

## A dispersal rate in a wisent population of Bieszczady Mountains

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**Abstract:** In the western subpopulation of wisents inhabiting Bieszczady Mountains, analysed was a tendency for the extension of a home range to the north. In studied period (2001–2008) the northern boundary of the home range was annually expanding on average by 2.6 km, which is much faster comparing to first 20 years after the establishment of this population (0.7 km per year). The total home range area of this subpopulation (between 2001 – 2008), grew up from about 140 to over 300 km<sup>2</sup>. This subpopulation is not restricted by habitat limits, and potential migration routes to the west and east are not blocked by any significant natural or man-made barriers. Wisents migrating north, encounter increasingly altered habitats and frequent presence of people. Probable explanation for such tendency of range extension to the north is the occurrence of favourable climatic conditions in valleys situated at low elevations, and high abundance of brambles in pine stands, established at former agricultural area.

**Key words:** wisent, *Bison bonasus*, Bieszczady, dispersal, home range

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### Introduction

Sedentary animal populations generally disperse in response to growing population numbers/density, and/or in reaction to deterioration of living conditions (e.g. habitat decline) (Gese, Mech 1991; Kendall *et al.* 2000; Tischendorf *et al.* 2005; Kojola *et al.* 2006). Population of wisents (*Bison bonasus*) in the western part of Bieszczady that was created by the end of the 80-ties, demonstrates a continuous increase in last 10 years (Perzanowski, Paszkiewicz 2000; Perzanowski *et al.* 2006). At the same time observed are changes in the area of the population annual home range, but the most obvious is a gradual expansion of this population towards the north.

This tendency is not desirable, in the context of planned increase of this population, until it would reach effective numbers, safe for its long term viability. Further extension of the population range northwards, would mean an intrusion of wisents into increasingly densely populated area, which will inevitably initiate conflicts with local landowners, road traffic etc.

The aim of this paper was to assess the rate and a direction of expansion of this population, and discuss possible reasons for such tendency.

## **Study area, Material, Methods**

The analysis of changes in a distribution of a wisent population was performed for so called western herd of Bieszczady, inhabiting the area administered by forest districts of: Baligród, Komańcza, Cisna and Lesko. This population was initiated in the late 80-ties of XXth century, by a gradual release of animals belonging to Lowland-Caucasian line, brought for the acclimatisation from various breeding centres of Poland to the enclosure at Wola Michowa (Komańcza Forest District). The population is monitored since 1998 (Perzanowski 2001; 2005; 2008), but for this analysis used were data obtained since 2001, i.e. the launch of a project on a continuous monitoring of Bieszczady wisent population in a cooperation with a Directorate of State Forest Administration at Krosno.

The assessment of population home range was based on data on wisents' presence, collected during random, as well as routine field observations, and with ground telemetry of 5 individuals being radiocollared at this area. In total, 21588 records of wisents' presence were used. Home range size, a distance from the acclimatisation enclosure, and the farthest wisent location recorded in consecutive years to the north, were analysed with ArcView 9.2.

## **Results**

Generally, in both measured parameters i.e. home range size and the distance from the acclimatisation enclosure (the point of the release to the wild) a growth of their values between 2001 and 2008 was observed. At the same time, also bison numbers in the western part of Bieszczady increased from 140 in 2001 to 271 animals in 2008 (Table 1).

The home range of this subpopulation grew up from almost 143 sq.km in 2001 to little over 300 sq.km in 2008, however in 2004 recorded was a sudden drop from over 240 sq.km in the preceding year to about 70 sq. km. Nevertheless, a year later the tendency for an extension of home range reappeared, and since then a steady increase of its size can be observed (Table 1).

A distance measured between the acclimatisation enclosure, where from founders of the herd were released to the wild in 1980, and the farthest locations to the north of a wisent's presence recorded in consecutive years, grew up from 14,65 km in the first year of the study to 35,89 km in 2008. It means, that in first 20 years after the release, a tendency for extension of the home range to the north was rather weak, on average about 0.7 km per year. In first few years, wisents tend to stay around the enclosure, especially during winters. During the studied period however, a distance between farthest locations recorded to the north in consecutive years was very variable, ranging between 0.7 km in 2005 and 5.33 km in 2003. On average, between 2001 and

**Table 1.** Population numbers, home range area, population density, "E" – farthest distance to the north from the release site (the acclimatisation enclosure), and "D" – a distance between the farthest points to the north, reached by the western population of Bieszczady wisents in consecutive years of the study.

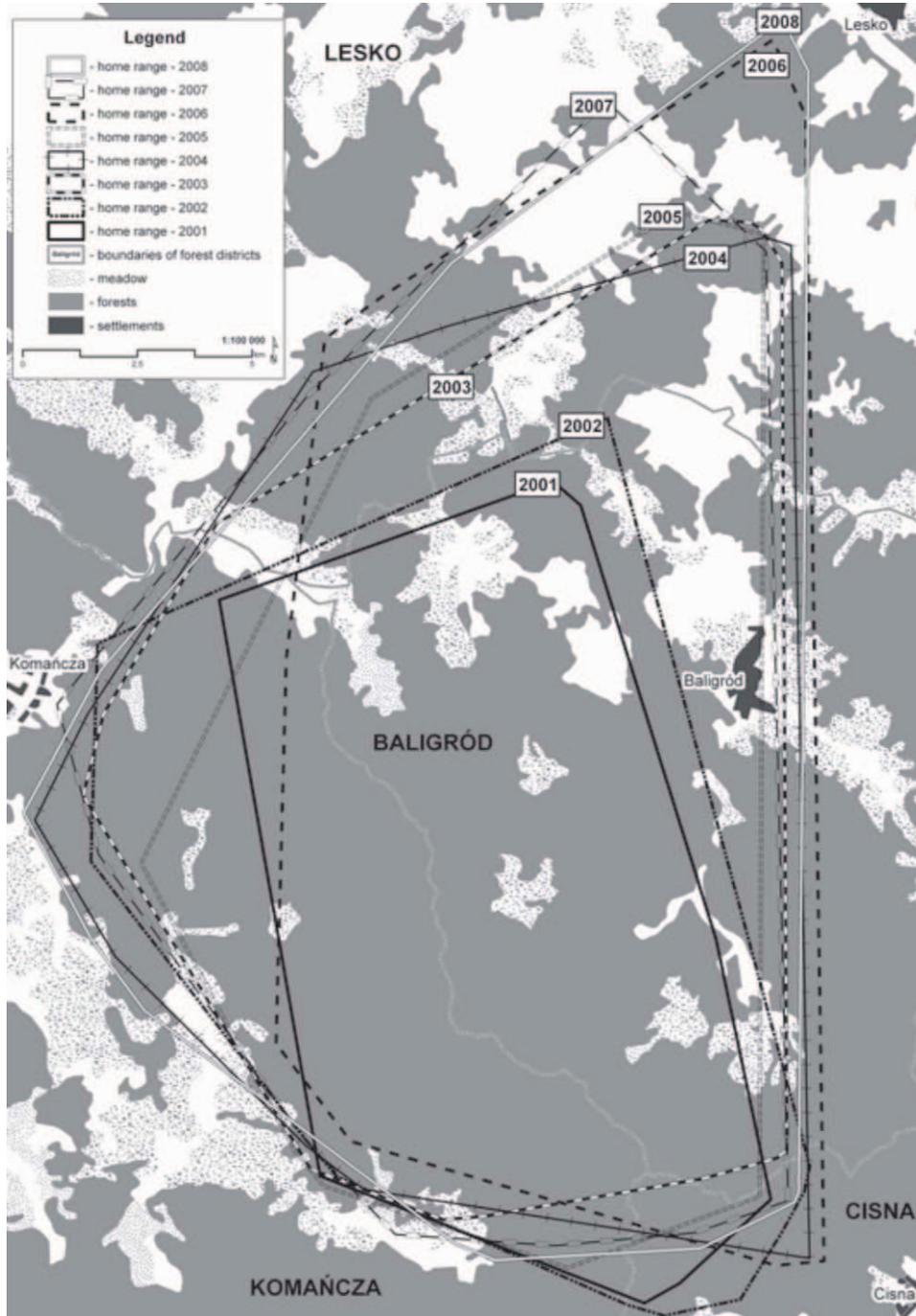
Year	Numbers	MCP (sq.km)	Population density/km <sup>2</sup>	"E" (km)	"D" (km)
2001	140	143,77	0,97	14,65	–
2002	150	196,48	0,76	16,45	1,80
2003	170	241,12	0,71	21,78	5,33
2004	199	71,31	2,79	22,78	1,00
2005	214	225,05	0,95	23,48	0,70
2006	201	252,71	0,79	27,76	4,28
2007	241	275,30	0,88	31,64	3,88
2008	271	300,30	0.90	35.89	4,25

2008, the population was spreading north on the rate of 2.6 km per year. Such obvious tendency for range extension towards east and west has not been found (Table 1, Fig. 1).

## Discussion

The population of wisents in Bieszczady Mountains, is an example of a young, still growing population of a large mammal, not being restricted by the limits of the habitat. The whole population (eastern and western parts) established first in 1963, now is occupying a home range of approximately 450 sq.km (end of 2009), but a potential area for its dispersal exceeds 2000 km<sup>2</sup> (just the area of Eastern Carpathian Biosphere Reserve is 2080 sq.km). Within this territory, there are no natural barriers for animals' expansion (e.g. large rivers or rocky ridges), and only few, low grade man-made obstacles (local roads and scattered settlements). Thus, this population may serve as a model for an expanding wisent population, not restricted by the size of available habitat (Perzanowski, Olech 2007, Perzanowski *et al.* 2007).

There are many factors affecting a dispersal rate in animal populations. Among the most important, there are: the environmental resistance depending on a number of barriers (natural and man-made) and a degree of their difficulty, as well as physiological constraints (a pace of animals' movements, frequency of feeding bouts typical for a given species etc.). Therefore it would be difficult to compare dispersal rate of large predators (e.g. wolves) able to cover long distances between successful hunts, and ruminants, forced to feed in regular time intervals. Permeability of environmental barriers depends also a lot on a size of an animal, as smaller creatures may easier find an adequate



**Figure 1.** A map of annual home ranges of a wisent population in the western part of Bieszczady, and location of northernmost records of wisents' presence between 2001 and 2008.

cover, and on the fact whether animals are moving as solitary individuals or in a group (Clevenger *et al.* 2002; Wierzchowski, Perzanowski 2004).

Wisent population in Białowieska Primeval Forest, which is surrounded with agriculture and human settlements, has very limited potential for expansion, and out of the population home range, the most frequent migrations are those of solitary bulls (Kraśńska, Kraśński 2007). Hence, for this population, the measurements of expansion rate are pointless.

Northward expansion of wisent population in Bieszczady cannot also be compared with seasonal movements of red deer there, which move along north-south direction, over a distance often exceeding 20 km, between their winter ranges situated in valleys to summer ranges at higher elevations, but their annual range covers the whole forested area of Bieszczady (Perzanowski, Krzakiewicz 2000).

Similar tendency is observed in wisent population, however despite of return upward migrations towards the main ridge of the Carpathians in spring and early summer, the extent of their range is moving every year further north. Surprisingly, even though there are no physical barriers for wisent migration towards eastern and western directions (over 85% of forest cover along the northern macroslope of the Carpathians in this region) they tend to extend the range mostly towards the north. As a result, so far there is no evidence for a contact of two sub-populations of wisents in Bieszczady: the eastern one established in the early 60-ties of XXth century, and the western initiated in the 80-ties, although a distance between both release sites in a direct line is about 50 km (Perzanowski, Paszkiewicz 2000).

The first aim of this paper was to assess an average annual rate of expansion towards the north in western subpopulation of Bieszczady wisents. During the studied time span of 8 years, it was estimated for 2.6 km on average, and comparing to the earlier period of 20 years just after the first release of introduced animals to the wild (0.7 km/year) it is significantly faster. However, in consecutive years of the study, the rate of expansion varied considerably (between 0.7 – 5.33 km/year) but with no obvious reasons for such differences.

The second aim of this study was an attempt to explain the tendency for northward extension of wisents' range. The most obvious reason for an increase of the area occupied by wisents seemed to be an increment of wisent numbers. However, only a low correlation was found between the rate of home range extension and growing population numbers ( $r^2=0.567$   $p<0.5$ ). Similarly, the correlation between population density and annual increments of the home range to the north was rather weak ( $r^2=0.54$   $p<0.5$ ).

With no doubts, climatic conditions, especially winter in Bieszczady, are becoming milder in northward direction. Elevation in main valleys drops to the level of 500 m above sea level (comparing to over 1000 along the main ridge of the Carpathians there), there is considerably less snow, and minimal temperatures are higher by several degrees. Forest stands are to a higher

degree there altered by forest management, having lower percentage of native species, typical for the Carpathians like beech and fir and considerably more of the Scotch pine. On the other hand though, the area towards the north becomes more and more densely populated by people, so the level of human related disturbance considerably grows there. Wisents of Bieszczady have an opinion of being the most human shy representatives of this species in Poland. Therefore it is difficult to explain why they tend to penetrate intensively managed forest habitats, risking at the same time encounters with people, which they carefully avoid in ranges situated farther south. Perhaps climatic factors play a key role in such pattern of habitat selection or a high availability of brambles, which standing crop is much higher in Scotch pine stands than in the Carpathian beechwood (Mazurek 2010). Nevertheless the explanation of this phenomenon would require further studies.

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#### Tempo poszerzania areалу w populacji żubrów bieszczadzskich

**Streszczenie:** W zachodniej subpopulacji żubrów zamieszkujących Bieszczady, analizowana była tendencja do poszerzania jej areалу w kierunku północnym. W ciągu badanego okresu (2001–2008), północna granica areалу przesuwiała się średnio 2,6 km rocznie, a więc znacznie szybciej w porównaniu do okresu pierwszych 20 lat po zainicjowaniu tej populacji (0,7 km rocznie). Całkowita powierzchnia areалу tej subpopulacji wzrosła pomiędzy rokiem 2001 a 2008 od ok. 140 do ponad 300 km<sup>2</sup>. Subpopulacja ta nie jest ograniczona barierami siedliskowymi a potencjalne szlaki migracyjne na wschód i zachód nie są przecięte żadnymi znaczącymi naturalnymi lub antropogenicznymi barierami. Żubry migrujące tu na północ, napotykają coraz bardziej przekształcone siedliska i częstą obecność ludzi. Prawdopodobnym wytłumaczeniem tej tendencji do poszerzania areалу na północ są sprzyjające warunki klimatyczne w dolinach usytuowanych na niższych wysokościach nad poziomem morza i wysoka dostępność jeżyny w drzewostanach sosnowych występujących na gruntach porolnych.

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