Applicability of selected map sources at different spatial scales to ecosystem services valuation

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Introduction

The socio-economic assessment of the global change impact on ecosystem services (ES) provision is not possible without appropriate description and classification of relevant ecosystems (biotopes, habitats) in the landscape and without a reliable quantification of their ES. The aim of our study was to compare the use of selected space data sources to assess habitats using the biotope valuation method (BVM), as one of the possibilities how to evaluate the habitat for species provision ES.

Methods

We chose the "habitat for species provision" ES, i.e. one of the supporting services according to Millennium ecosystem assessment conceptual framework (2005), and valuated it using biotope valuation method (BVM; Seják et al. 2003) on the base of different data and on different spatial scales. The effect of spatial scale on landscape value was tested on 10 selected map sheets (area of 1 map sheet 18.5 km^2; Fig. 1), which differ in percentage of natural and near-natural habitats mapped in Natura 2000 framework and type of landscape use (Löw & Novák 2008). We studied both components of scale: grain and extent. The extent was changed by dividing area of map sheets into 1/2 (9.31 km^2), 1/4 (4.66 km^2), 1/8 (2.33 km^2), 1/16 (1.17 km^2), 1/32 (0.58 km^2) and 1/64 (0.29 km^2) of their original size (Fig. 2). Change in grain was represented by two different methods – BVM mapping with fine grain (0.25 ha) and coarse-grained CORINE land cover database (CLC) with minimum mapping unit of 25 ha. The average point values were calculated for all CLC classes occurring in the Czech Republic in the same way as for BVM habitat mapping. Percentage of present habitats for particular CLC classes in the Czech Republic was specified using the CzechTerra landscape inventory system (Šímová et al. 2009). On the local level (whole map sheet, 18.5 km^2) we tested applicability of a newly proposed method – use the CLC data only for more anthropogenically influenced habitats and complete it by habitat mapping of Natura 2000 framework for natural and near natural habitats. Financial values of habitats were recalculated from points to EUR via method of average national costs of restoration measures, necessary for maintaining and improving biodiversity of habitats (Seják et al. 2003). Results were tested statistically using paired T-test.

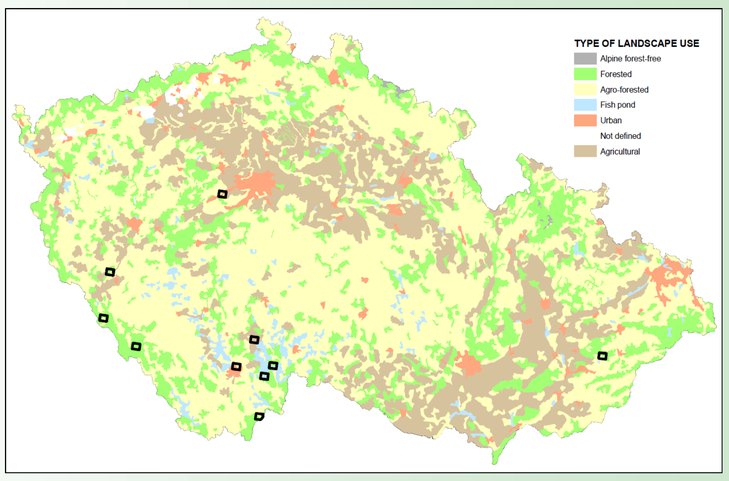

Fig. 1

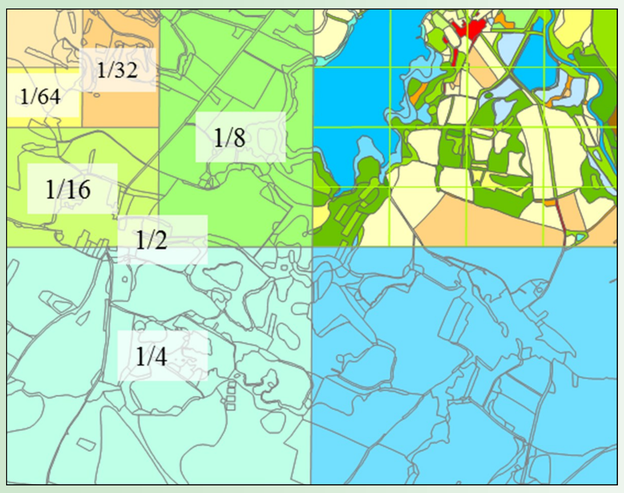

Fig. 2

Results and Discussion

Values of habitat for species provision ES in the 10 studied areas (map sheets), calculated from all three above mentioned map layers are shown in Fig. 3. Values obtained from the BVM map data differ significantly from values obtained from coarse-grain CLC data (paired T-test: t=2.23, p=0,05). The general trend shows the higher percentage of natural and near-natural habitats the higher difference in values. However, the point of intersection of linear fitting lines (18.6 % of natural and near-natural habitats) determines whether the values obtained from CLC map data rather overestimate values obtained from the BVM data (% of natural and near-natural habitats is lower than 18,6) or underestimate it. Results of dividing area of map sheets (18,5 km^2) into 1/2 - 1/64 (scaling) show the same trend as for the all 10 map sheets, but the range of values obtained from CLC data is broader and thus make the results less obvious. We tried to explain this fluctuation and divided valuated map sheets into landscape types and compared the datasets again (Tab. 1). These results shows that there are really significant differences among particular landscape types. The situation is further illustrated in Fig. 4, where the range of average values for particular landscape types within the whole Czech Republic is plotted for most frequent CLC classes. In case that all types of habitats are included, the results show very high fluctuation (Fig. 4A), whereas if only more anthropogenically influenced habitats are considered, almost no fluctuation of assessed values appears (Fig. 4B).

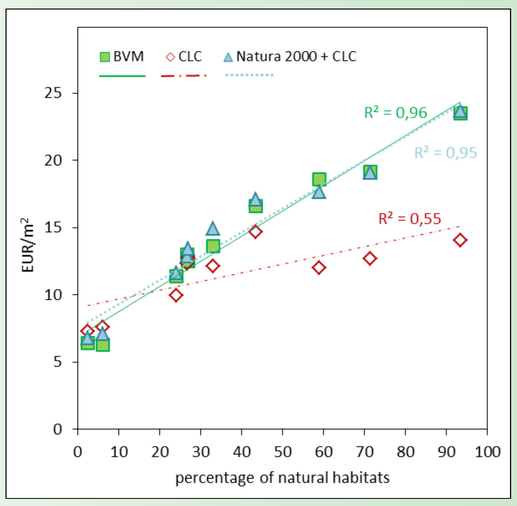

Fig. 3

Section	Area [km^2]	T-test statistic																	
		All landscape types			Urban			Agricultural			Agro-forested			Forested			Fish pond		
		t	df	p	t	df	p	t	df	p	t	df	p	t	df	p	t	df	p
1	18,56	2,23	9	0,05	-2,08	1	0,29	0,48	2	0,68	0,99	7	0,35	3,13	6	0,02	1,46	2	0,28
1/2	9,28	3,12	19	0,01	-2,67	3	0,08	0,31	3	0,78	1,66	13	0,12	4,02	15	< 0,01	2,43	4	0,07
1/4	4,64	4,25	39	< 0,01	-2,38	7	0,05	0,66	6	0,53	1,88	26	0,07	5,57	29	< 0,01	3,48	8	0,01
1/8	2,32	5,91	79	< 0,01	-3,50	12	< 0,01	0,19	10	0,85	2,93	46	0,01	6,75	55	< 0,01	-3,50	16	< 0,01
1/16	1,16	7,97	159	< 0,01	-3,04	22	0,01	0,004	21	1,00	3,58	83	< 0,01	8,74	94	< 0,01	5,07	30	< 0,01
1/32	0,58	10,74	318	< 0,01	-3,25	38	< 0,01	0,29	39	0,82	4,32	150	< 0,01	12,02	173	< 0,01	6,43	35	< 0,01
1/64	0,29	14,35	637	< 0,01	-4,08	69	< 0,01	-0,43	78	0,67	4,67	268	< 0,01	16,14	314	< 0,01	8,01	99	< 0,01

Tab. 1

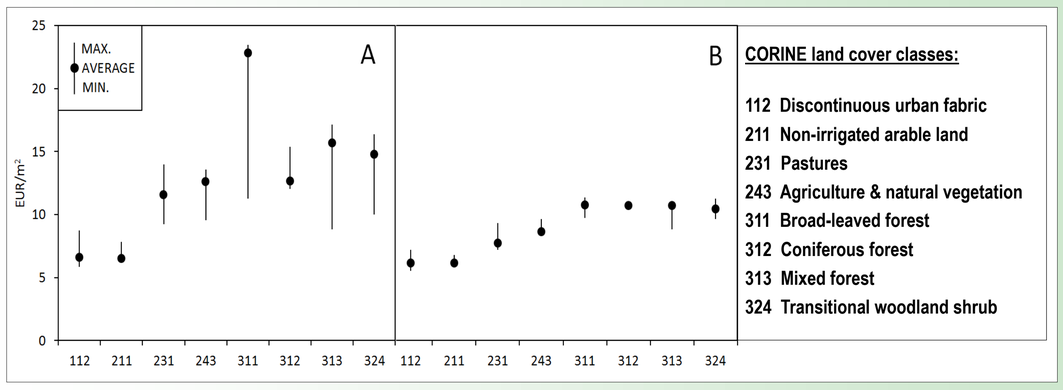

Fig. 4

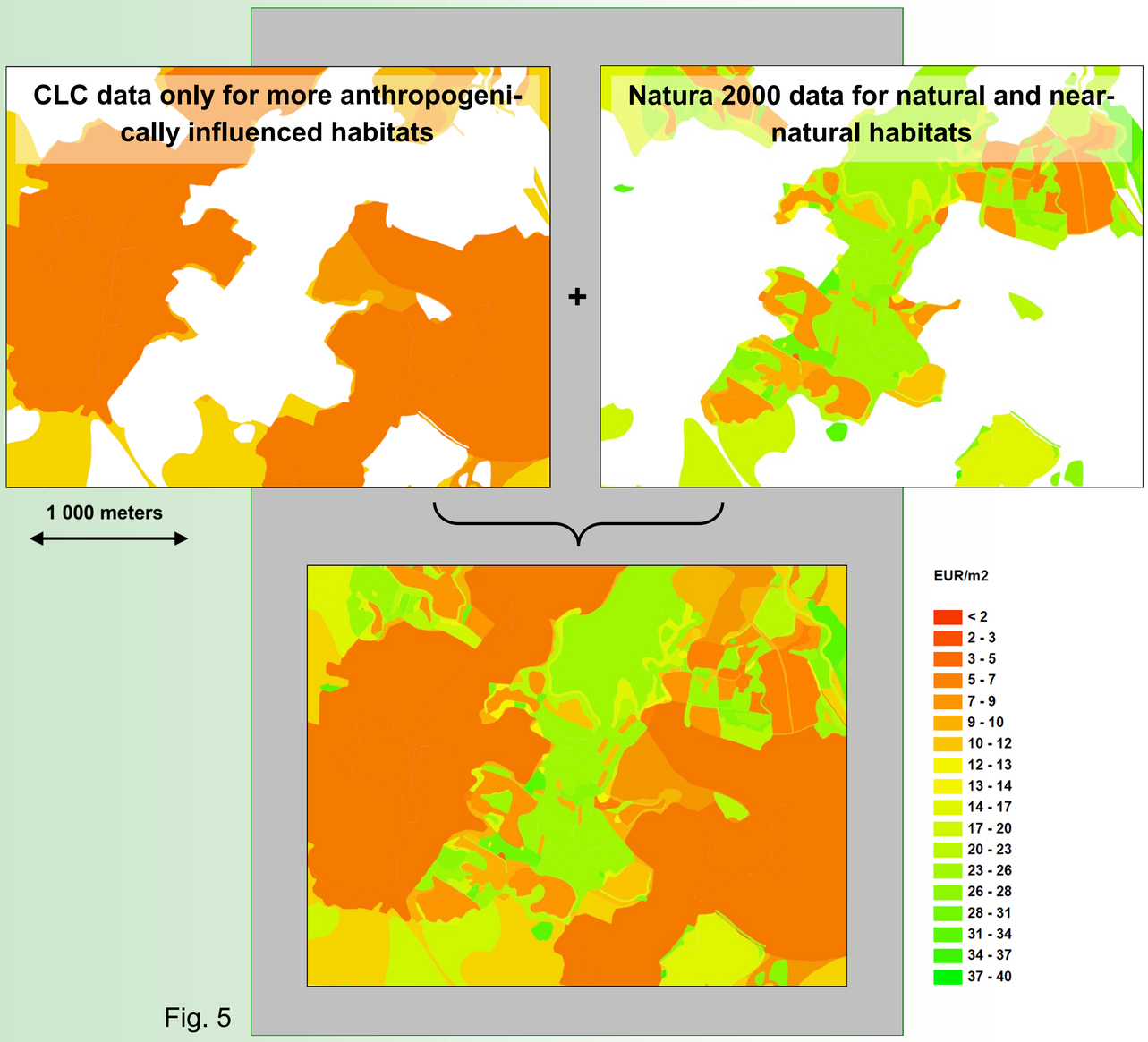

Fig. 5

These results let arose the idea to establish a new method combining the CLC data only for more anthropogenically influenced habitats and complete them by the data of natural and near-natural habitats arising from the habitat mapping for Natura 2000 framework (example of 1 valuated map sheet in Fig. 5). Reliability of this method was verified in the 10 studied map sheets, final values are plotted in Fig. 2. The linear fitting line almost imitate the linear fitting line created from the BVM data. Values of this method differ not significantly from values obtained using BVM data (paired T-test: t=-1,65, p=0,13). Advantage of this method consists in relative independence of scale of studied area. It is possible to use it from small areas at local level (e.g. one map sheet, 18,5 km^2) to the national level (i.e. the whole Czech Republic).

This approach can solve one of the main problems - high generalization of CLC data, mentioned by other authors using CLC data as a basic source data for landscape valuation. Thanks to an extraordinary detailed and area-wide mapping of natural and near-natural habitats all over the Czech Republic acquired in relation with the establishment of the Natura 2000 framework, it is possible to specify the generalized CLC data rather easily, without necessity of the time-consuming field work.

Acknowledgement

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