

## Primary search of woodlands suitable for free ranging *Bison bonasus* populations in Ukraine

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**Abstract:** Since 1990, Ukrainian population of European bison (*Bison bonasus* L.) has diminished three-folds. Presently the problem began to attract due attention, and restoration of bison became a priority in national environmental policy. Taking into account optimal habitat size, we used GIS Arc/Info 8.1 to screen Ukrainian and adjacent woodlands for territories where subpopulations of the species could exist in regard to forests' sizes and densities of settlements and roads. Several other parameters were also included in the study. We found 4 inland and 6 transboundary territories, fit for maintaining a hundred bison each, and 3 transboundary territories with carrying capacity about 1000 heads each. A thorough environmental assessment is required to determine which of these areas are suitable for developing or creating new bison populations.

**Key words:** European bison, *Bison bonasus*, habitats, GIS, viable subpopulation, restitution

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### Introduction

Ukrainian population of European bison (*Bison bonasus* L.) is dwindling. Since 1990, it has decreased three-folds (Boreiko, Sesin 2007; Kryzhanovsky 2007), being unanimously overlooked by officials and scientists, and feasted upon by poachers. To develop some course of action, it is necessary to analyze future prospects of restitution and introduction.

An important task is to assess whether the habitat quality is enough to sustain new or expanded populations according to the international criteria for species' survival. In Soviet times, the principle was to create as many populations as possible, with little regard as to where and how it was done. Ministry of Environmental Protection of Ukraine lost the Archive of bison husbandry, with all the data on assessment and description of lands. It happened that the selected habitats sometimes allowed the continued growth of livestock, as in the cases of Daniv (Chernigiv oblast), Uladiv (Vinnytsa oblast), Volyn, and Chernivtsi populations, which exceeded the threshold of 100 animals.

Some data on ecological preferences of bison, estimates of required acreage and possible sites for bison settlements can be found in the Action Plan for European bison (*Bison bonasus* L.) Conservation in the fauna of Ukraine (Kryzhanovsky 2007). But this plan is just a frame. It contains general information and recommendations, but no specific implementation dates,

undertakers and funding. We used the GIS program to review the list of Ukrainian lands, searching for territories, suitable for maintaining European bison. The aim of this work was to identify natural woodlands fit for short-and long-term existence of bison.

To achieve this goal, the following objectives were set:

- To determine the acreage needed for the short-and long-term existence of bison populations, based on international experience of bison breeding.
- To examine, using GIS, the distribution and quality of sufficiently spacious woodlands in Ukraine, taking into account density of settlements, roads, swamps and river network in order to select the most promising areas for further research.

## Materials and Methods

To assess the size of territory, needed for the establishment of viable bison population, it was necessary to determine such population. We analyzed some publications about acreage per animal in several existing populations of European bison (Zablotsky, 1974; Sipko, Kazmin 2004; European Bison Pedigree Book 2007; Kryzhanovsky 2007; Bozik 2008; Tracz et al. 2008; Krasieńska, Krasieński 2004, 2008; Perzanowski et al. 2008; Perzanowski 2009).

These estimates, along with the general notions that bison is a sylvan animal and that most of its European populations inhabit woodlands, allowed us to conduct a GIS analysis using Arc/Info 8.1 (a full-featured geographic information system by ESRI) to identify suitable woodlands both inland and bordering Ukraine. We used the following layers of the digital topographic map of Ukraine (1:200 000): administrative boundaries, forested areas (the layer covers territory of Ukraine and nearest areas of neighbour countries), rivers, lakes, swamps, roads and settlements.

Firstly, we evaluated the area of all woodlands. Then, we selected those spacious enough to support a viable bison population of 100 to 1000 heads. Taking into account eventual conflicts (bison versus farmers & poachers) and road-killings, we calculated settlements' and roads' density (SRD) in Arc/Map (extension of Arc/Info program) on the scale from 1 to 9 points. We chose then woodlands that had SRD 4 or lower. Also, densities of swamps and river net were analyzed, because the habitat should have enough fresh water without being waterlogged. Selected territories and their SRD values are listed in Table 1. If a large territory fell into several SRD zones, only the parts with SRD 4 or lower were considered suitable.

## Results and Discussion

### Population/area ratio

According to Polish school of bison husbandry, free bison herds can be created in all territories that remained in natural conditions, taking into

consideration their capacity. The population must be no less than 100 individuals to reduce the risk of losing genetic diversity (Kraśńska, Kraśński 2008). According to European Bison Pedigree Book 2005, Polish Białowieża and Bieszczady populations meet this criterion. In Polish publications, we could not find a precise acreage estimate. We derived these values from the reported population sizes, resulting in 1 bison per 125 to 600 hectares; so on average one animal should have near 300 hectares or 3 sq. km of grounds. Belarusian approach is similar to the Polish one (Kozło 1999; Bunevich 1999).

Some Russian specialists think that according to the 50/500 an effective population size of 50 individuals guarantees short-term survival (the effective size for ungulates is 25–30% of the total population). At the same time, creating such herds is inadvisable, because long-term preservation of bison can be provided by 1000–5000 heads (Sipko, Kazmin 2004). Ukraine doesn't have such populations. In Poland the most promising populations are Białowieża (approximately 400 heads now and maximum size of 500, (Kraśńska, Kraśński 2008)) and Bieszczady (286 and 400 animals, respectively (Perzanowski 2009 and pers. comm.)). Larger herds are possible only in the Caucasus, where the territory allows up to 5000 heads. According to Russian estimate of one bison per 2 to 10 sq. km (Sipko, Kazmin 2004), to create a population of 1000 individuals we would need 9–12 thousand sq. km.

It coincides well with our previously obtained assessment on the basis of Polish data (1 bison per 3 sq. km), and so we propose for short-term survival of 100 individuals – 300 sq. km, for long-term maintaining of 1000 specimens – 3000 sq. km.

### Search for habitats

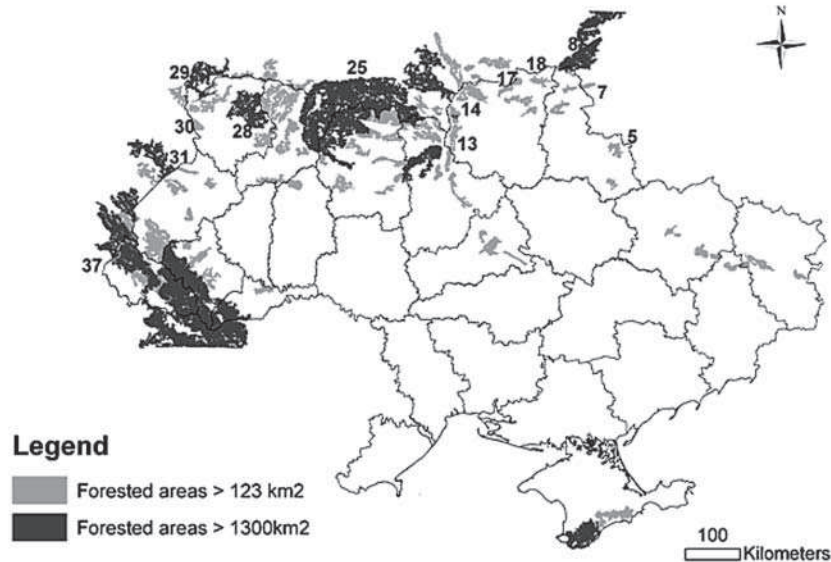
Analyzing Ukrainian woodlands, we chose all forested territories larger than 123 sq. km (minimal required size for 40–100 specimens), and those larger than 1300 sq.km (500–1000 specimens) (Fig. 1). We selected 38 territories.

Taking into account their SRD values, we selected 13 territories (Table 1):

1. Four inland woodlands, suitable for existence of near 100 bison each: (forests near river Psel (Sumy region); Mizhrichenski forest (Kyiv and Chernigiv region); forests between Semenivka and Schors settlements (Chernigiv region); forests to the north of Novgorod-Siversky (Chernigiv region).

Theoretically, the forests to the north of Novgorod-Siversky (area 18) can hold only 70 bison, but according to Polish data (Kraśńska, Kraśński 2008) and the derived density of bisons in Białowieża, a herd of a hundred animals is quite real.

2. Six transboundary territories capable of supporting more than 100 bison: (forest near river Ivotka, Sumy region + Russian forests near Sevsk (Russia, Bryansk region); Desnyansko-Starogutski forests of Ukraine united with Bryansk forests of Russia (including Russian Nature Reserve “Bryanski les”); Ripkinski and Gorodnyanski forests of Chernigiv region with adjacent



**Figure 1.** Woodlands suitable for creating free-ranging populations of European bison in Ukraine  
 Note: number on the map is the number of analyzed area. It corresponds with the number of area in Table 1.

Byelorussian ones; Tsuman forest (Volyn region) and Belarusian ones; Forests of Volodymyr and Luboml districts of Volyn region and Bialopole forests of Poland (including Strzelecki Landscape Park); Rava-Ruska forests (Lviv region) and Lubachyvski forests of Poland (including Poludnioworoztoczanski Landscape Park).

As for quality of bison habitats in Tsuman, Bukovyna and Skolivski Beskydy (where nowadays exist bison populations), they are suitable for populations of near 100 specimens. However, if combined with adjacent territories, they could hold populations of 1000 heads:

3. Three transboundary woodlands suitable for populations over 1000 specimens: Carpathian forests including existing Bukovyna and Skolivski Beskydy populations and adjacent grounds in Poland, Slovakia and Romania; Shatski forests (Volyn region) and areas of Poland (including Sobiborski Landscape Park and Poleski National Park); Polesye woodlands of Rivne and Zhytomyr regions at the border with Belarus.

Also, there were Chernobyl Zone and Crimean mountain forests in the list of suitable territories. As for Chernobyl, the radiation factor forces us to reject this area as a perspective territory. Not one of the few attempts made in XX century to settle thoroughbred bison in Crimea was to any extent successful, and the last one (1972–73) led to numerous conflicts, after the bison had been left on the northern slopes of the Crimean mountains in Bakhchisaray district. In 1980, these 20 animals were evacuated to Chernigiv region (Dulickij 2001; Kryzhanovs'kyj 2007). Also, Crimea is a popular resort area and settlements here are quite dense.

**Table 1.** Woodlands suitable for creating free-ranging bison populations in Ukraine

N° on the map	Territory	Area, sq. km	Number of bisons	A	B	C	D	E
5	Forests near river Psel, Sumy region	270	90	4	5	3	3	2
7	Forests near river Ivotka, Sumy region + Russian forests near Sevsk	120+120 (in Russia)	40+40 (in Russia)	2-3*	5-6	3-5	3-6	1-2
8	Desnyansko-Starogutski forests of Ukraine united with Bryansk forests of Russia (including nature reserve "Bryanski les")	162+700 (in Russia)	54+233 (in Russia)	2	6	2-3	4-6	1
13	Mizhrichenski forests (Kyiv and Chernigiv region)	489	163	3-4	6	4-8	5-6	2-7
14	Ripkinski and Gorodnyanski forests of Chernigiv region and adjacent Belarusian woodlands	400+1000 (in Belarus)	133+333 (in Belarus)	3	6	2-3	5-6	1
17	Forests between Semenivka and Schors settlements (Chernigiv region)	350	117	3-4	6	2-3	6	1
18	Forests on the north from Novgorod-Siversky (Chernigiv region)	231	77	3	5	3	6	1
25	Polesye woodlands of Rivne and Zhytomyr regions at the border with Belarus	10000+8000 (in Belarus)	3333+2667 (in Belarus)	2-5	7-8	4-6	4-9	2-6
28	Tsuman forest (Volyn region) + Belarusian ones	733+700 (in Belarus)	244+233 (in Belarus)	3-5	6-7	4-7	8-9	2-4
29	Shatski forests (Volyn region) + areas of Poland (including Sobiborski Landscape Park + Poleski National Park)	7000	2333	2-4	5-7	2-5	5-9	1-3
30	Forests of Volodymyr and Luboml districts of Volyn region + Bialopole forests of Poland (including Strzelecki Landscape Park)	270+90 (in Poland)	90+30 (in Poland)	4	7	4-5	7	2-3
31	Rava-Ruska forests (Lviv region) + Lubachyvski forests of Poland (including Poludnioworoztoczanski Landscape Park)	200+700 (in Poland)	67+233 (in Poland)	2-6	6-8	3-6	2	4-6

Table 1. (cd.)

N° on the map	Territory	Area, sq. km	Number of bisons	A	B	C	D	E
37	Carpathian forests (with territories of Bukovyna and Skolivski Beskydy populations) + adjacent grounds from side of Poland, Slovakia and Romania	20000	6667	2-8	5-9	3-6	1	2-5

Note: For each selected area the theoretical number of bison was calculate according to the estimate – 3 sq. km for 1 bison; A-E – density of analyzed objects; evaluated in points from 1 (the lowest) to 9 (the highest)

A – density of settlements

B – density of rivers

C – density of roads

D – density of swamps

E – density of big roads

\* Some large areas fall into several zones, in which case there are 2 numbers in the table: a-d. It means that territory covers zones with SRD from “a” to “d”. In this situation, we selected as suitable parts of the territories, which have SRD 4 or lower.

However, some territories where the bison currently live or have been recently extirpated weren't picked: Konotop forests and Khmilnik forestry (Uladiy population), forests near River Styr in Lviv region (Lopatyn population) and southwestern forests of Chernigiv region (Daniv population, poached into extinction). SRD here exceeded 4 points.

On one hand, it may be partially explained by the limited facilities of available maps, and on the other hand it may be due to the ability of bison populations to inhabit areas with denser network of settlements and in forests smaller than calculated necessary for viability (Konotop population occupies only 270 sq. km, and the SRD is 5). Here, bison possibly use adjacent meadows and arable lands. Moreover, bison seasonally change stations, as in Bieszczady (Perzanowski *et al.* 2008), thus it may be essential to separately search for areas supporting bison in summer and in winter.

So, the next stage of the research should be a rigorous study of relevant habitat conditions on territories known from previous Ukrainian bison husbandry and suggested in our survey.

## Conclusions

We found 4 inland woodlands in Ukraine, which are capable to hold nearly 100 bison, 6 transboundary ones capable to hold more than 100 bisons each, and 3 transboundary woodlands suitable for populations exceeding 1000 specimens.

Also, some territories where Ukrainian bison populations exist (Konotop, Uladiy, Lopatyn) or have existed until recently (Daniv population) were not chosen. This can be explained by insufficient quality of available cartographic materials used in geospatial analysis and the possibility of bisons inhabiting

areas with denser network of settlements and/or smaller than estimated forests for their viable survival.

In any case, selected territories are worth to be rigorously studied for the purpose of relevant environmental factors to determine the prospects of creating new or maintaining existing bison populations.

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