

# Assessment of Human Pressure on Forest Ecosystems in the Czech Republic

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**Abstract**— Forest ecosystems play an important role for natural environment as well as for human society. With population and economic growth forests are put under increasing pressure leading to destruction of habitats and irreversible biodiversity loss. Quantification and interpreting the degradation of forest ecosystems can help raise public and political awareness needed for preserving the remaining species. In this study, human pressure on forest ecosystems in the Czech Republic and its impact on biodiversity loss were assessed. One of the main tools used is Mean Species Abundance indicator assessing human-induced changes in biodiversity including land-cover change, land-use intensity and fragmentation. Results are supplemented by statistical outputs of the National Forest Inventory and the Databank of natural forests of the Czech Republic. The results show serious decrease of mean species abundance in all landscape including forests. Most of the forested areas in the Czech Republic are affected by long-term human influence resulting in significant biodiversity loss and forest degradation.

**Keywords**-forest; human pressure; biodiversity; mean species abundance.

## I. INTRODUCTION

In European landscape, forest ecosystems present an irreplaceable part of natural environment for habitat they provide, ability of climate regulation, flood and erosion control, water cycle and others including many services and products used directly by humans [1]. With growing population and demand for natural sources, forests are under increasing pressure. In the Czech Republic, an inland human-dominated Central European country with an area of approximately 79,000 km<sup>2</sup>, forests currently cover 33 % of the area. Although forested areas have continuously expanded there since the end of 19th century, they suffer from pollution, fragmentation and unsustainable management [2].

In our ongoing research, the anthropogenic pressure on ecosystems in the Czech Republic and its impact on biodiversity loss are assessed. Forested area assessment is one of the key parts of the study as forest ecosystems represent most of natural preserved and protected areas in the Czech Republic. The aim of the work is to quantify the extent of anthropogenic pressures on ecosystems, assess their

spatial patterns and compare impacts in forested area with other landscape.

Methods of the study are described in Section 2 of this paper, including specification of spatial datasets and indicator used for assessing biodiversity loss. In Section 3, first results are presented, followed by conclusion in Section 4.

## II. METHODS

Main steps of this study were (1) creating datasets of spatial distribution of Mean Species Abundance indicator (MSA) in the Czech Republic as a measure of anthropogenic pressure, (2) comparing impacts in forested area with other landscape, (3) supplementing results by statistical outputs of the National Forest Inventory in the Czech Republic.

### A. Spatial datasets

To calculate MSA values based on land use and land cover data, the Consolidated Layer of Ecosystems of the Czech Republic (CLES) [3] was used as the most detailed currently available dataset of ecosystem distribution on the national-wide level. CLES distinguish 41 categories of habitats on a fine spatial resolution, including information on the degree of naturalness for each habitat category. Where a clarification was needed, actual land cover was compared to original landscape using a map of potential natural vegetation in the Czech Republic [4]. Data and results were supplemented by statistical outputs of the National Forest Inventory in the Czech Republic [5] and the Databank of natural forests of the Czech Republic [6].

### B. Mean Species Abundance

MSA is an indicator developed for model GLOBIO3 assessing human-induced changes in biodiversity based on simple cause-effect relationships between environmental drivers and biodiversity impacts [7]. Drivers considered in this study are land-cover change, land-use intensity and fragmentation as they are assumed to be the main cause for biodiversity loss [8][9]. MSA values indicate relative remaining mean species abundance of original species compared to primary vegetation scaled between zero and one (1 = all original species, 0 = no original species). Water surfaces are not evaluated in this version of MSA indicator [7].

First step was assigning MSA impact values of land-cover change and land-use intensity to 41 CLES categories of habitats in the Czech Republic. Alkemade et al. [7] define 14 categories of land cover types and their MSA values based on a broad meta-analyses of available literature. Most of the CLES categories were assigned by their definition (artificial surfaces, natural vegetation) while several CLES categories were evaluated as intermediate and given a proportional value of two MSA categories following approach used by Prydatko et al. [10]. Geographical distribution of MSA values was then processed in GIS software. Another step was assessing fragmentation impact based on the extent of individual patches of forested areas based on approach of Alkemade et al. [7]. Neither distance nor shape of patches is considered in this version of MSA indicator.

### III. RESULTS

Mean species abundance in the Czech Republic reached 31% of original biodiversity in intact ecosystems. That means that human pressures decreased original biodiversity on average by almost 70 %. The biggest impact was located in intensively used agricultural areas in the lowlands. Forested mountain ranges in the border areas, as well as other forested interior parts of the country, achieved the highest values indicating they present relatively best preserved ecosystems in comparison with other landscape ( $MSA_{AVERAGE}=23,7\%$ ). However, the MSA in forested areas ( $MSA_{AVERAGE}=43,9\%$ ) is still decreased by human pressure on average by more than half.

Although forested areas cover about 33 % of the Czech Republic, most of them are fragmented into small patches with an area less than 100 km<sup>2</sup> as a result of dense road network, urban areas and intensively used agriculture land.

While potential natural vegetation are represented on most of the area by mixed or broad-leaved forests with dominant proportion of oak and beech, due to economic pressure a lot of planted forests are monocultures, with coniferous trees occupying almost 82 % of forested area.

Only 1,2 % area of all forests in the Czech Republic can be regarded as natural forests close to its original condition defined by [6]. All other areas including protected forests are affected by long-term human influence resulting in significantly modified species composition, spatial and age structure and soil degradation.

### IV. CONCLUSION

Forests present potential natural vegetation on most of the Czech Republic's area and thus provide important habitat for big part of original fauna and flora, as well as play important role for human society in provision of many ecosystem services. This study documents significant human pressure on forest ecosystems and their degradation.

### ACKNOWLEDGMENT

Special thanks go to David Vačkář from Charles University in Prague and anonymous reviewers for useful comments. The work was supported by the grant SVV-2015-260 237.

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