

# Habitat parameters within seasonal migration trails of Bieszczady wisents

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**Abstract:** Habitat features within wisents' (*Bison bonasus*) home ranges were already described in the number of papers. We analyzed habitat characteristics along seasonal (spring and autumn) migration trails of wisents in Bieszczady Mountains, south-eastern Poland. Used were data on records of wisents' occurrence from the period 2006–2015, collected during their migration between summer and winter ranges. In total 896 of such records were available from spring and 791 from the autumn. Habitat parameters included the elevation above sea level, the type of forest habitat, the age of a tree stand, dominating tree species and the closure of tree canopy. In spring, wisent moved at average elevation of 594 m a.s.l. mostly through tree stands 75 years old on average, with broken canopy and dominated by Scotch pine followed by fir and beech. In autumn, migration took place at average elevation of 634 m a.s.l. through tree stands on average 74 years old also mostly with broken canopy and dominated by Scotch pine followed by fir and beech. Such information can be used for identification of most probable course of wisents' movements i.e. serve for the protection of their potential migration corridors.

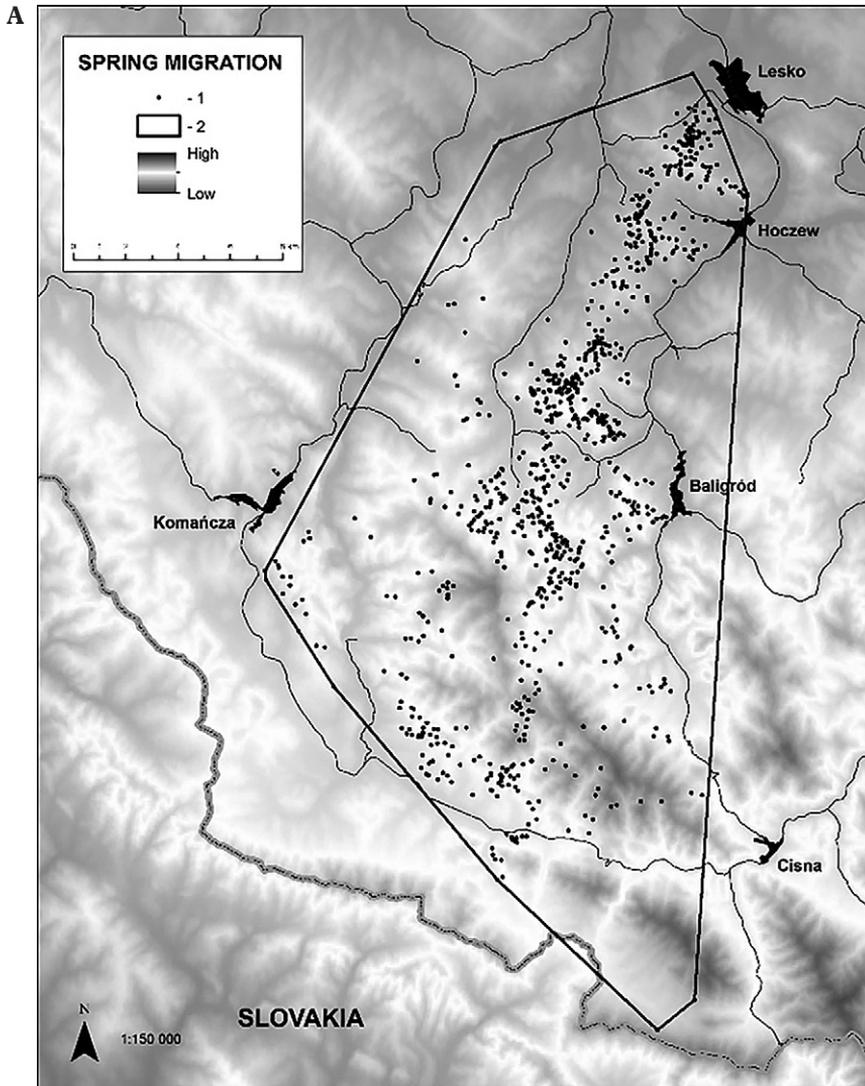
**Key words:** European bison, seasonal movements, habitat, the Carpathians, conservation

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## Introduction

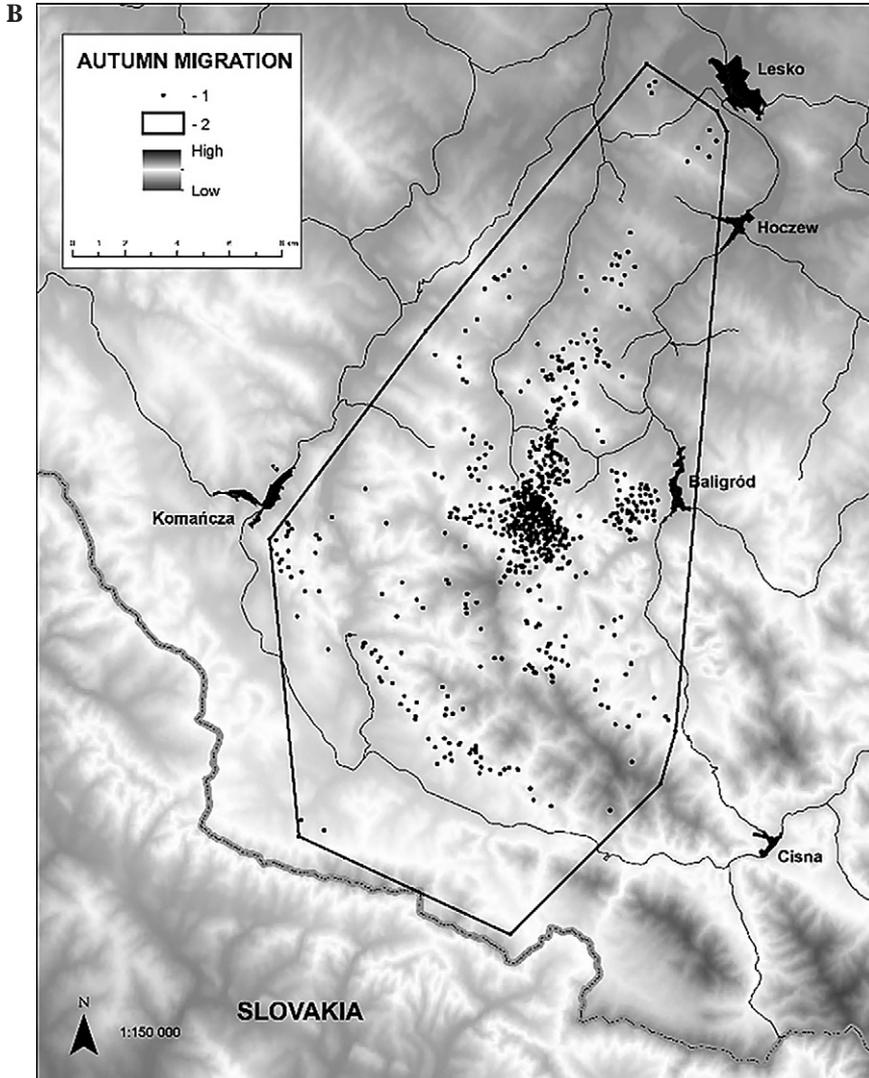
Seasonal movements of animal populations within their annual home range are characteristic for species inhabiting the boreal and temperate Euro-Siberian region, as well as the Nearctic zone of North America. Similar phenomenon is observed for species of alpine type mountain ranges with distinct climatic differences at consecutive elevations. Those movements are connected with searching for more abundant and nutritious forage as well as with a tendency for avoiding harsh climate (Pullin 2002; Dingle 2014).

In the case of wisents, most of studies on the pattern of spatial use of their ranges were conducted in lowland forests, where seasonal movements are relatively small (Krasińska i in. 2014, Krasińska, Krasiński 2017). However,



summer and winter ranges of wisents inhabiting Bieszczady Mountains are separate. Therefore during a couple of weeks in spring and in autumn, wisent herds are moving between those area, sometimes over a distance of more than 10 km. At that time they are using parts of local habitats that are not frequented for the most of the year (Perzanowski *et al.* 2012; 2016; Marszałek, Perzanowski 2018).

Those seasonal movements of Bieszczady wisents are triggered by a significant increase of temperatures in spring, and by an appearance of first snow fall in autumn (Perzanowski *et al.* 2012; 2013). Since those movements are



**Fig. 1** A,B. Records of wisents' occurrence during spring (A) and autumn (B) migrations collected for the western subpopulation of this species at Bieszczady Mtns. between 2006 and 2016. 1 – wisents' occurrence records, 2 – the boundary of subpopulation's home range. High/Low – elevations.

gradual and take a considerable period of time it is important for those animals to have then an access to habitats with appropriate food supply and cover.

Therefore, findings of this study may be helpful in identification and securing of optimal habitat patches suitable for supporting wisents' movements allowing for undisturbed dispersion of this population.

## Study area, materials, methods

For this analysis we used data on wisents' occurrence collected between 2006 spring and autumn of 2016, within annual home ranges of the western wisent subpopulation of Bieszczady Mountains, dwelling within Forest Districts of Komańcza, Cisna, Baligród and Lesko (Fig. 1A, B).

Those data originated from the database created for the program for continuous monitoring of wisent population in Bieszczady mountains, supervised by the Regional Directorate of State Forest at Krosno. In spring collected were 896 records of wisents' occurrence, out of which 750 were from the forested area, while in autumn there were 791 and 711 of such records respectively.

Parameters considered for the description of habitat included: open/forested area, closure of tree canopy, dominating tree species, age of the stand, elevation above sea level.

Types of habitats and their area were identified and measured with ArcGis 9.2 software using the numeric forest map of the region.

## Results

During the spring migration the proportion of wisents' occurrence within open and forest habitats along migration routes was 83,7 vs. 16,3%.

In this period, the minimal age of tree stands where the presence of wisents was recorded was 9 years, while the maximal – 146 years. The average age of tree stands was 75 years  $\pm$  28,06 SD.

Only 2,3% of records of wisents' presence were found in tree stands with fully closed canopy, 64,3% within stands with broken canopy, 10,7% in stands with loose canopy and 22,8% in stands with moderately closed canopy.

As much as 32,4% of wisent records were reported from stands dominated by the Scotch pine, 25,6% from stands dominated by fir, and 21,7% from stands dominated by beech. Only 10,7% of records were from alder stands, 4,8% from spruce stands and remaining 4,8% from stands dominated by ash, sycamore, larch, birch and hornbeam.

During spring migration, wisents were recorded at higher elevations within forested area than in the open and this difference exceeded 55 m (Table 1).

In autumn, wisents frequented forest and open habitats along their migration routes in the proportion: 89,9 vs. 10,1%.

In this season, the minimal age of tree stands where the presence of wisents was recorded was 7 years, while the maximal – 146 years. The average age of those tree stands was 73,4 years  $\pm$  30,60 SD.

**Table 1.** A comparison of elevations above sea level where wisents' presence was recorded within forested and open area along their migration trails in spring

Elevation above sea level [m]	All records	Within the forest	Within open area
minimal	316	379	316
maximal	954	954	849
average	593,89	603,03	547,28
SD	105,16	104,56	95,38

Just less than 1% of records of wisents' presence was found under fully closed canopy, 68% within stands with broken canopy, 11,7% in stands with loose canopy and 18,8% in stands with moderately closed canopy.

In that season 23,5% of wisent records were from stands dominated by the Scotch pine, 27,4% from stands dominated by fir, and 16,3% from stands dominated by beech. As much as 22,1% of records were from alder stands, 4,8% from spruce stands and remaining 5,9% from stands dominated by ash, sycamore, and larch.

Similarly like in spring, during autumn migration, wisents were recorded on average at higher elevations within forested area than in the open but this difference was only about 32 m. However in this season, minimal elevation where the presence of wisents was recorded was lower within forested area (Tabl. 2).

**Table 2.** A comparison of elevations above sea level where wisents' presence was recorded within forested and open area along their migration trails in autumn

Elevation above sea level [m]	All records	Within the forest	Within open area
minimal	379	379	436
maximal	950	950	768
average	633,97	637,19	605,58
SD	76,36	77,27	61,55

## Discussion

In general, habitat patches that are suitable for migration may have less favourable parameters, than habitats providing proper conditions for supporting a population and breeding in a long term. During movements animals are anyway more exposed than when remain motionless in refuges but since they constantly change their position the quality of cover is not so important.

Similarly, since animals on a move remain in one place for only short period of time, also food resources in such habitat patches can be less abundant. Nevertheless, habitat quality along migration routes however suboptimal, should be sufficient to secure basic nutritional requirements and cover, at least effective for a part of the day (e.g. during night) (Hemming 1971; Rettie & Messier 2000; Perzanowski 2012; Dingle 2014).

Although so far most papers concerned the habitat quality within seasonal ranges of wisents, some studies were focused also on environmental parameters along their movement routes between areas occupied in summer and winter. It has been found that wisents preferred S and SW slope expositions in spring, while W, NW and E, NE slopes were more frequently used in autumn. Also, movements in spring occurred at slightly lower elevations above sea level (by about 30m) than in autumn. Open areas, were frequented by wisents almost twice more often in spring than in autumn. Regarding the forest type, in spring, wisents moved mostly within coniferous stands, while in autumn mostly within deciduous and mixed stands. The presence of heavy traffic was a significant obstacle for wisent movements (Perzanowski *et al.* 2012; 2016; Ziółkowska *et al.* 2017).

This study, based upon 10 years long data, confirmed that spring movements take place at lower elevations than in autumn, but the proportion of the number of wisents' records from forested and open areas was 5:1 in spring and as high as 9:1 in autumn and in both seasons they tend to move at higher elevations along forested patches. Slightly over 30% of wisent movements occurred in Scotch pine stands in spring but only about 23% in autumn while in both seasons, beech-fir stands were frequented at the rate of about 45%. However, as much as 22% of movements in autumn and about 10% in spring were within alder stands. In both seasons wisents avoided stands with close canopy and strongly preferred those with broken canopy (64 and 68% of records in spring and autumn respectively).

Such data can be used for modeling a sequence of the most suitable habitat patches for wisents' migrations in mountains therefore providing the basis for planning the establishment of secure migration corridors.

## **Acknowledgements**

Data for this paper were collected under the framework of the project supported by the Regional Directorate of State Forests in Krosno "The continuous monitoring of wisent population in Bieszczady Mountains".

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### **Parametry siedlisk w obrębie sezonowych tras migracyjnych bieszczadzkich żubrów**

**Streszczenie:** Parametry siedlisk w obrębie arealów bytowania żubrów (*Bison bonasus*) zostały opisane w wielu publikacjach. My analizowaliśmy cechy pozwalające scharakteryzować siedliska wzdłuż sezonowych (wiosennych i jesiennych) tras migracyjnych żubrów w Bieszczadach, pld. – wsch. Polska. Wykorzystane zostały dane o stwierdzeniach obecności żubrów z okresu 2006–2015, zebrane podczas ich migracji pomiędzy letnimi a zimowymi arealami. W sumie dostępnych było 896 takich stwierdzeń z sezonu wiosennego i 791 z jesieni. Parametry opisujące siedliska obejmowały: wysokość n.p.m., typ siedliskowy lasu, wiek drzewostanu, dominujący gatunek oraz zwarcie koron drzew. Wiosną żubry migrowały na średniej wysokości 594 m n.p.m, głównie poprzez drzewostany o średnim wieku 75 lat o przerywanym zwarcu koron i zdominowane przez sosnę a w dalszej kolejności jodłę i buka. W okresie jesiennym migracja odbywała się na średniej wysokości 634 m n.p.m, przez drzewostany o średnim wieku 74 lata również głównie o przerywanym zwarcu koron i zdominowane przez sosnę a w dalszej kolejności jodłę i buka. Dane takie mogą posłużyć do identyfikowania najbardziej prawdopodobnego przebiegu przemieszczeń żubrów, a więc być wykorzystane do ochrony ich potencjalnych korytarzy migracyjnych.

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