

Integrated assessment of ecosystem services in the Czech Republic



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ABSTRACT

Mainstreaming the concept of ecosystem services has been receiving increasing attention in recent years. Initially, most studies on ecosystem services assessments addressed global, sub-global or local levels. More recently, development of ecosystem services assessments at national level has been emphasized. Following this trend, integrated assessment of ecosystem services has been performed in the Czech Republic.

Our study aimed to identify and value ecosystem services delivered in the Czech Republic. To estimate the total value of Czech ecosystems, we developed a geographically-specific database of ecosystem service values. The structure of the assessment is given by six ecosystem types (agricultural ecosystems, grasslands, forests, aquatic ecosystems, wetlands and urban areas) and 17 ecosystem services delivered from these ecosystems. Ecosystem types are further classified into 41 ecosystem categories based on a habitat approach. Specific literature review strategy was conducted to fill the database with biophysical and economic values of ecosystem services. Developed database consists of more than 190 values of ecosystem services, approximately half of them has been used for a benefit transfer to calculate total ecosystem values in the Czech Republic. The resulting average value of ecosystem services in the Czech Republic represents 1.5 the current national GNP (gross national product).

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1. Introduction

Ecosystem services assessments substantially contribute to developing knowledge on the state of the environment and the sustainable management of natural capital. This has been confirmed by numerous studies and ongoing international debate on biodiversity conservation, ecosystem management, ecosystem services delivery and the value of ecosystem services for human well-being (e.g. MA, 2005; Braat and de Groot, 2012; Frank et al., 2012; Haines-Young and Potschin, 2010). The frequently stated aims of ecosystem services assessments are, inter alia, to make nature's value visible, to integrate the value of ecosystem services into decision-making and to streamline ecosystem services into management by developing maps and indicators (TEEB, 2013).

After global and sub-global assessments within the framework of the Millennium Ecosystem Assessment (MA) have been established, the scientific interest and policy demand tend to initiate and conduct studies at a lower, national scale. Scientific interest has increased steadily since the late 1990s (Costanza et al., 1997; De Groot et al., 2002) while policy demand for specific ecosystem governance has become notable only recently (Perrings et al.,

2011). Actual policy demand is driven mainly by the Aichi Targets (Strategic Goal D) and the EU Biodiversity Strategy to 2020 (Action 5) which promote consistent ecosystem assessments at national or regional level. Both documents stress the importance of ecosystem services in maintaining human well-being and prosperity. Therefore, conducting an inventory of ecosystems and their services through mapping and assessment is one of the keystones of the EU Biodiversity Strategy. National biophysical assessments by the EU member states are expected to be delivered by 2014 and economic accounting is expected to be complete by 2020 (COM, 2011).

In response to the EU Biodiversity Strategy and national TEEB assessments (TEEB, 2013), we follow national ecosystem services assessment initiatives and conduct an integrated assessment of ecosystem services in the Czech Republic. After a pilot study accounting for the full benefits provided by grassland ecosystems in the Czech Republic (Hönigová et al., 2011), this assessment represents the first inclusive assessment of ecosystem services provided by the diverse ecosystem types in the country. Recently, a national assessment accounting for the total value of ecosystem services has been promoted as an approach to the inclusion of ecosystem services in national wealth (Kubiszewski et al., 2013; Liu et al., 2010). Without the knowledge of the extent of benefits provided by nature, ecosystem services have been degraded beyond the sustainability limits of human society (Costanza et al., 1997; MA, 2005).

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The main aims of the study are to identify ecosystems services being delivered specifically by the ecosystems in the Czech Republic and to value these services based on a benefit transfer. Another substantial aim of the study is to provide a methodology that would be applicable for an integrated assessment of ecosystem services in the Czech Republic at both a national and a regional scale in order to enable the development of effective policy responses to ecosystem service degradation in the future.

To fulfill these aims, we mapped and quantified ecosystem services in terms of biophysical and economic values. Our approach combines a synthesis of the state of the art, review of data resources, development of the valuation database, values geo-referencing and mapping and finally, data analysis and interpretation.

2. Methods

2.1. Study area

The Czech Republic is an inland state located in central Europe (between latitudes 48° and 51°N, and longitudes 12° and 19°E). Despite its relatively small size (compared to other European countries) of about 7,886,600 ha, the country has exceptionally variable landscape providing diverse habitat types. The fauna and flora occurring within the Czech Republic reflect four WWF ecoregions: Western European broadleaf forests (85%), Carpathian montane conifer forests (9%), Pannonian mixed forests (4%) and Central European mixed forests (2%). The climate is temperate continental with relatively high seasonal amplitude as well as with great variation of temperature and precipitation depending on altitude. The long-term average annual precipitation is 689 mm, and average annual temperature is 7.5 °C. The country overlaps with three main river basins: the Elbe River (western part), the Oder River (north-eastern part) and the Danube River (south-eastern part). Agricultural land use represents more than 53% of the total area of Czech Republic, followed by forests covering about 33%, water bodies and built-up area (both about 2%) and other areas (9%). Protected areas cover almost 16% of the country.

2.2. Methodological framework

An overall approach to an integrated assessment of national ecosystems and their services is based on the concept of value or benefit transfer. Benefit or value transfer techniques, nowadays commonly applied in the field of ecosystem services valuation, facilitate the assessment of ecosystem services benefits for human welfare (Liu et al., 2010; Wilson and Hoehn, 2006). In principle, the method enables the derivation of values (and other information) of the ecosystem examined based on data which have been previously carried out in order to value similar goods and services in a similar context (Liu et al., 2010). The strengths of this method are its time and cost effectiveness as well as the potential to substitute primary data when specific data is unavailable (Wilson and Hoehn, 2006). On the other hand, the application of the method introduces a risk of fundamental errors and biases. Eigenbrod et al. (2010) defined uniformity error, sampling error and regionalization error as the three main components of generalization inaccuracy.

Commonly two basic types of benefit transfer are distinguished – unit transfer and a function transfer (Plummer, 2009). Schägner et al. (2013) add to these two types adjusted unit values transfer and meta-analytic value function transfer. Alternatively, others recognize four levels of value transfer such as basic value transfer, expert modified value transfer, statistical value transfer and spatially explicit functional modeling (Kubiszewski et al., 2013).

These four approaches differ in accuracy, time intensity and costs requirements in a growing trend from the first to the fourth level.

As the data available for the majority of ecosystems as well as services are limited, we apply the unit transfer technique to transfer data from existing studies to the case of the Czech Republic. Based on the biophysical and economic values of ecosystem services present in our database, we transferred values according to the ecosystem accounting approach, which takes into account specific natural ecosystem units occurring on the area of the Czech Republic. Our approach to a benefit transfer application as well as detailed explanation of data collection, classification of ecosystems, their services and ecosystem services values calculation is described in the following section. Fig. 1 illustrates the methodological framework of the database set up of biophysical and economical values and subsequent benefit transfer valuation. The methodological framework included four basic components, namely (1) systematic review of literature, (2) the database construction, (3) benefit (value) transfer and (4) the analysis and subsequent data interpretation.

2.2.1. Data collection

To collect input data for the database on biophysical and economical values we followed a specific search strategy. The search was done in two electronic journal databases, Web of Science (WoS) and Scopus. As a combination of keywords we applied (as demonstrated on an example of grasslands) “Ecosystem service* AND valuation AND grassland*” and “Ecosystem service* AND assessment AND grassland*”. For other ecosystems we replaced “grassland*” by one of the relevant keywords as stated in Table 1. We considered all document types published from 1st January 2000 to 31st December 2012. Additionally, we went through first 50 records for each keywords combination at Google Scholar, published in the same period, to check gray literature. However, no extra contribution was found for the predefined keyword chains and therefore we did not exploit this data resource more thoroughly.

Criteria for data selection were defined similarly to those applied in the case of the Ecosystem Service Valuation Database (ESVD) creation (Van der Ploeg et al., 2010). Among other reasons, this approach increases the compatibility of our findings with the database, where they can be potentially added.

In order to ensure applicability of the transferred data to Czech conditions, we only used data sources from between the latitudes

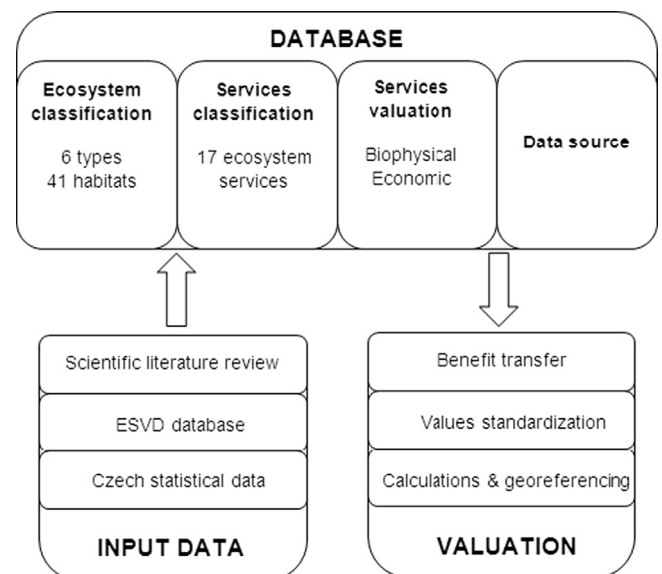


Fig. 1. A methodological framework.

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