EFFICIENCY OF FOREST NATURAL HABITATS CONSERVATION IN THE OUTER WESTERN CARPATHIANS (CZECH REPUBLIC)

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Abstract

The Outer Western Carpathians (OWC) in the Czech Republic is forested mountain region interesting from the viewpoints of biodiversity conservation. Currently, the OWC region is covered by Beskydy and White Carpathians protected landscape areas (PLAs). In this study, the original expert method the NCEI (Nature Conservation Efficiency Index) is applied to the assessment of the forest natural habitats conservation efficiency in the OWC. The assessment is based on mapping of natural habitats in the frame of establishment the Natura 2000 network. NCEI has been calculated as a ratio of the total area of a particular habitat type in both PLAs divided by the total area of that same habitat in the Czech Republic. The conservation efficiency of FNH reflect their area cover in OWC and does not directly correlate with the threat rate of individual FNHs.

Keywords: forest biodiversity, habitat mapping, Natura 2000, Nature Conservation Efficiency Index

Introduction

The Outer Western Carpathians (OWC) in the Czech Republic is a forested mountain region interesting from the point of view of biodiversity conservation (Wolf et al., 2013). Conservation importance of this region is supported by the presence of large carnivores (Kovařík et al., 2014) and extraordinary plant diversity (Otypkova et al., 2011). The OWC in the territory of the Czech Republic consist of the two main mountain systems: Beskydy Mountains and White Carpathian Mountains. Both of these mountains belong to the Flysch Belt of the OWC. Most of the OWC in the Czech Republic was not influenced by human activities even up to the end of 16th century when extensive grazing activity and deforestation occurred. This period is so-called Wallachian colonization of montane forestland (Gebica et al., 2013). Extensive grazing can be considered as one of the main factors forming the current cultural landscape of Beskydy and White Carpathians (Opršal et al., 2016) with very high alfa-biodiversity of natural habitats. Currently, both Beskydy and White Carpathians are proclaimed as protected landscape areas (PLA). The prevailing land covers (matrix) of the landscape of both PLAs are formed by forest habitats. Major part of these forest habitats have been transformed into spruce monocultures with low alpha-diversity in the past, while some have maintained the character of forest natural habitats. These remaining forest natural habitats represent important biodiversity refugees of Carpathian forests within the OWC. The aim of the study is to assess the efficiency of protected areas for conservation of Carpathian forest biodiversity in territory of the Czech Republic.

Materials and methods

We applied the NCEI index (Nature Conservation Efficiency Index, see in detail Pechanec et al., 2018) to measure the effectiveness of habitat conservation. The NCEI index is calculated for specific habitat types as the total area of a particular habitat type in the studied PLAs (Beskydy and White Carpathian) (TANHPLA) divided by the total area of particular habitat in the Czech Republic (TANHCZ):

$$NCEI = TANHPLA / TANHcz \quad (1)$$

The method is used the data from the mapping of natural habitats in the Czech Republic within the of Natura 2000 system. Natural habitats are defined in the Catalogue of Habitats in the Czech Republic (Chytrý et al., 2010). The NCEI index ranges from 0 (absence of protection) to

1 (totally effective protection). The calculated value of NCEI > 0.75 indicates a highly effective habitat protection (more than 75% of the total area of all identified natural habitats are protected by means of PLA), values between 0.74–0.50 indicate intermediate habitat protection (more than 50% of the total area of natural habitats are integrated in PLAs, and values NCEI ≤ 0.49 indicate low habitat protection (PLAs cover less than 50% of the total area of a particular natural habitat).

Results

Of the total of 43 types of forest natural habitats in the Czech Republic, there are 12 types in the WCPLA and 15 types of forest natural habitats (FNH) in the BPLA. In the south-located WCPLA, thermophilous types of FNH: L3.4 (Pannonian oak-hornbeam forests), L6.1 (Peri-Alpidic basophilous thermophilous oak forests) and L6.2 (Pannonian thermophilous oak forests on loess) were mapped. These FNH types occur in the low-level part of WCPLA in a few mapped segments (Table 1), where the southern boundary of the WCPLA reaches the northern boundary of Pannonian biogeographic provinces.

Tab.1: Mapped forest natural habitats in WCPLA

Habitat	Habitat code according to Catalog	Total area of habitat in the PLA [km2]	Total area of habitat in Czech Republic [km2]	NCEI
Alder carrs	L1	0.01	37.47	0
Ash-alder alluvial forests	L2.2	9.98	796.04	0.01
Hardwood forests of lowland rivers	L2.3	0.19	241.38	0
Willow-poplar forests of lowland rivers	L2.4	0.01	26.43	0
Pannonian-Carpathian oak-hornbeam forests	L3.3	74.79	437.58	0.17
Pannonian oak-hornbeam forests	L3.4	0.22	57.05	0
Ravine forests	L4	1.62	209.33	0.01
Herb-rich beech forests	L5.1	117.21	1229.28	0.1
Acidophilous beech forests	L5.4	2.66	1473.99	0
Peri-Alpidic basiphilous thermophilous oak forests	L6.1	0.01	9.11	0
Central European basiphilous thermophilous oak forests	L6.4	3.41	39.18	0.09
Dry acidophilous oak forests	L7.1	0.23	397.51	0

On the contrary, in the BPLA with dominating higher altitudes, the FNH segments typical for the climatically cooler Carpathian mountain areas (Table 2) were mapped in the mountainous locations: L2.1 (Montane gray alder galleries), L8.1 (Boreo-continental pine forests) , L9.1 (Montane Calamagrostis spruce forests), L9.2 (Bog and waterlogged spruce forests) and L9.3 (Montane Athyrium spruce forests). The situation of the northwest BPLA into the Polonian biogeographical region is the cause of FNH L3.2 occurance (Polonian oak-horbeam forests). Several segments of FNH L7.2 (Wet acidophilous oak forests) are bound by their occurrence on the specific ecological conditions of pseudogley soils that rarely occur in the BPLA in regions dominated by FNH Acidophilous beech forests (L5.4).

All forest natural habitat types both in the WCPLA (Tab. 1) and in the BPLA (Tab. 2) are associated with low effeciency of protected areas (NCEI ≤ 0.49). The low conservation efficiency by NECI (Tab. 1 – 2) of both studied PLAs for forest natural habitats reflects I) their large total area within the Czech Republic and ii) the fact that the landscape in the OWC has been seriously changed by human activities in the past.

Discussion

The results of the mapping of forest natural habitats in the OWC have shown differences in the representation of habitat types in the BPLA and the WCPLA, although both the PLAs are immediately adjacent. Differences between the occurrence of FNH types in the WCPLA and the BPLA are subject to a slight difference in the geographical location of both PLAs combined with the different altitude range of both areas, which is manifested in a different representation of the vegetation stages. Habitat protection in the Czech Republic is concentrated primarily on the smallest segments of rare natural habitats. The maximum conservation efficiency (NCEI = 1) in the form of protected areas in the Czech Republic applies to 22 types of natural habitats, for example to almost all natural habitats of the alpine zone above the tree line, which represents a unique environment threatened by the climate-induced upward tree-line shift (Machar et al., 2017). The analysis performed in the OWC by NCEI index calculation for each of FNH show very low conservation efficiency of both PLAs. NCEI index calculation, of course, contains a certain degree of uncertainty, characteristic of each environmental index, based on data visualization through GIS (Brus et al., 2017), so its interpretation must take into account the specific regional context. This context for both studied PLAs is due to the priority focus of both PLAs on the protection of non-forest habitat types (Machar, 2012). Therefore, the very low NCEI values (Table 1 and Table 2) indicate little significance for both PLAs for the protection of forest biodiversity in the OWC. So far, the most commonly used method for the assessment of the efficiency of protected areas is the conceptual procedure proposed by IUCN (Plesník, 2012). Under this approach, good care for protected areas is based on an understanding of its existing values and threats that is followed by reasonable planning and funding. The care for protected areas should then foster ecosystem services, providing local people with concrete benefits (Alexander, 2008). Detailed data from field mapping of natural habitats are a very valuable source of information on biodiversity in the protected PLAs. The authors of this article believe that data from the field habitat mapping can be considered as one of the key positive benefits of European nature conservation legislation in the EU Member States, unlike the practical use of Natura 2000 to protect biodiversity that is sometimes lacking practicality (Opermanis et al., 2013).

Tab. 2: Mapped forest natural habitats in BPLA

Habitat	Habitat code according to Catalog	Total area of habitat in the PLA [km^2]	Total area of habitat in Czech Republic [km^2]	NCEI
Alder carrs	L1	0.32	37.47	0.01
Montane grey alder galleries	L2.1	1.07	5.56	0.19
Ash-alder alluvial forests	L2.2	6.63	796.04	0.01
Polonian oak-hornbeam forests	L3.2	2.39	112.58	0.02
Pannonian-Carpathian oak-hornbeam forests	L3.3	12.89	437.58	0.03
Ravine forests	L4	14.93	209.33	0.07
Herb-rich beech forests	L5.1	72.07	1229.28	0.06
Montane sycamore-beech forests	L5.2	0.85	19.51	0.04
Acidophilous beech forests	L5.4	111.67	1473.99	0.08
Dry acidophilous oak forests	L7.1	0.54	397.51	0
Wet acidophilous oak forests	L7.2	0.22	104.13	0
Boreo-continental pine forests with lichens on sand	L8.1A	0.01	11.73	0
Montane Calamagrostisspruce forests	L9.1	4.59	438.81	0.01
Bog spruce forests	L9.2A	0.46	60.02	0.01
Waterlogged spruce forests	L9.2B	2.91	298.13	0.01
Montane Athyriumspruce forests	L9.3	1.59	9.44	0.17

Conclusion

This research on forest biodiversity has a great conservation potential, for example as a decision support tool for landscape management (Czajkowski et al., 2009). Analyses are based on field mapping of natural habitats in 2001 - 2005. This field habitat mapping was implemented within the Natura 2000 European network. The presented results of analyses can support conservation effort of natural forest habitats in the OWC. It can be also important in the wider frame of forest ecosystem services evaluation because of biodiversity is directly joining with ecosystem service provisioning (Nadrowski et al., 2010).

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Souhrn
V této studii je expertní metoda aplikována na hodnocení účinnosti ochrany lesních přírodních stanovišť v oblasti západních Karpat. Hodnocení je založeno na datech mapování přírodních stanovišť v rámci vytvoření evropské sítě Natura 2000. NCEI byl vypočten jako podíl celkové plochy konkrétního typu biotopu v CHKO děleno celkovou plochou stejného biotopu v ČR. Účinnost ochrany přírodních lesních biotopů odráží jejich plošné pokrytí v karpatské oblasti a přímo nekoreluje s mírou ohrožení jednotlivých biotopů. Prezentované výsledky analýz mohou podpořit úsilí o ochranu přirozených lesních biotopů nejen v této lokalitě. Mohou být důležité i v širším rámci hodnocení lesních ekosystémových služeb, protože biodiverzita se přímo propojuje s poskytováním ekosystémových služeb.

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