at the territory of the Berezinsky Reserve. Rutting ends in October–November after the animals' return to the winter ranges. Our observations show, that a male taking part in reproduction, during autumn migration follows female group, and arrive to the winter ranges in the same group. Other males are not allowed to join female groups. Females with young and individuals that do not take part in reproduction move towards winter ranges in separate groups.

Herd instinct. It is typical for this species to form groups that count from 3–4 to 50–60 individuals (Geptner *et al.* 1961; Baskin 1976; 1979). Smaller groups are more stable, but larger do not exist for a long time, and as a rule are connected with definite stations (Wróblewski 1927). There is no close kinship among animals in a group, although hierarchical relations are well expressed (Geptner *et al.* 1961).

After three years of the existence of the Borisov population animals remained in one group. A male moved away from females only in April 1977. The first division between females and young animals happened in winter 1977–1978, and was caused by the old male aggression towards one calf. Animals formed two groups with 5 individuals in each of them (Lavov, Voronova 1982) but by the autumn they gathered into one herd.

By winter 1979–1980 there were two mature males in the herd. An older bull (11 years old) was driven out of the group by younger competitor and stayed alone through all winter. However in the rutting period he was a dominant in the herd. The young bull kept separately during this time.

From the beginning of the 80s at late-autumn and winter periods, especially with deep snow cover, bison grouped in a large herd that in spring and summer divided into smaller groups, of defined sex – age composition and family relations (mother – calf). Such groups lived separately for a long time, not mixing with each other.

By the mid 90s a formation pattern of winter groups has changed significantly. In spring-summer period with the beginning of vegetative season bison split into small groups (less than 5–6 individuals), consisting of as animals of different sex and age. With the beginning of winter and establishment of snow cover bison formed two large groups, counting from 10 to 19 individuals. As a rule one such group was formed by an adult male and some females, that took part in the rut but did not lead young. Essentially they make up reproductive potential of the population for the next year. The second group was formed by adult females and young animals at the age up to 4 years as well as some old females not participating in reproduction. Either alone or in small groups separated from the main herd were young and old males, driven away by stronger competitors and without significant role in reproduction. Permanent exchange was observed between the groups consisting of females and young, but adult males stayed away from the main herd for the whole winter. Only in spring before the seasonal migration they could join females. Then, animals formed small groups of 3–7 individuals which were

moving to their summer habitat. According to our data, groups formed in this period are quite stable, though there is a constant exchange between them.

Karcov (1903) maintains that bison strictly stay with their herd, and neither migrate to other one, nor meet strangers if possible. Our observations disprove this opinion. There is intensive exchange of animals between herds and group composition changes.

Spatial pattern and seasonal migrations. At first, a selection of a home range by the Borisov-Berezina population was accidental. In the first winter after the release most important was relatively high accessibility of forage at the Borisov forestry. Since herd founders were raised in captivity a disturbance factor was of secondary importance.

After a year animals moved in to the third part of the territory, which the herd inhabits until now. During the first two years they did not travel far, occupying relatively small area, making short trips between agricultural fields and farms, but during hot periods moving to the territory of the Berezinsky Reserve. Bison penetrated the nearest areas quite fast. Reportedly (Lavov, Voronova 1982) by 1980 they reached meliorated flood plain of the Can river at the border of Borisov and Logoisk districts. Until now this area is the farthest point of the herd's penetration in south-eastern direction. By the mid 80s the territory inhabited by bison reached its maximum size and since then has not changed a lot. At present time it is divided into two (western and eastern) parts situated 20 km from each other.

The western area is bordering from the south-west the Berezinsky reserve. It consists partially of protected forest tracks of the Borisov forestry and agricultural fields near the villages of Korsakovichy, Budenichy, Selec and Borovljany. This territory is used by the population in spring and summer period from May until October. Young are born here, and bison are rutting there between August-October.

From November until April bison stay at the territory situated near the river flood plain in neighborhood of the villages of Gancevichy and Pogranich'e. This area due to its topography is the most optimal for the herd's wintering. Small forest tracks interchange with the plots of agricultural fields, and there is a large amount of overgrown cuts.

The total home range of the Borisov population is about 7.5 thousand hectares. However not whole of this territory is used by the animals with the same intensity. The total area of sites of summer and winter concentration is smaller than 3 000 ha.

The herd's movement to summer ranges begins about two weeks after the melt of snow cover. Before migration bison stay in large groups of 20–25 individuals and in the day they visit fields with winter crops situated in the neighborhood. Gradually small groups of 3–7 animals are being formed and start the movement towards the west. They cross the distance of 15–20 km in 10–15 days. While migrating, they follow forest tracks which make a continuous

corridor between western and eastern parts of the range. The animals move along permanent migration routes that stay unchanged for many years.

Winter migration begins from the mid October and can last to the beginning of December. As in spring, the crossing takes 10–15 day. The level of disturbance has a key meaning for spatial distribution of animals in winter ranges. If the animals are not disturbed they can spend the most of winter at the small area close to feeding stations, moving away for less than 200–200 meters per day. Intensive hunts for ungulates taking place from October until the mid January strongly affect spatial distribution of bison. The animals seldom visit open places, and often leave the area of feeding stations, towards the area of the reserve. If natural food supply is sufficient bison may stay at the reserve for the whole winter long until migrations to summer ranges.

Such migration pattern was more characteristic for Caucasian bison (Nemcov *et al.* 2003), than to lowland populations of Belovezha line. Filatov (1910, 1920) for Caucasian bison, reported human pressure as the main reason for animals' movements. In case of Borisov-Berezina population we indicate increased disturbance in winter ranges and the need for appropriate places for calving. The accessibility of natural forage during the summer time is of secondary importance.

Conclusions

There are four main periods in the growth of the Borisov-Berezina E. bison population:

- Primary population growth between 1975–1981 mainly due to reproductive potential of the founder females;
- Period of stability between 1981–1988, coinciding with reaching the sexual maturity by the 1st and 2nd generation of free living bison, accompanied by a decline of food supply and increase of animals' mortality;
- Brief period of sudden increase of the herd in 1988–1992, caused by an improvement of protective measures and regular provision of supplemental forage in winter;
- Long period of stability between 1992–2008 connected with poor management, an increase of disturbance and higher mortality rate due to poaching and hunts for foreigners.

Thirty years history of this population prove that the animals successfully managed to adapt to environmental conditions, developed a pattern of seasonal migrations. Generally, agricultural activities at winter ranges of the herd habitat are a leading factor determining the formation of spatial – temporal and behavioral characteristics of the Borisov-Berezina population. In the fifth-sixth generation after the formation of the herd some symptoms of inbreeding depression have appeared, like a low birth rate of calves and the ratio of fertile females (Kashtalian *et al.* 2006). This can be mitigated by

supplementing this population with individuals from other herds of Lowland line. However this depends on the development of the "Program for preservation and conservation of E. bison", accepted for the period 2009–2013.

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