



European Bison habitat in the Carpathian Mountains

Tobias Kuemmerle^{a,*}, Kajetan Perzanowski^{b,c}, Oleh Chaskovskyy^d, Katarzyna Ostapowicz^e, Lubos Halada^f, Andriy-Taras Bashta^g, Ivan Kruhlov^h, Patrick Hostertⁱ, Donald M. Waller^j, Volker C. Radeloff^a

^a Department of Forest and Wildlife Ecology, University of Wisconsin-Madison, 1630 Linden Drive, Madison, WI 53706, USA

^b Chair of Applied Ecology, Catholic University of Lublin, Konstantynow 1H, 20-708 Lublin, Poland

^c Museum and Institute of Zoology, Polish Academy of Sciences, Ogródowa 10, 38-700 Ustrzyki Dolne, Poland

^d Ukrainian National Forestry University, vul. Gen. Chuprynyk, 103, 79031 Lviv, Ukraine

^e Department of GIS, Cartography and Remote Sensing, Jagiellonian University, ul. Gronostajowa 7, 30-387 Kraków, Poland

^f Institute of Landscape Ecology, Slovak Academy of Sciences, Branch Nitra, Akademická 2, P.O. Box 23B, 949 01 Nitra, Slovakia

^g Institute of Ecology of the Carpathians, National Academy of Sciences of Ukraine, Koselnytska St. 4, 79026 Lviv, Ukraine

^h Geographical Faculty, Ivan Franko University of Lviv, vul. Doroshenka, 41, 79000 Lviv, Ukraine

ⁱ Department of Geography, Humboldt-University Berlin, Unter den Linden 6, 10099 Berlin, Germany

^j Department of Botany, University of Wisconsin-Madison, 430 Lincoln Avenue, Madison, WI 53706, USA

ARTICLE INFO

Article history:

Received 15 September 2009

Received in revised form 11 November 2009

Accepted 25 December 2009

Available online 25 January 2010

Keywords:

Large herbivores

Bison bonasus

Wisent

Species distribution modeling

Maxent

Post-socialist land use change

ABSTRACT

European Bison (*Bison bonasus*) barely escaped extinction in the early 20th century and now only occur in small isolated herds scattered across Central and Eastern Europe. The species' survival in the wild depends on identifying suitable habitat for establishing bison metapopulations via reintroductions of new herds. We assessed European Bison habitat across the Carpathian Mountains, a stronghold of European Bison and one of the only places where a viable bison metapopulation may be possible. We used maximum entropy models to analyze herd range maps and habitat use data from radio-collared bison to identify key habitat variables and map European Bison habitat across the entire Carpathian ecoregion (210,000 km²). Forest cover (primarily core and perforated forests) and variables linked to human disturbance best predict bison habitat suitability. Bison show no clear preference for particular forest types but prefer managed grasslands over fallow and abandoned fields. Several large, suitable, but currently unoccupied habitat patches exist, particularly in the eastern Carpathians. This available suitable habitat suggests that European Bison have an opportunity to establish a viable Carpathian metapopulation, especially if recent trends of declining human pressure and reforestation of abandoned farmland continue. Our results also confirm the suitability of a proposed Romanian reintroduction site. Establishing the first European Bison metapopulation would be a milestone in efforts to conserve this species in the wild and demonstrate a significant and hopeful step towards conserving large grazers and their ecological roles in human-dominated landscapes across the globe.

© 2009 Elsevier Ltd. All rights reserved.

1. Introduction

Land use, particularly habitat loss, degradation, and fragmentation, is the primary driver of global biodiversity declines (Ceballos and Ehrlich, 2002; Fischer and Lindenmayer, 2007; Foley et al., 2005). Large carnivores and herbivores are particularly at risk as they require large tracts of intact habitat, often conflict with people and land use, and are susceptible to poaching (Enserink and Vogel,

2006; Gordon and Loison, 2009). As a consequence, many large mammals are now limited to small, clustered populations or have been extirpated. Large mammals, however, play key roles in ecosystem functioning, meaning their absence may trigger ecological meltdown (Dobson et al., 2006; Pringle et al., 2007). Ensuring the long-term persistence of large mammals and restoring their ecological roles are therefore top conservation priorities (Ceballos et al., 2005; Gordon and Loison, 2009; Vera et al., 2006).

The European Bison or wisent (*Bison bonasus*) is a prime example of a large herbivore that nearly became extinct due to habitat loss and overhunting (Krasinska and Krasinski, 2007; Pucek et al., 2004). Only two sub-populations survived by the early 20th century. The last wild bison was poached in 1927 and only 54 animals survived in zoos (Pucek et al., 2004). Thanks to a systematic breeding program, there are now about 3000 European Bison, 1600 of

* Corresponding author. Tel.: +1 608 261 1050; fax: +1 608 262 9922.

E-mail addresses: kummerle@wisc.edu (T. Kuemmerle), StacjaKarpacka@miiz.waw.pl (K. Perzanowski), oleh.chaskov@googlegmail.com (O. Chaskovskyy), kostapowicz@gis.geo.uj.edu.pl (K. Ostapowicz), lubos.halada@savba.sk (L. Halada), atbashta@ukr.net (A.-T. Bashta), ikruhlov@gmail.com (I. Kruhlov), patrick.hostert@geo.hu-berlin.de (P. Hostert), dmwaller@wisc.edu (D.M. Waller), radeloff@wisc.edu (V.C. Radeloff).

which occur in about 30 reintroduced herds throughout Eastern Europe (Daleszczyk and Bunevich, 2009; Krasinska and Krasinski, 2007; Pucek et al., 2004). The European Bison is the last surviving species of Europe's large grazers.

Despite this conservation success, Europe's largest terrestrial mammal remains at risk from extinction. The European Bison population has low genetic diversity due to its genetic bottleneck (only 12 founders), reducing reproduction rates and disease resistance (Olech and Perzanowski, 2002; Pucek et al., 2004). Thus, the effective bison population size (N_e) is far smaller than its census numbers. Moreover, most free-ranging bison herds remain small (<50 animals) and isolated. Minimum viable population size is estimated at ~1000 animals, much larger than any current herd (Perzanowski et al., 2004; Pucek et al., 2004). The challenge is thus to create viable bison metapopulations capable of ensuring genetic exchange among herds. Connecting herds will require both enlarging existing herds and additional reintroductions (Perzanowski et al., 2004; Pucek et al., 2004).

To accomplish this, we need a better understanding of existing suitable European Bison habitat and maps of where such habitat exists. Habitat preferences for a few herds have been studied in depth, primarily in the Polish and Belarusian Bialowieza forest (Krasinska et al., 1987, 2000; Krasinska and Krasinski, 2007). However, little is known about habitat selection in other bison herds or the species as a whole (Pucek et al., 2004). For example, although bison are generally considered a deciduous forest species preferring landscape mosaics, they also thrive both in coniferous forest (Krasinska et al., 2000; Pucek et al., 2004) and more open landscapes (Balčiauskas, 1999). Moreover, most habitat studies to date were conducted at fine spatial scales in small areas (e.g., individual forest districts, Daleszczyk et al., 2007; Krasinska et al., 1987; Perzanowski et al., 2008). Broad-scale assessments are thus needed to guide conservation efforts.

The Carpathian Mountains in Central Europe have been a stronghold for reintroduced wild European Bison populations. Furthermore, human pressure has decreased considerably in the Carpathians after the breakdown of socialism, large farmland areas were abandoned (Kuemmerle et al., 2008; Turnock, 2002), and large carnivore and herbivore populations are increasing (Enserink and Vogel, 2006). This may offer opportunities to establish the first viable, free-ranging metapopulation of European Bison, which would be a milestone for conserving this species in the wild (Olech and Perzanowski, 2002; Perzanowski and Olech, 2007; Perzanowski et al., 2004).

An obstacle to achieving this optimistic scenario is our current lack of knowledge regarding bison habitat preferences and the availability of such suitable habitat in the Carpathians (Perzanowski et al., 2008; Pucek et al., 2004). Addressing this information gap was identified as a top research need in the species' conservation action plan (Pucek et al., 2004). One factor precluding an area-wide assessments of bison habitat in the Carpathians has been the lack of comprehensive bison presence/absence data, as required by traditional statistical habitat suitability models (Guisan and Zimmermann, 2000). Fortunately, recent approaches allow modeling habitat based on presence-only data, even when occurrence data are sparse (Elith et al., 2006; Wisz et al., 2008).

Our goal was to assess habitat suitability for Carpathian bison and to map potential European Bison habitat for the entire Carpathian ecoregion, thus assuming that the species currently does not realize its full potential distribution and that areas occupied by bison herds constitute suitable habitat. Our aim was not to quantify habitat connectivity or population viability. Specifically, we ask:

1. What determines suitable European Bison habitat in the Carpathians at the landscape scale?

2. What is the distribution of suitable European Bison habitat in the Carpathians?

2. The Carpathians

The Carpathians, Europe's largest mountain range, encompass an area of about 210,000 km² (~44.0–50.0N, 17.5–27.5E) in eight central European countries (Austria, Czech Republic, Poland, Slovakia, Hungary, Ukraine, Romania, and Serbia). Elevation ranges from 100 to 2665 m and topography is dominated by gentle slopes. Climate is temperate-continental with strong altitudinal gradients in mean annual temperature (9 °C in the plains to below 0 °C on mountain peaks) and precipitation (<500 mm to >2000 mm). Natural vegetation occurs in four altitudinal zones: foothills (<600 m) dominated by beech (*Fagus sylvatica*), hornbeam (*Carpinus betulus*), and oaks (*Quercus* spp.), montane mixed forests with beech and fir (*Abies alba*) (600 to 1100 m in the north/1400 m in the south), sub-alpine coniferous forests (up to 1500 m/1800 m) with Norway spruce (*Picea abies*), pine (*Pinus cembra*), and alpine above treeline (UNEP, 2007; Webster et al., 2001).

The Carpathian region has exceptional conservation value. It harbors substantial old growth and semi-natural forests as well as valuable cultural landscapes, is rich in endemic biodiversity, and retains viable populations of all native large carnivores (brown bear, wolf, lynx, UNEP, 2007; Webster et al., 2001). The Carpathians are also one of the few places where European Bison roam freely. Six free-ranging bison herds currently exist: two in the Polish Bieszczady Mountains (western herd: about 150 animals, eastern herd: about 140 animals), one in northeast Slovakia (9 animals), and three herds in Ukraine (Skole District: 14 animals; Bukovina Mountains: two herds, together 80 animals). A seventh herd of 22 animals is being reintroduced in 2009/2010 in the Vanatori Neamt Nature Park in Romania.

Genetic diversity of the Carpathian bison population is low (e.g., 90% of the combined gene pool was provided by seven founders, Olech and Perzanowski, 2002; Perzanowski and Olech, 2007). The current effective population size also remains too small to ensure long-term viability. Moreover, the Ukrainian herds are isolated. Conservation of wild European Bison depends on substantially enlarging the Carpathian bison population as a whole and on establishing a free-ranging bison metapopulation (Perzanowski and Kozak, 2000; Perzanowski and Olech, 2007; Perzanowski et al., 2004). This goal, however, requires habitat maps across the Carpathians to identify suitable areas for reintroductions, range extension, and where we might best link existing herds. For our analyses, we adopted the ecoregion definition of the Carpathian Ecoregion Initiative (Webster et al., 2001), buffered by 30 km to include adjacent forests. We excluded the Serbian Carpathians as no bison exist there and the Danube River prevents dispersal.

3. Datasets used

3.1. Bison occurrence data

We used two types of European Bison occurrence data: (1) radio-telemetry points and GPS-locations of bison presence (direct observations, tracks, etc.) from the two Polish herds, and (2) range maps from all Carpathian herds. Telemetry data were collected from 2002 to 2006. Six bison were fitted with radio collars (one female, five males); positions were determined every 2–3 days using ground triangulation and a GPS. Records on bison presence have been collected weekly by State Forest and Polish Academy of Sciences staff since 2001. In total, 9922 bison locations were available within a minimum convex polygon of 1200 km².

Download English Version:

<https://daneshyari.com/en/article/4385774>

Download Persian Version:

<https://daneshyari.com/article/4385774>

[Daneshyari.com](https://daneshyari.com)