Biodiversity valuation of the Czech Republic measured by expert and restoration cost method

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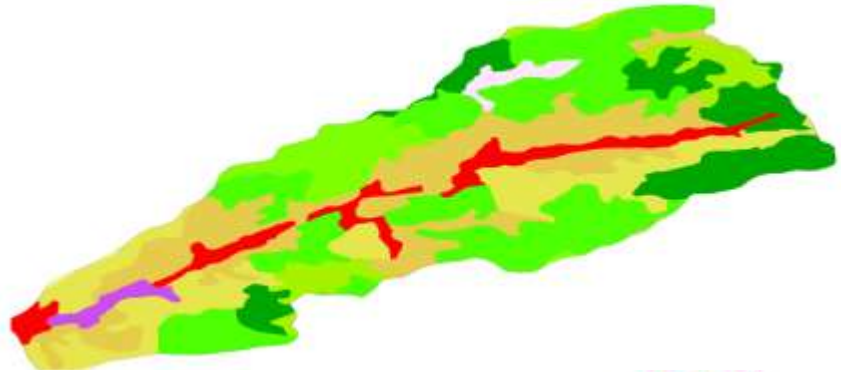
CzechGlobe

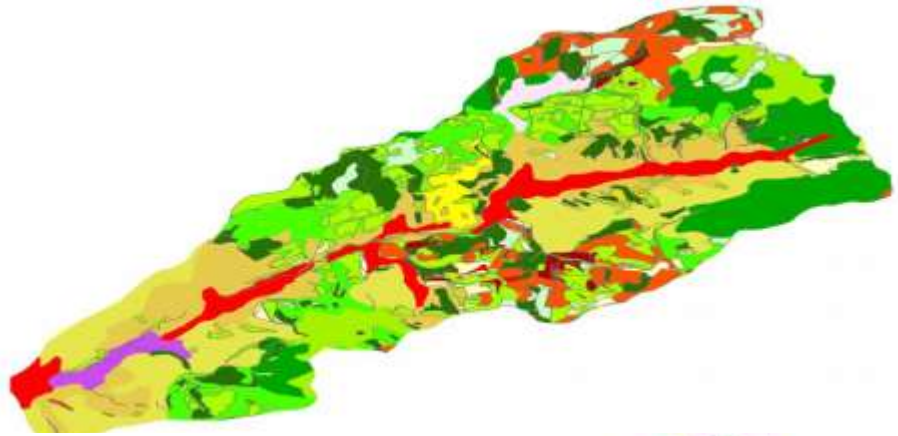
LU / LC = habitat maps

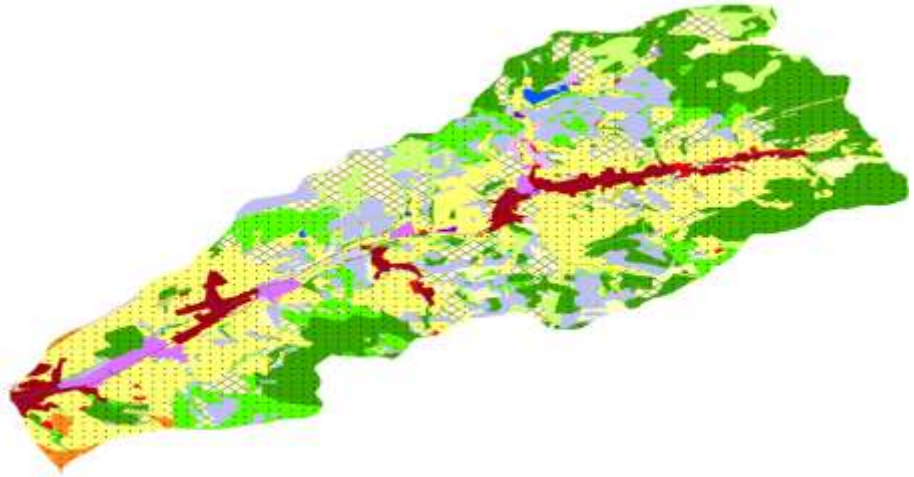
Habitat map = **geospatial matrix**

- **uniform** for whole area of CR
- **integrated** - several important datasets
- attach **knowledge base -** coeficients for assesment
- ecological point
- economic value
- fulfilment rate of selected ES

Corine LC	**Combined habitat layer**	**Detailed habitat layer**
1 : 100 000	1 : 100 000 & 1 : 10 000	1 : 10 000
national level	regional/local level	regional/local level







Creating a basemap of habitats

Landuse: Basic geographic data base (® ZABAGED)

Forests: Dominant leaf type 2018 (© ESA - Copernicus),
Forest growth stages (© ÚHÚL 2015)

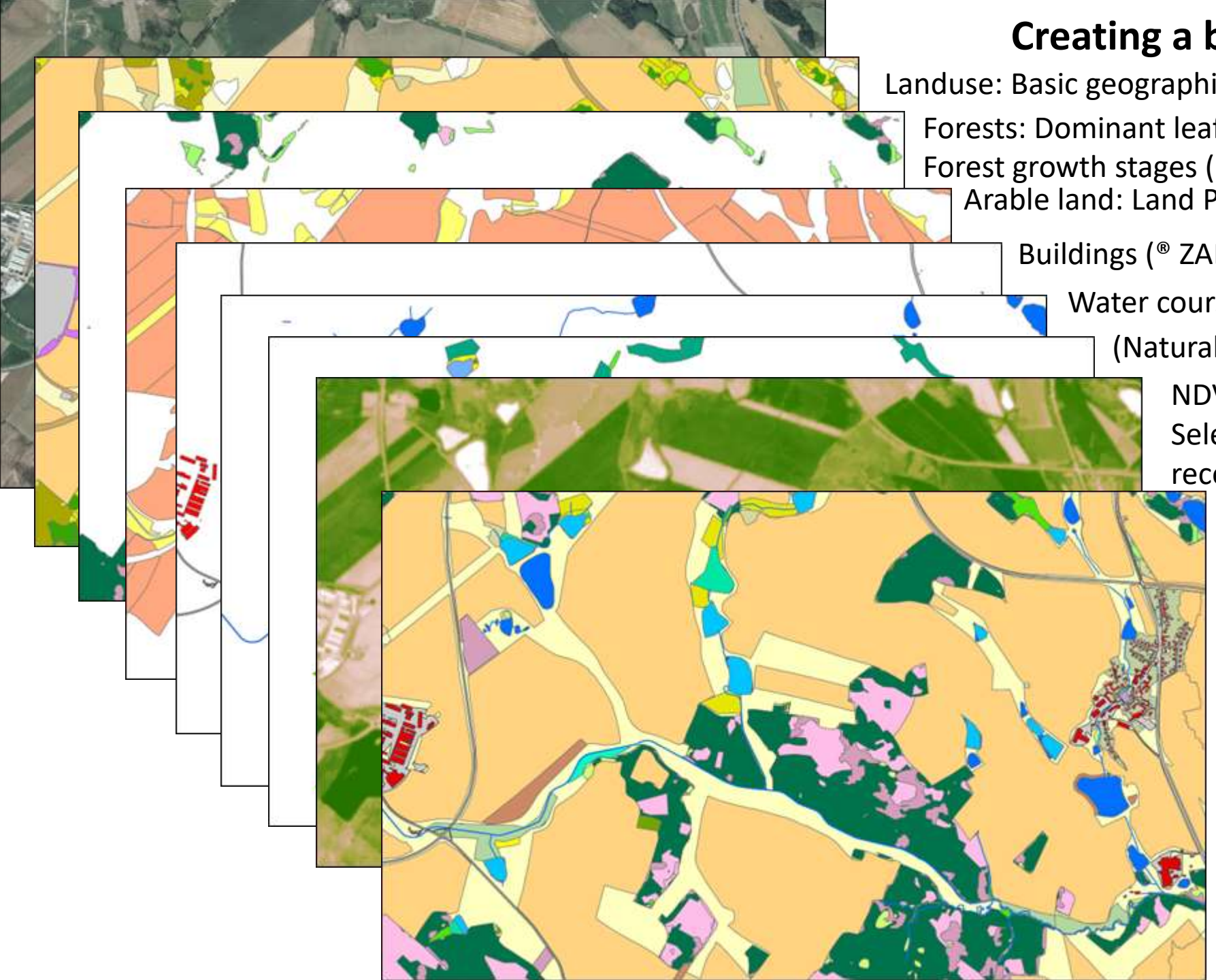
Arable land: Land Parcel Identification System (LPIS)

Buildings (® ZABAGED), Roads and Railways (© OSM)

Water courses and waterbodies (® ZABAGED)

(Natural) habitat mapping (© NCA CR)

NDVI (Sentinel-2 data 2020, 2022, © ESA)
Selecting areas without vegetation and recent forest clearings.



Detailed habitat layer

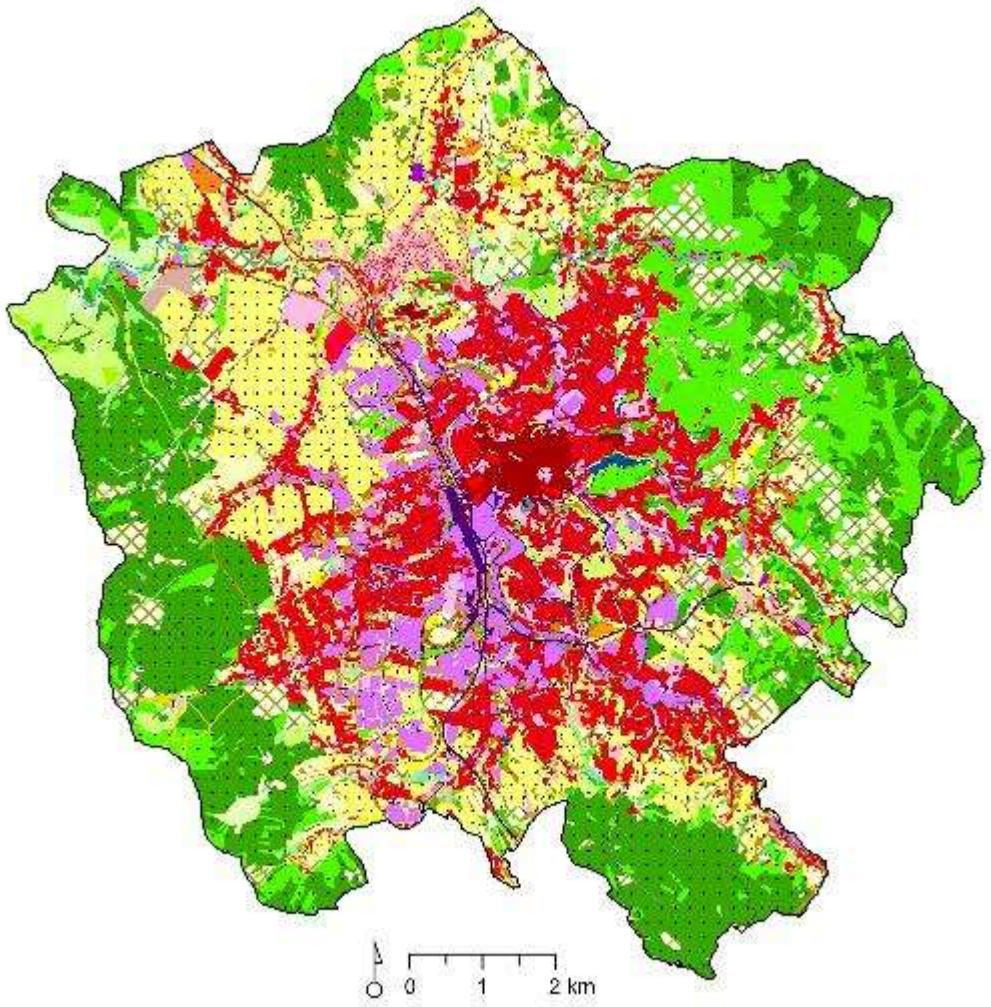
Updated to 2020 - 2022

Habitat Valuation Method – HVM

- Total value of nature is unlimited and it is not possible to calculate its price
- It is possible to valuate habitats as biodiversity carriers, e.g. by the Habitat Valuation Method – BVM (Seják et al. 2003)
- HVM (based on the original Hessen method) valuates 192 habitat types in the Czech Republic (138 Natura 2000 natural and near to nature habitats and 53, now 38 un-natural habitats)

CURRENT SUPPLY OF EF

Map data – Combined habitat layer



- **47** categories of natural and semi-natural habitats
- **38** categories of un-natural habitats
- Habitat Mapping of Nature Conservation Agency of the CR, complemented by GIS layers: LPIS, Urban Atlas, OSM, Dominant Leaf Type - Copernicus Programme)

Habitat Valuation Method (HVM)

- All habitats were divided into five groups according to their naturalness, from natural to anthropogenic habitats

- Natural habitats – (forests, wetlands, peat bog)
- Semi-natural habitats – (meadows)
- Slightly degraded habitats (degradaded meadows)
- Strongly degraded habitats (arable land)
- Totally degraded habitats (built-up area)





Expert evaluation of habitat types

Relative value of biotope types is calculated from eight characteristics that represent ecological quality and rarity (endangereness).

Ecological charakteristics		**Charakteristics of rarity or endangereness**	
1. diversity of species	1 – 6 points	5. rarity of biotope type	1 – 6 points
2. diversity of structures	1 – 6 points	6. rarity of species in the biotope type	1 – 6 points
3. matureness	1 – 6 points	7. vulnerability	1 – 6 points
4. naturalness	1 – 6 points	8. endangereness of amount and quality	1 – 6 points

Calculation:

[(1.+ 2.+ 3.+ 4.) * (5.+ 6.+ 7.+ 8.) / 576] * 100 = relative point value of habitat type (3-100)

Output: The list of habitat types and their relative point values.

Source: Seják, Dejmal (2003), Valuation of biotopes in the Czech Republic (in Czech)

Individual evaluation corrects the basic point value in the case when the habitat does not correspond with the conditions, described for given type in Catalogue of habitats (Chytrý et al. 2001). The correction is made by means of the coefficients based on following criteria:

Criterion	Base for valuation	Coefficient extent
Ontogenetical matureness	% of fulfiling its ecological functions	0,6 – 1
Naturalness	Presence of invasive and expansive species	0,6 – 1
Fullness of species	% fullness of diagnostical species	0,6 – 1,2
Fullness of protected species	% fullness of protected species	0,6 – 1,3
Fulness of structures	% of potentially present vegetation layers	0,6 - 1
Integrity	a) according to the biotope size (ability to sustain in the landscape)	0,6 – 1
	b) ability to influence positively the ecological stability	1 – 1,3
	c) bioregional point of view (suitability of the biotope)	1 – 1,2

Source: Seják, Dejmal (2003), Valuation of biotopes in the Czech Republic (in Czech)

Habitat Valuation Method (HVM)

- Each biotope was identified and ranked by point values according to its plant biodiversity and its endangerment

- The financial values of one point (0.58 EUR in 1990 and 1.20 EUR in 2017) were derived from 136 (145) restoration projects and presents the cost that government payed in past in the frame of restoration programs to increase the ecological quality of 1 m^2 of habitat by 1 point

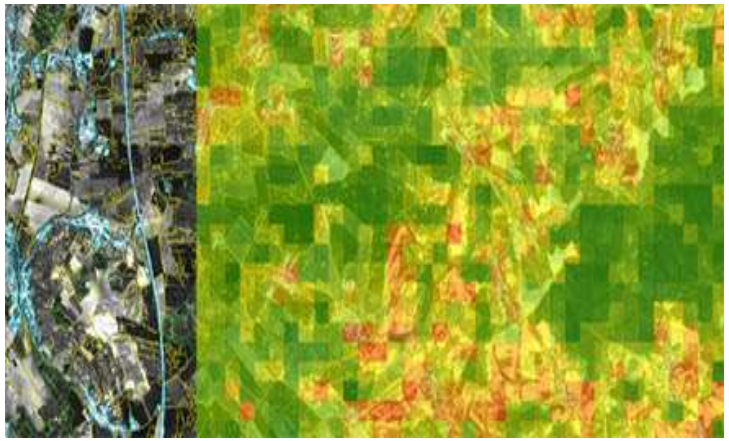
http://www.dotace.nature.cz/res/data/000205_05_000576.jpg?seek=1219922991

Application of Habitat Valuation Method

- in quantification of ecological lost during landscape management
- in landscape planning
- in reasonable subsidy policy
- in affectiveness in restoration and adaptation measure valuation
- in selection of optimal alternative during the EIA process

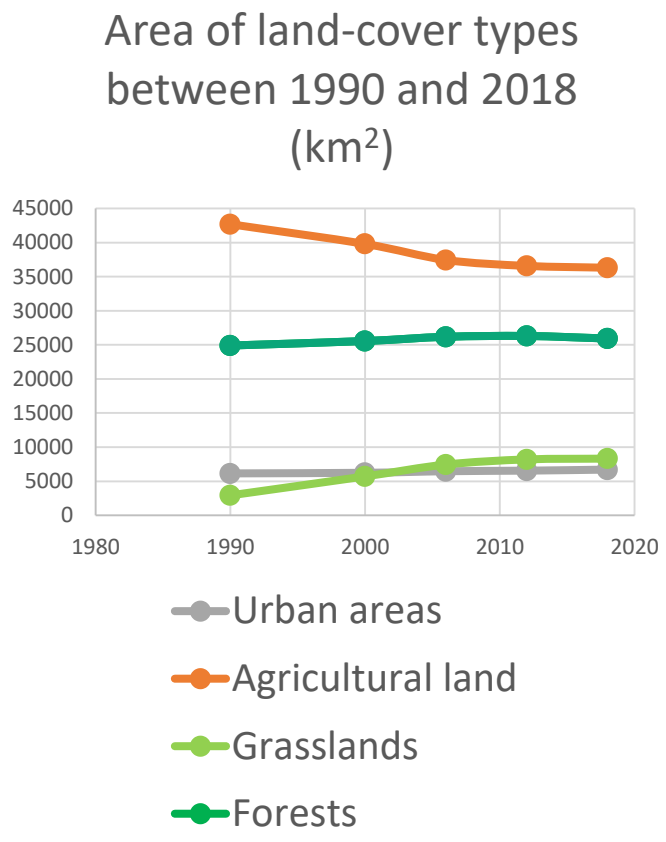
The changes in biodiversity values determinated in the Czech republic

- Since 90ties of 20th century – positive ecological changes
- Changes were caused by:
  - transformation of part of arable land to meadows
  - increasing of the forest area
- in the year 1990 – 629 billions EUR
- in the year 2000 – 652 billions EUR



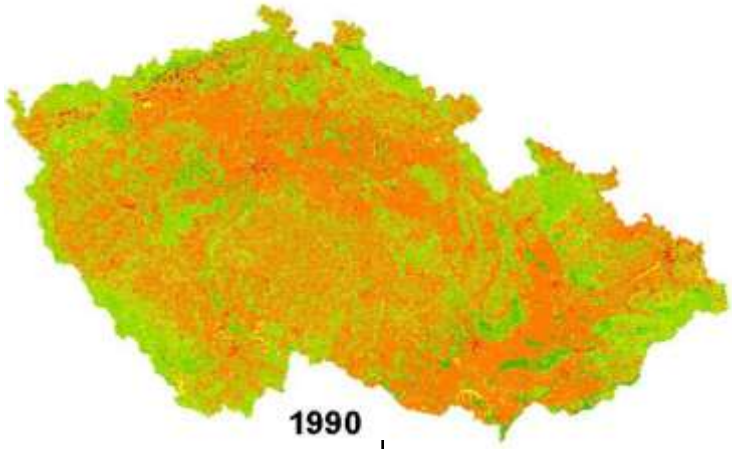
Summary of the overall changes in land cover categories (1990 – 2018)

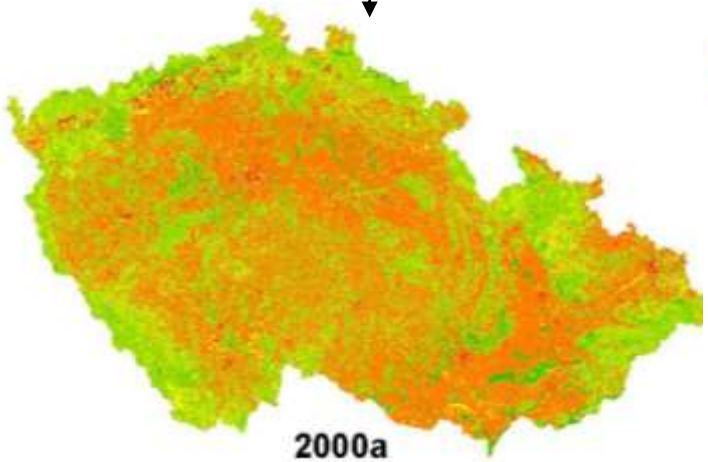
Land cover categories		Area (km2) in years:				
		1990	**2000**	**2006**	**2012**	**2018**
Urban areas	Continuous urban fabric	14,64	14,64	15,67	15,67	15,70
	Industrial or commercial units	521,2	547,7	602,1	631,0	656,5
	Road and rail networks and associated	48,1	52,7	62,6	72,1	71,9
	Discontinuous urban fabric	3579	3626	3784	3825	3947
	Total urban areas	**6152,41**	**6240,95**	**6469,91**	**6556,03**	**6709,17**
Agriculture	Non-irrigated arable land	35541	32622	29892	28991	28705
	Complex cultivation patterns	415	430	476	473	474
	Agricultural land with natural elements	6736	6748	7079	7114	7128
	Total agriculture	**42693**	**39799**	**37447**	**36578**	**36307**
Grasslands	Pastures	2528	5317	7186	7944	8068
	Natural grasslands	405	392	262	257	252
	Total grasslands	**2932**	**5709**	**7448**	**8201**	**8320**
Forests	Broad-leaved forest	2495	2527	2783	2839	2834
	Coniferous forest	16552	16993	17227	17126	16658
	Mixed forest	5855	6042	6174	6337	6437
	Total forests	**24902**	**25563**	**26184**	**26302**	**25929**

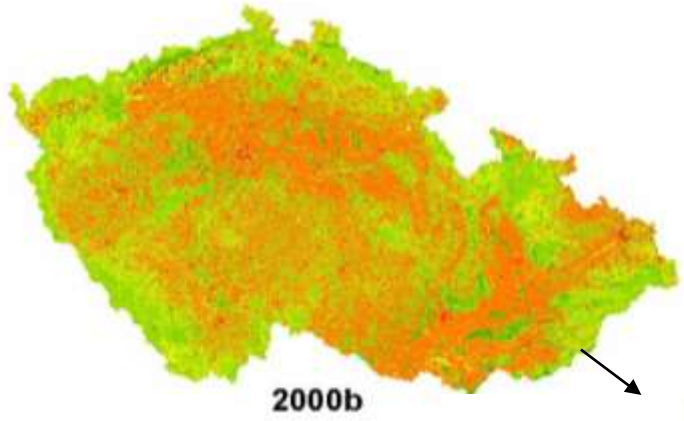


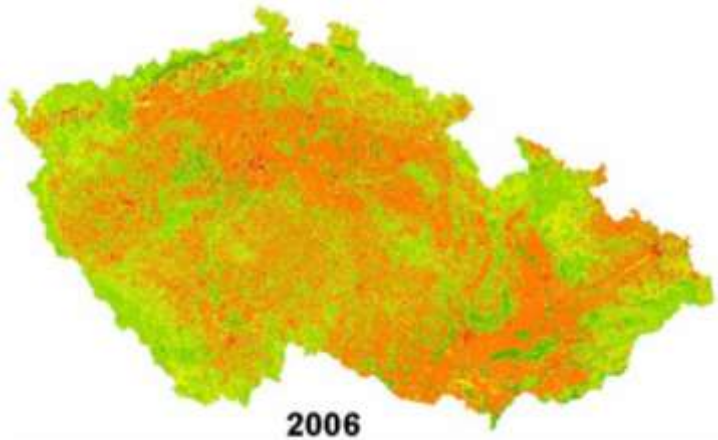
The map of biodiversity value of the Czech republic created on the base of the CORINE-LC data in 1990, 2000 and 2006

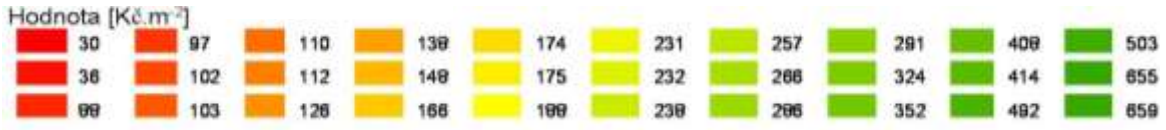
CLC	Total point value	Point value [point.m^{-2}]	Financial value [billion Kč]	Financial value [Kč.m^{-2}]
1990	1440654767357	**18,27**	17777	**226**
2000 a	1470545909371	**18,65**	18146	**231**
2000 b	1490783235757	**18,90**	18426	**234**
2006	1497232440841	**18,98**	18475	**235**











Application of HVM method in practise

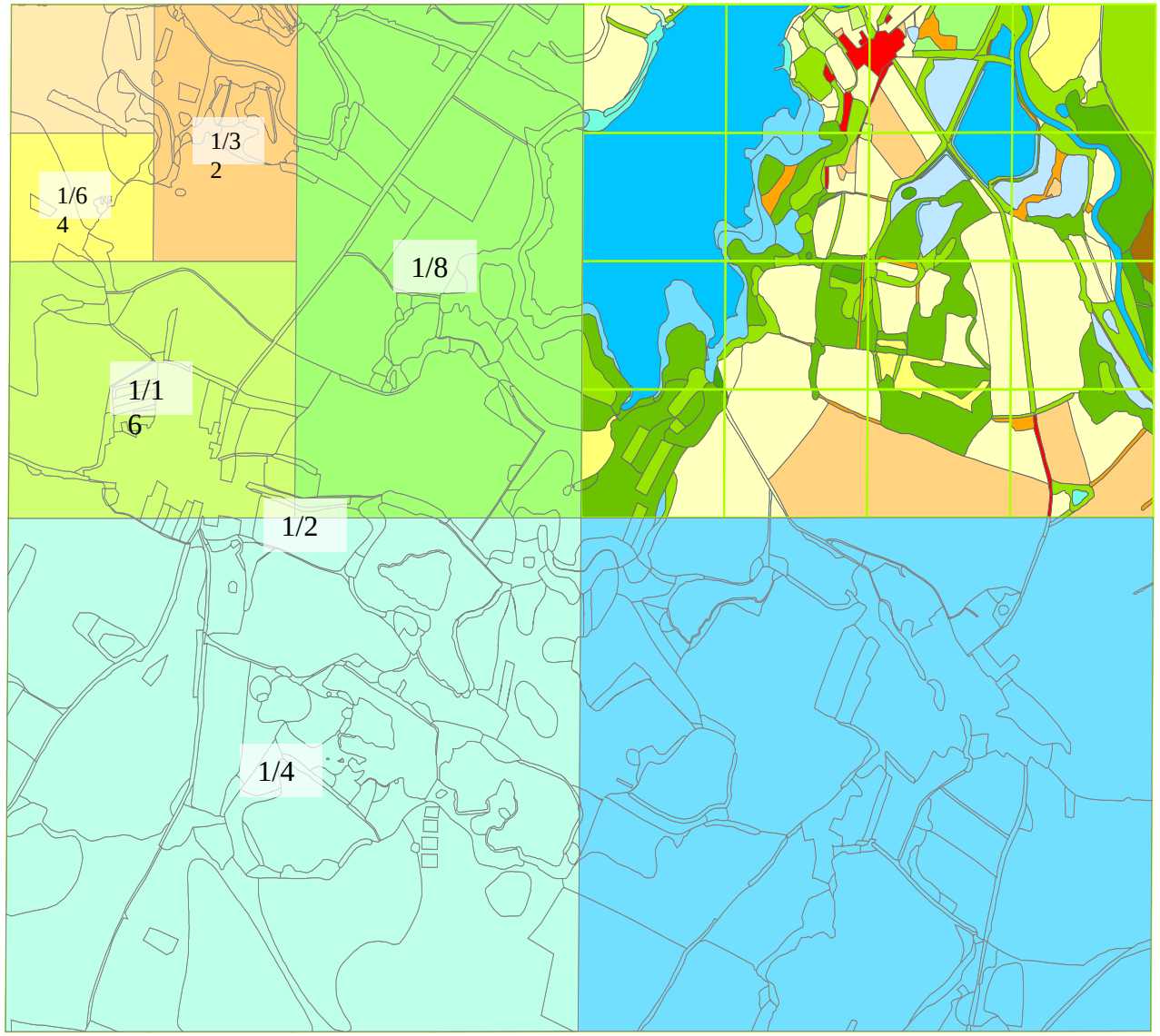
- **Assessment of biotopes before and after the restoration of the Litovicko-Šárecký stream in Prague**

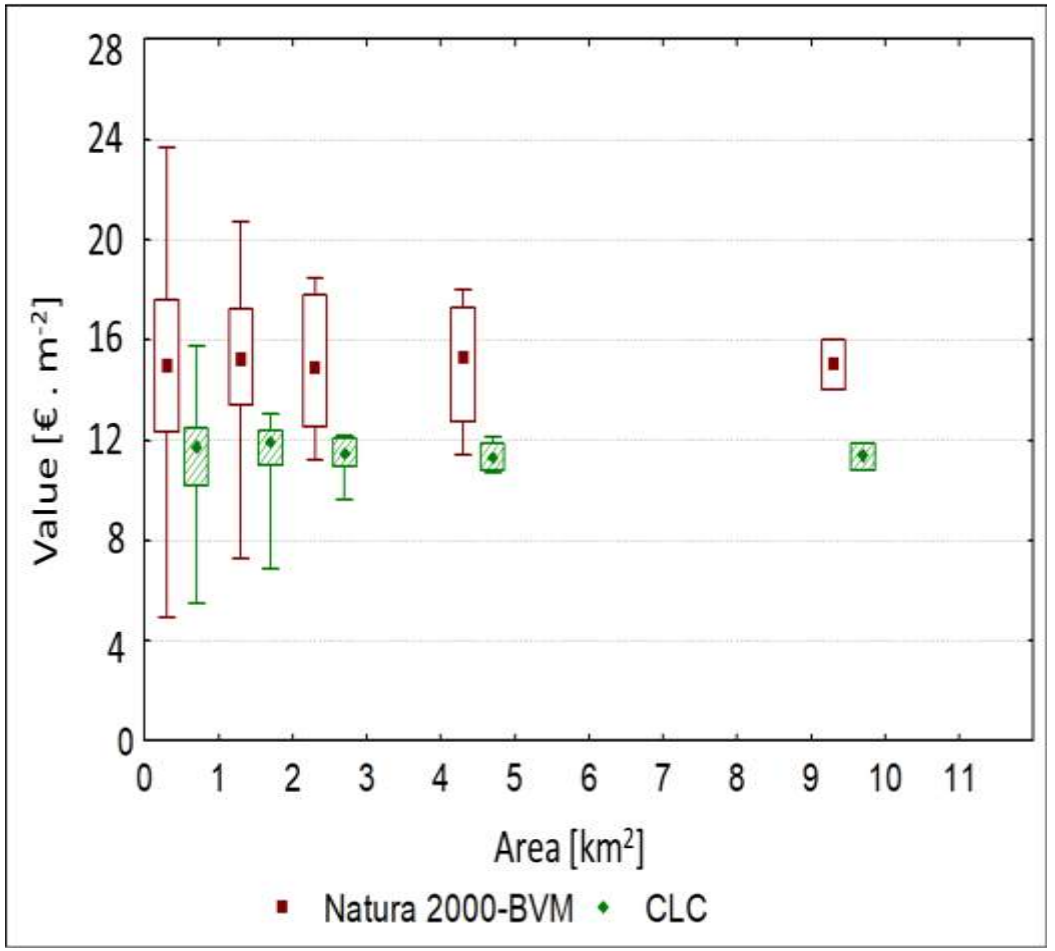
The value of biodiversity increased for 219 815 CZK after restoration and in 30 years the value is predicted for next 180 257 CZK.

- **Estimation of ecological damage and loss of ecosystem services from the implementation of the Prague-Klánovice golf course construction project**

It was established that the realization of the golf course would cause permanent ecological damage in the amount of 73 million CZK, or after an individual assessment of the habitats in question, this damage was estimated at 79.4 million CZK.

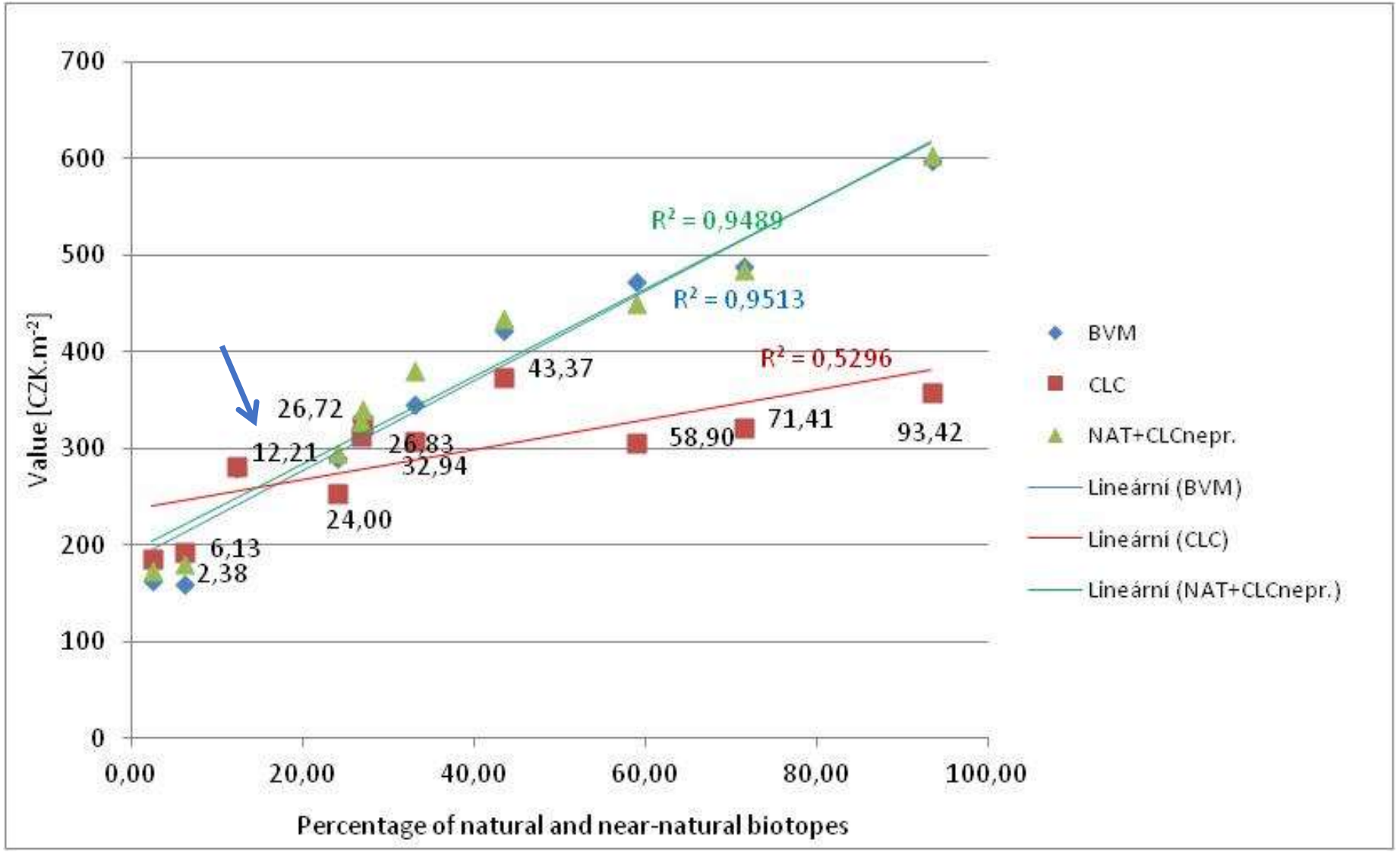
Scaling experiment





Scaling: map sheet cut to 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 (18.6 km^2). Created in ArcMap 9.0.

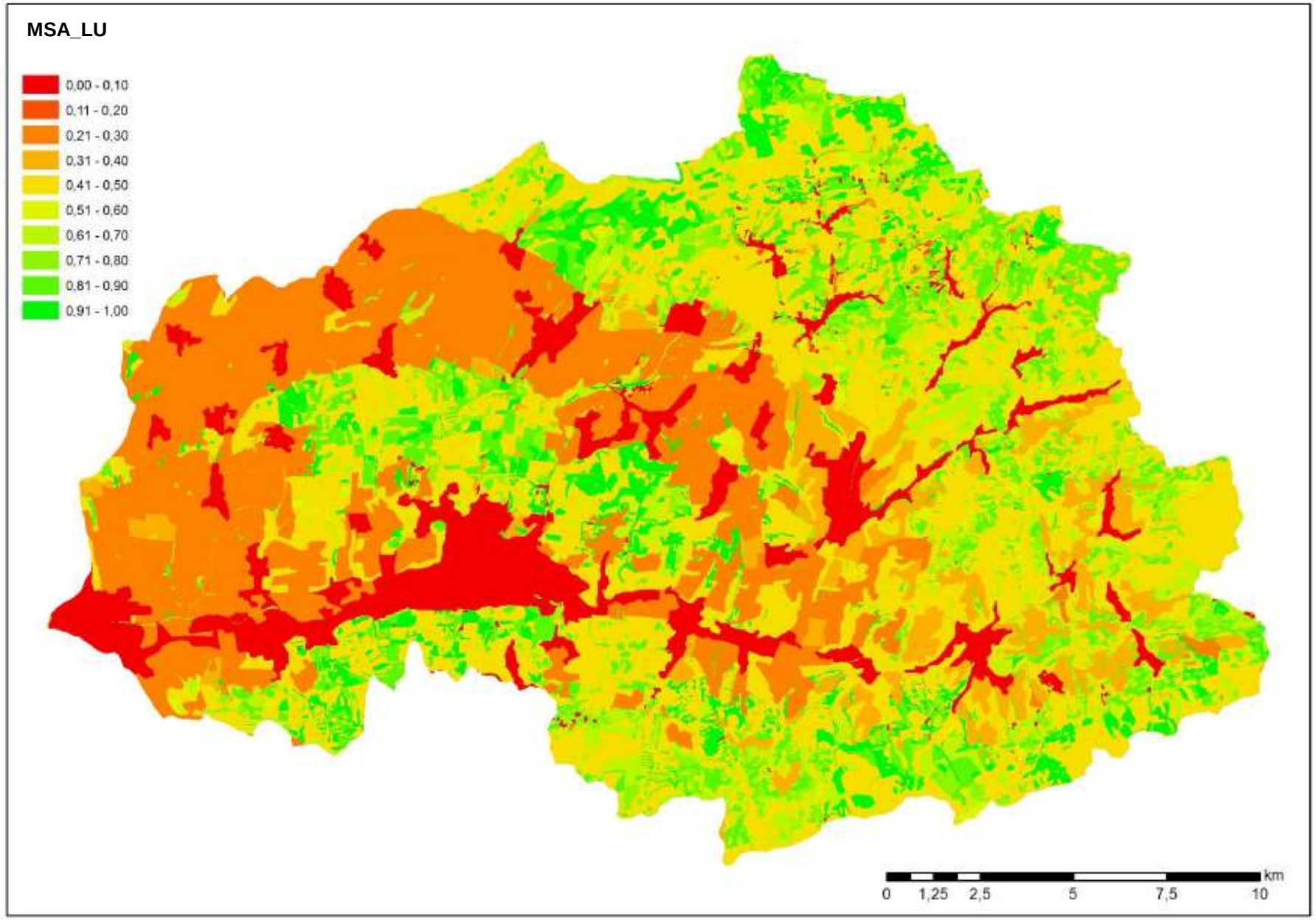
Dependence of habitat financial values on the percentage of natural habitat representation



GLOBIO3 (Global Biodiversity model)

- GLOBIO 3 is a tool for valuation of naturalness – losses of the diversity of origin species
- Model assesses risk of the reduction of biodiversity in the future
- GLOBIO3 works with 5 drivers which impact to biodiversity:
  – land use
  – increase of settlement and infrastructure
  – landscape fragmentation
  – atmospheric nitrogen deposition
  – climate change (changes in temperature and precipitation)
- MSA indicator (mean species abundance per area) reflects the worldwide threat to selected endangered species
- With regard to the conditions of the Czech Republic, we used MHV (mean habitat value per area); it reflects the naturalness of habitats according to BVM method

MSA – evaluation of habitat naturalness

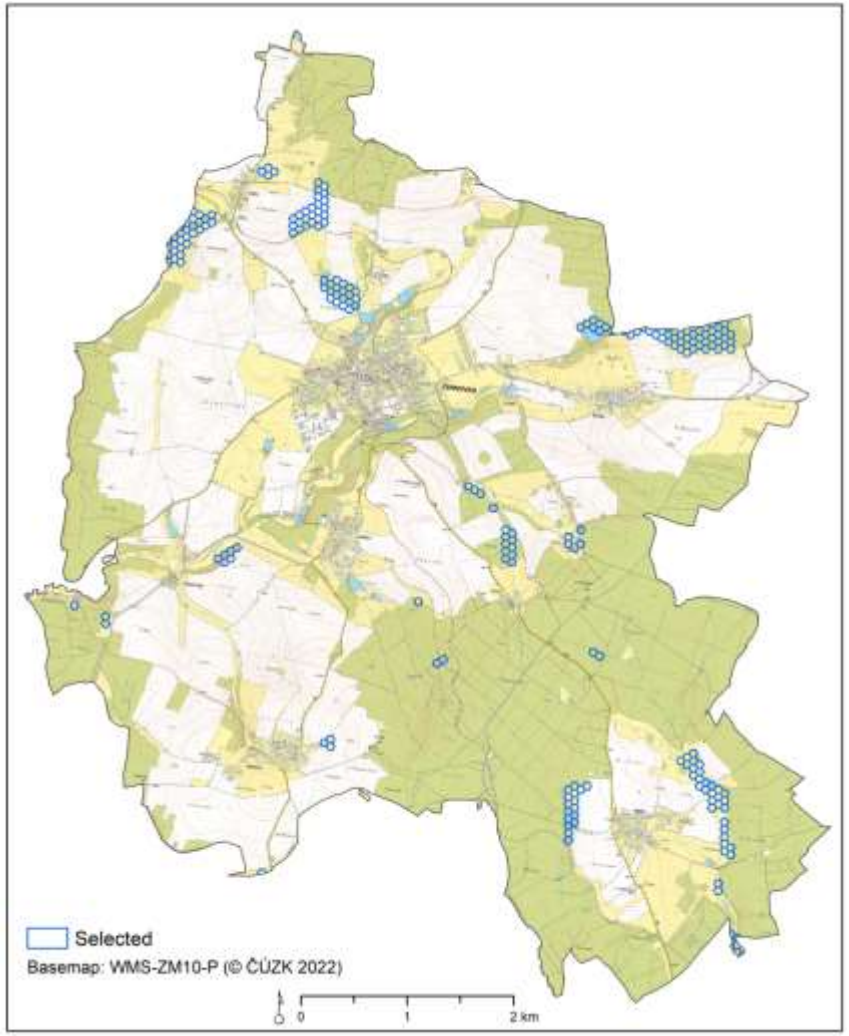


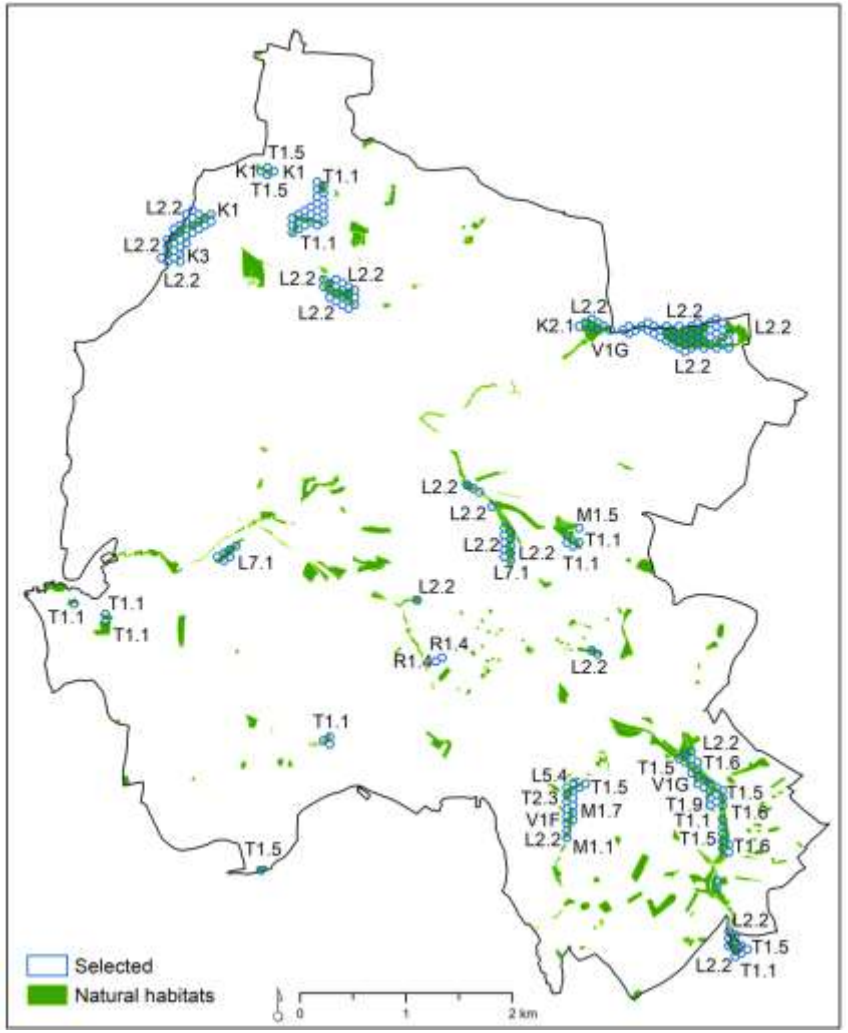
Marxan

- Marxan - software created for desicion in nature protection
- Software selects the combination of planning units, regarding to the selection of as much as possible defined conservation elements and least total expenses (Game, Grantham, 2008).
- Conservation elements could be individual species, habitats or whole biomes (Ardron a kol. 2010).

Results of the Marxan model for the territory of Černovice town

The selection of planning units (Selected), expressed by hexagons according to the distribution of conservation elements and the display of natural biotopes in the territory





A tool for assessing the resilience of selected EF/ES and landscape stability to climate change and creating proposals for their restoration and adaptation measures