Naturalness analyses of Hungarian landscapes by CORINE Land Cover data and Natural Capital Index

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- Concepts (definitions) of naturalness and hemeroby
- Land cover as the indicator of naturalness? Methods for evaluation the level of naturalness (hemeroby) based on CORINE Land Cover data
- New objective method, for identifying the multiplying factors of different aggregated land cover classes (based on our studies)
- Results and discussion

Concepts of Hemeroby (and Naturaleness):

- The hemeroby is "reverse" index of naturalness *(Grabherr et al., 1998; Kimet al., 2002).*
- To measure the degree of human impact on ecosystems *(Steinhardt et al., 1999). Sukopp et al. (1990)*
- Integrative analyses for the impact of all human interventions on ecosystems.
- Hemeroby is the magnitude of the disturbation from the potential natural vegetation caused by human activities

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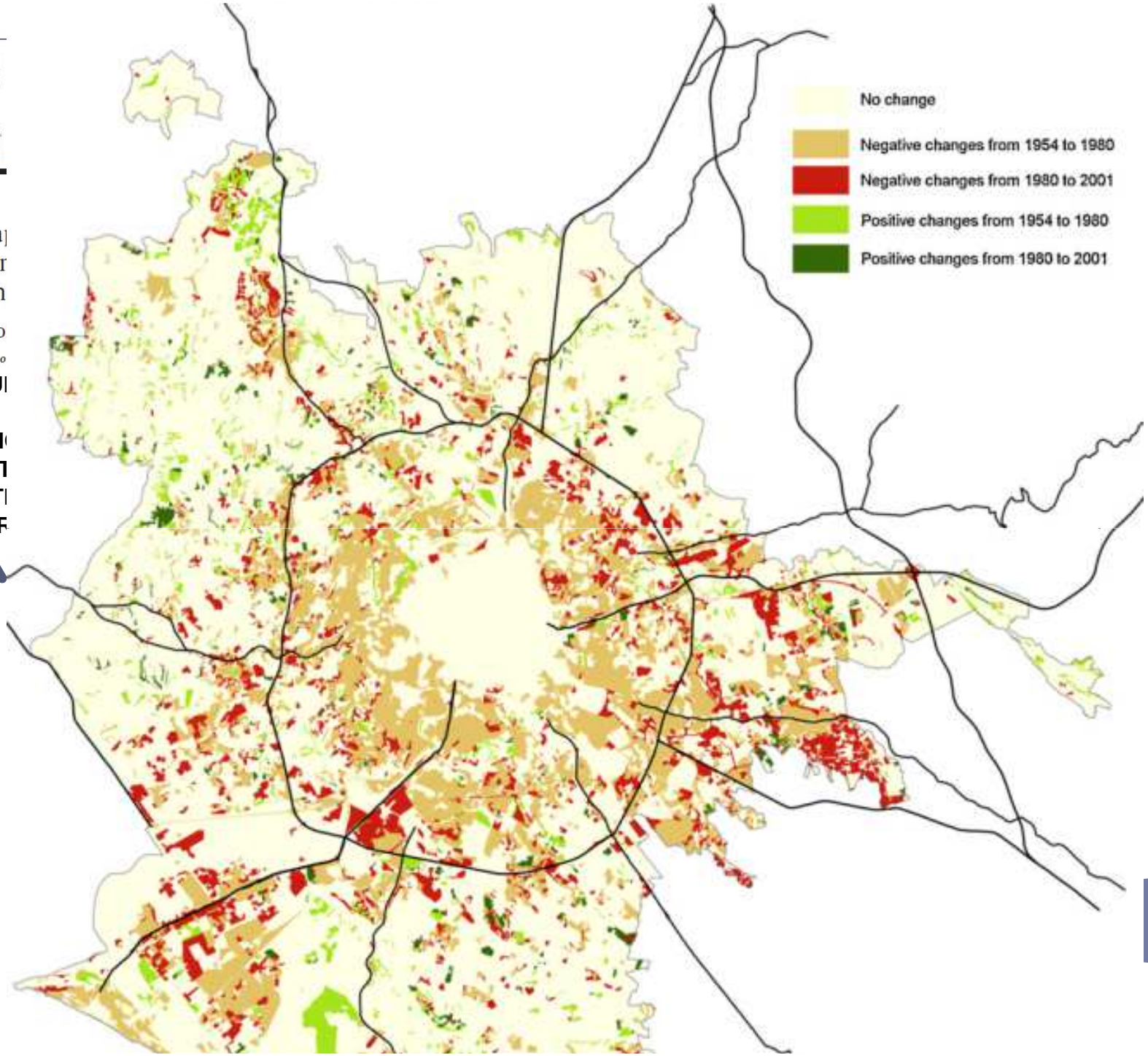
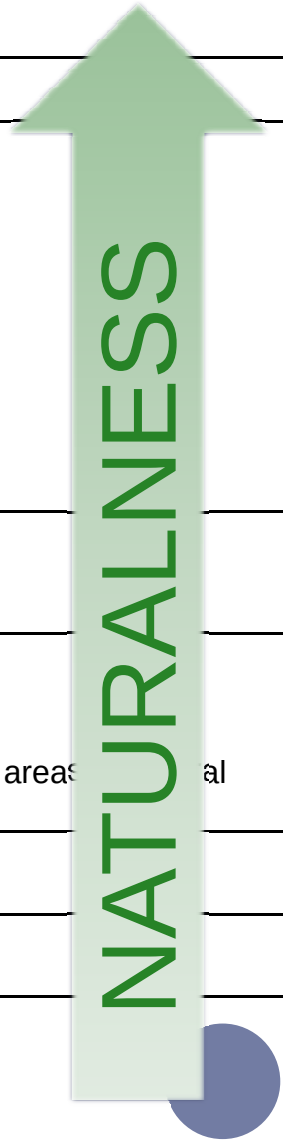


Hemeroby levels based on Land Cover (*P. Csorba and Sz. Szabó 2006)*

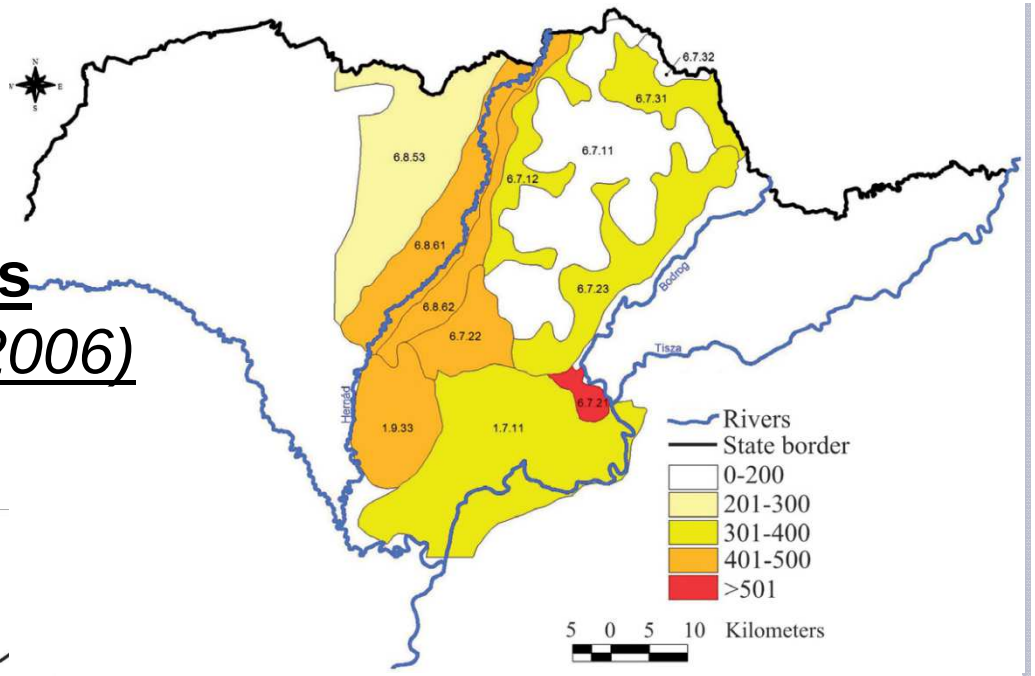
CORINE land use categories were used to identify the scale of human impact on the landscapes

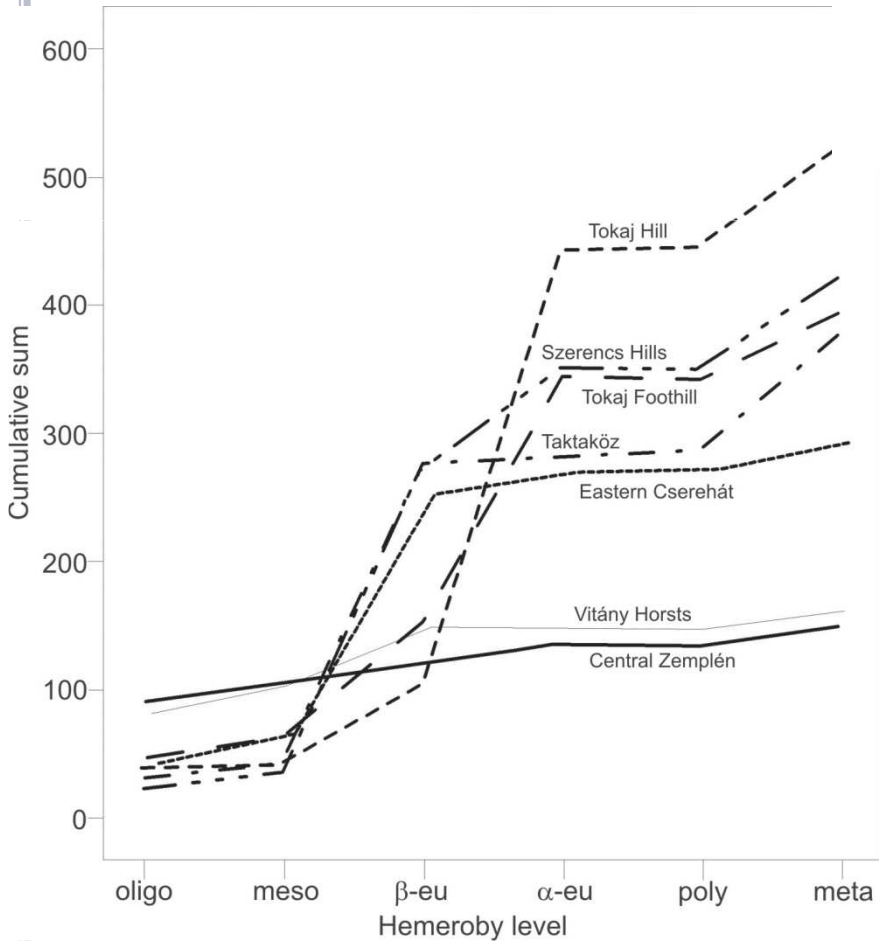
Level of Hemeroby	CLC 100 categories
ahemerobe	Does not appear in Hungary
oligohemerobe	3.1.1: Broad-leaved forest 3.2.1: Natural grasslands 3.2.2: Moors and heathland 3.2.4: Transitional woodland-shrub 3.3.2: Bare rocks 3.3.3: Sparsely vegetated areas 4.1.1: Inland marshes 4.1.2: Peat bogs 5.1.1: Water courses 5.1.2: Water bodies
mezohemerobe	2.3.1: Pastures 3.1.2: Coniferous forest 3.1.3: Mixed forest
alfa-euhemerobe	2.1.1: Non-irrigated arable land 2.4.1: Annual crops associated with permanent crops 2.4.2: Complex cultivation patterns 24.3: Land principally occupied by agriculture, with significant areas al vegetation
beta-euhemerobe	2.2.1: Vineyards 2.2.2: Fruit trees and berry plantations
polihemerobe	1.3.2: Dump sites 1.4.1: Green urban areas
metahemerobe	1.1.1: Continuous urban fabric 1.1.2: Discontinuous urban fabric 1.2.2: Road and rail networks and associated land 1.2.4: Airports 1.3.1: Mineral extraction sites 1.3.3: Construction sites 1.4.2: Sport and leisure facilities



Weighted hemeroby values

(P. Csorba and Sz. Szabó, 2006)

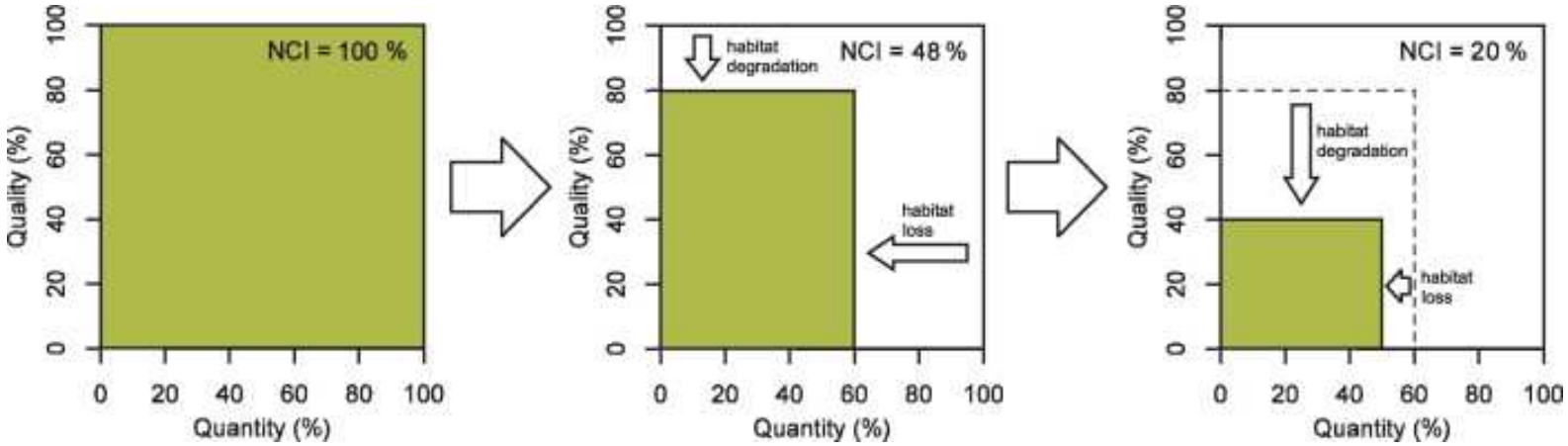


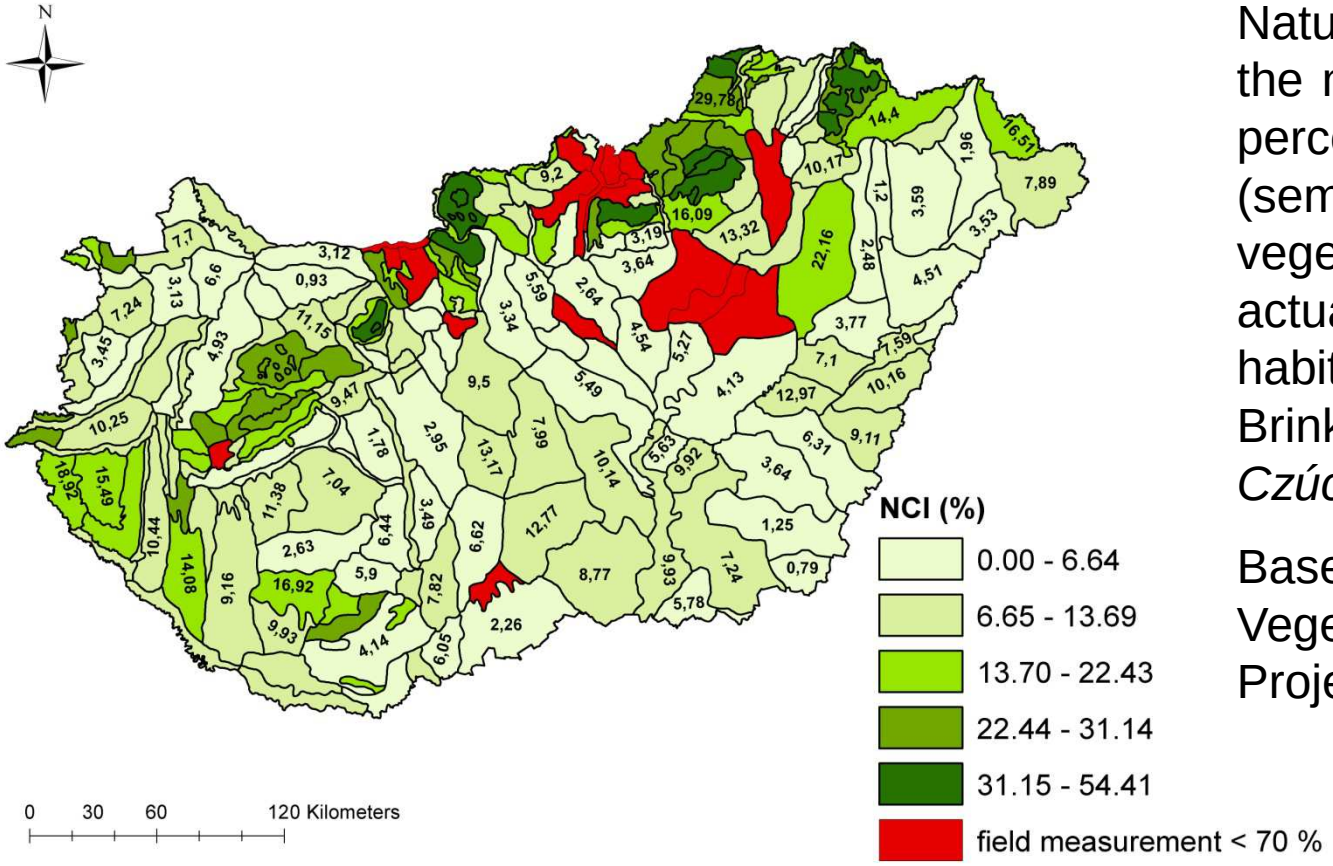


Level of Hemeroby	Multiplying factor
ahemerobe	Does not appear in Hungary
oligohemeribe	1 ?
mezohemerobe	2 ?
alfa-euhemerobe	4 ?
beta-euhemerobe	8 ?
polihemerobe	10 ?
metahemerobe	15 ?

RESEARCH GOALS:

- Testing the use of CORINE database for identifying vegetation (Natural Capital Index) based naturalness of landscape units.
- To find an objective method to calculate the multiplying factors of the different aggregated land cover classes.
- To calculate the naturalness of those areas where the naturalness of the vegetation (NCI) has not (sufficiently) been investigated yet.



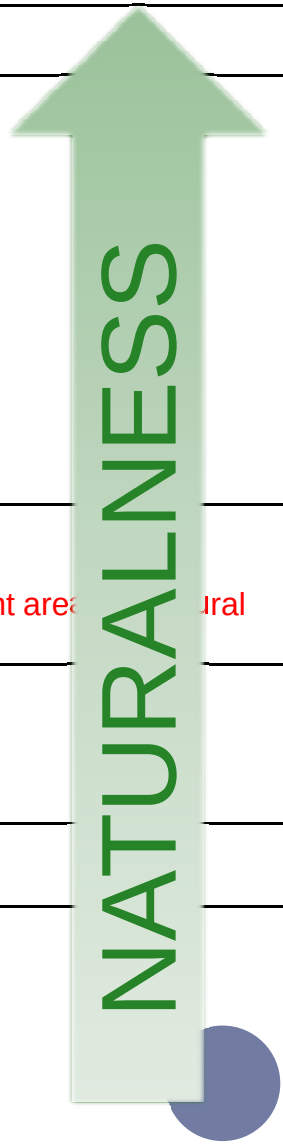


Natural Capital Index: the multiplication of the percentage area of (semi-) natural vegetation and the actual quality of the habitat patches. *(*ten Brink *et al.* 2002, *Czúcz et al. 2006)*

Based on Hungarian Vegetation Mapping Project (MÉTA 2000)

Hemeroby levels based on aggregated Land Cover (*P. Csorba and Sz. Szabó 2006) modified by the authors*

Level of Hemeroby	CLC 100 categories
ahemerobe	Does not appear in Hungary
oligohemerobe	3.1.1: Broad-leaved forest 3.2.1: Natural grasslands 3.2.2: Moors and heathland 3.2.4: Transitional woodland-shrub 3.3.2: Bare rocks 3.3.3: Sparsely vegetated areas 4.1.1: Inland marshes 4.1.2: Peat bogs 5.1.1: Water courses 5.1.2: Water bodies 2.3.1: Pastures
mezohemerobe	3.1.2: Coniferous forest 3.1.3: Mixed forest 2.4.3: Land principally occupied by agriculture, with significant area ural vegetation
alfa-euhemerobe	2.1.1: Non-irrigated arable land 2.1.3. Rice fielads 2.4.1: Annual crops associated with permanent crops 2.4.2: Complex cultivation patterns
beta-euhemerobe	2.2.1: Vineyards 2.2.2: Fruit trees and berry plantations
Polihemerobe and metahemerobe	1.3.2: Dump sites 1.4.1: Green urban areas 1.1.1: Continuous urban fabric 1.1.2: Discontinuous urban fabric 1.2.2: Road and rail networks and associated land 1.2.4: Airports 1.3.1: Mineral extraction sites 1.3.3: Construction sites 1.4.2: Sport and leisure facilities



$$NCI_{LUN_{1–222}} = \sum_{k=5} \left(HEM_{TIP_{1–5}} * W_{TIP_{1–5}} \right)$$

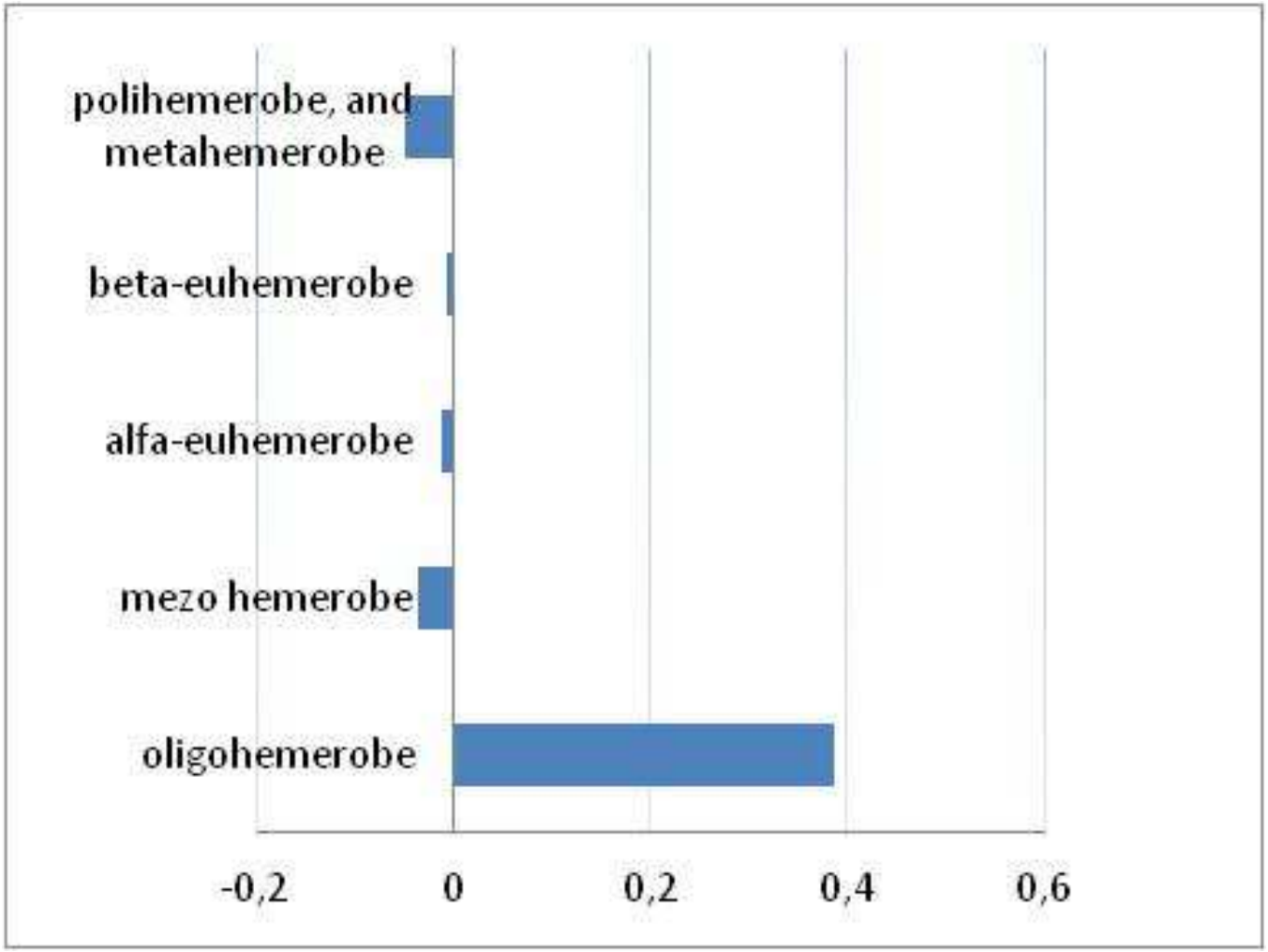
where

NCI_{LUN} The Natural Capital Index of the landscape units

HEM_{TIP} The area of the hemeroby based on aggregated CLC categories in %

W_{TIP} The weight number (multiplying factor) of different hemeroby based on aggregated CLC categories

The multiplying factors (weights) of the naturalness based on aggregated CLC categories



1. and 2. Level land cover classes of the CLC database:

Level 1	Level 2	Level 3
1. Artificial surfaces	1.1 Urban fabric	1.1.1 Continuous urban fabric
		1.1.2 Discontinuous urban fabric
	1.2 Industrial, commercial and transport units	1.2.1 Industrial or commercial units
		1.2.2 Road and rail networks and associated land
		1.2.3 Port areas
		1.2.4 Airports
	1.3 Mine, dump and construction sites	1.3.1 Mineral extraction sites
		1.3.2 Dump sites
		1.3.3 Construction sites
	1.4 Artificial, non-agricultural vegetated areas	1.4.1 Green urban areas
		1.4.2 Sport and leisure facilities
2. Agricultural areas	2.1 Arable land	2.1.1 Non-irrigated arable land
		2.1.2 Permanently irrigated land
		2.1.3 Rice fields
	2.2 Permanent crops	2.2.1 Vineyards
		2.2.2 Fruit trees and berry plantations
		2.2.3 Olive groves
	2.3 Pastures	2.3.1 Pastures
	2.4 Heterogeneous agricultural areas	2.4.1 Annual crops associated with permanent crops
		2.4.2 Complex cultivation patterns
		2.4.3 Land principally occupied by agriculture with significant areas of natural vegetation
		2.4.4 Agro-forestry areas
3. Forests and semi-natural areas	3.1 Forests	3.1.1 Broad-leaved forest
		3.1.2 Coniferous forest
		3.1.3 Mixed forest
	3.2 Shrub and/or herbaceous vegetation associations	3.2.1 Natural grassland
		3.2.2 Moors and heathland
		3.2.3 Sclerophyllous vegetation
		3.2.4 Transitional woodland scrub
	3.3 Open spaces with little or no vegetation	3.3.1 Beaches, dunes, sand plains
		3.3.2 Bare rock
		3.3.3 Sparsely vegetated areas
		3.3.4 Burnt areas
		3.3.5 Glaciers and perpetual snow
4. Wetlands	4.1 Inland wetlands	4.1.1 Inland marshes
		4.1.2 Peat bogs
	4.2 Coastal wetlands	4.2.1 Salt marshes
		4.2.2 Salines
		4.2.3 Intertidal flats
5. Water bodies	5.1 Continental waters	5.1.1 Water courses
		5.1.2 Water bodies
	5.2 Marine waters	5.2.1 Coastal lagoons
		5.2.2 Estuaries
		5.2.3 Sea and ocean

$$NCI_{LUN_{1-222}} = \sum_{k=5} \left(HEM_{CLC_{1-5}} * W_{CLC_{1-5}} \right)$$

where

NCI_{LUN} The Natural Capital Index of the landscape units

HEM_{CLC} The area of the 1. level CLC categories in %

W_{CLC} The weight number (multiplying factor) of different second level CLC categories

$$NCI_{LUN_{1-222}} = \sum_{k=12} \left(HEM_{CLC_{1-12}} * W_{CLC_{1-12}} \right)$$

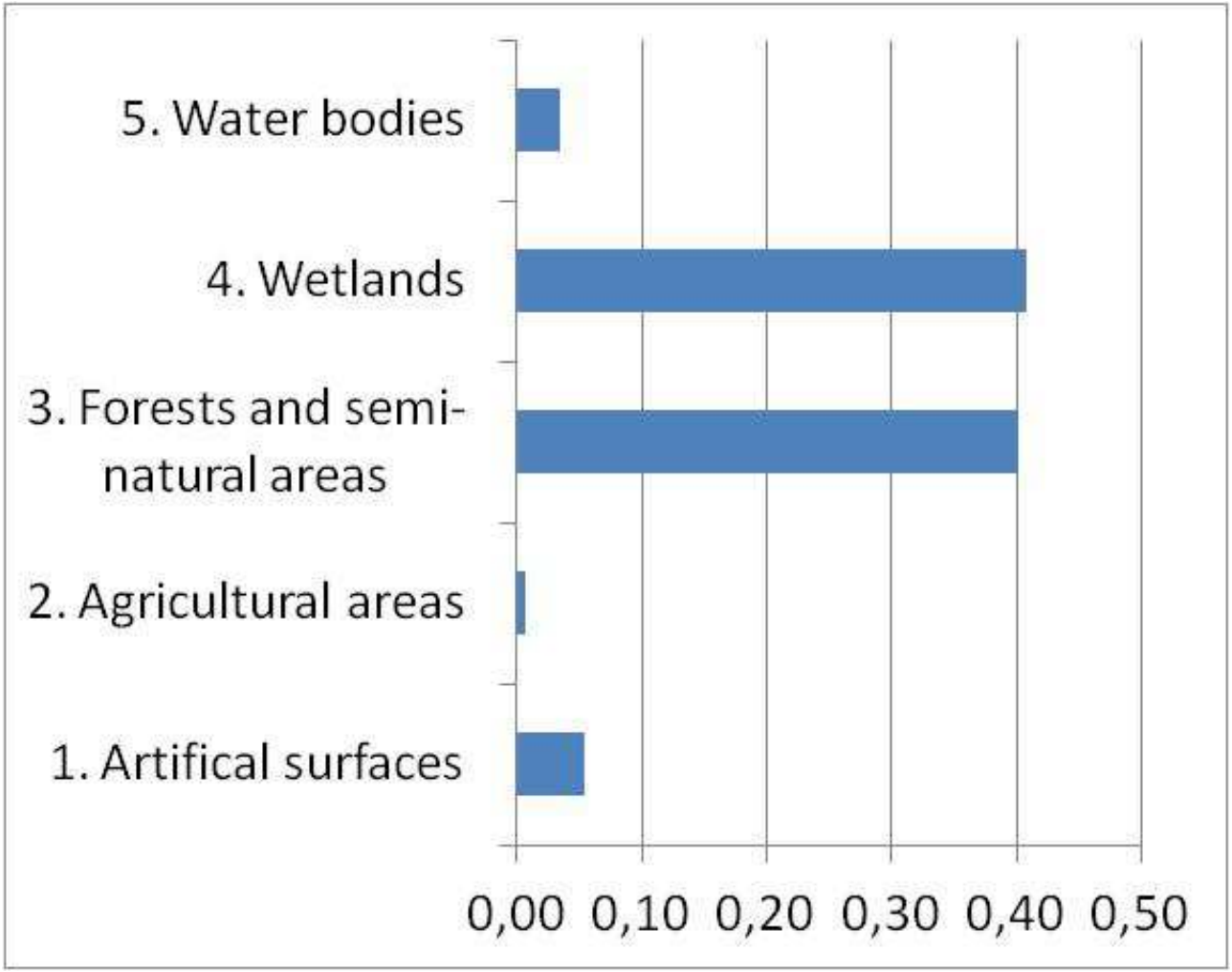
where

NCI_{LUN} The Natural Capital Index of the landscape units

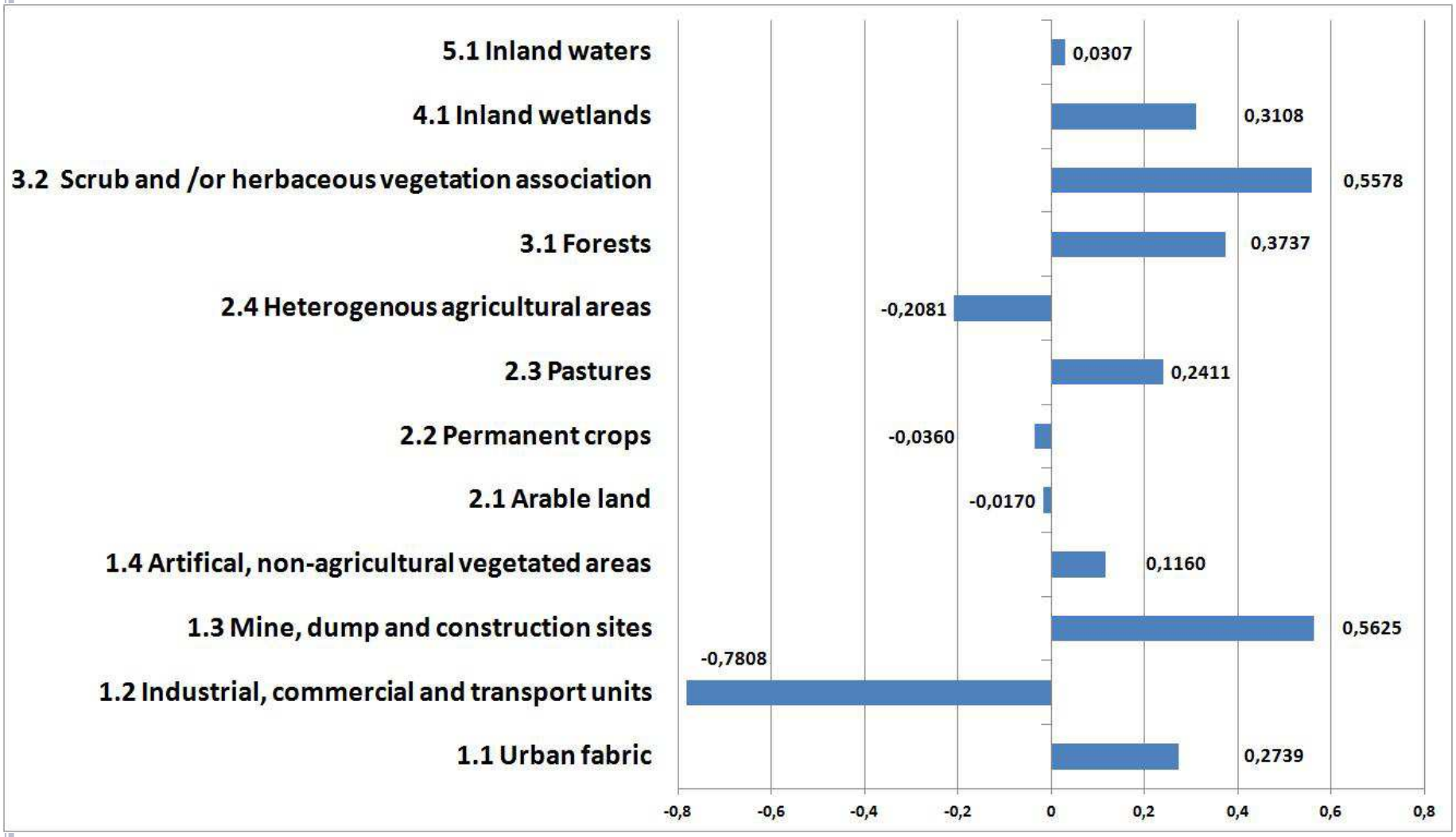
HEM_{CLC} The area of the 2. level CLC categories in %

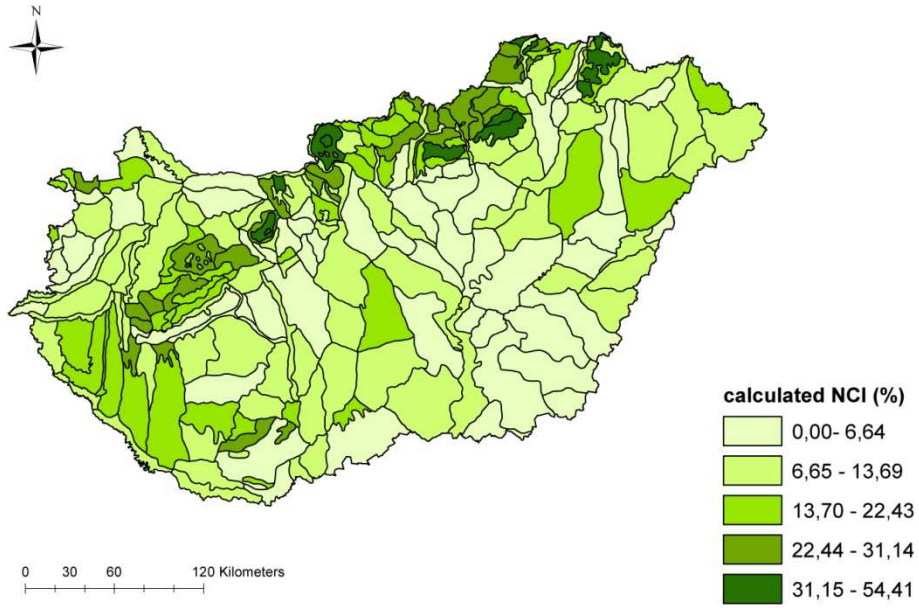
W_{CLC} The weight number (multiplying factor) of different second level CLC categories

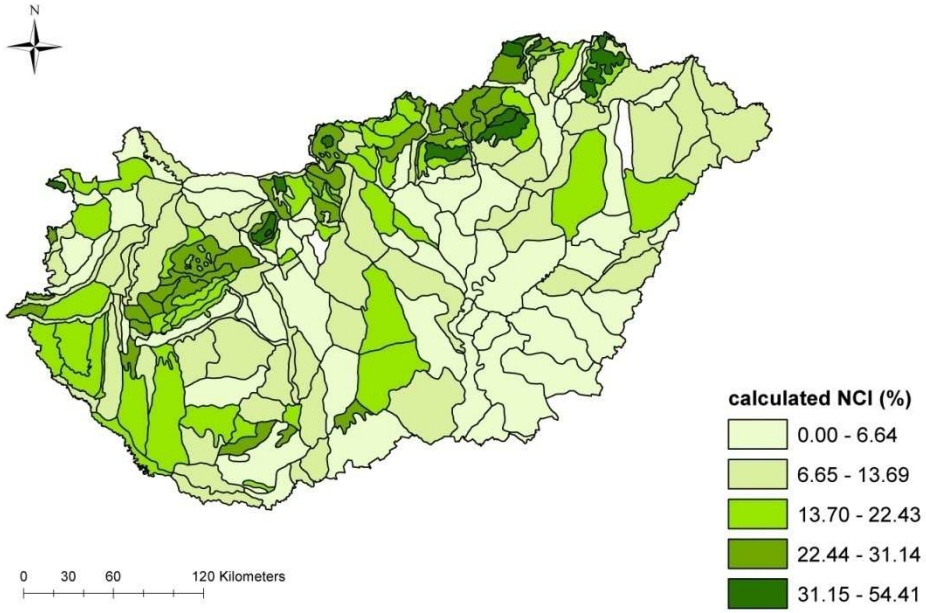
The multypliing factors (weights) of the naturalness 1. level CLC categories



The multypliing factors (weights) of the naturalness 2. level CLC categories





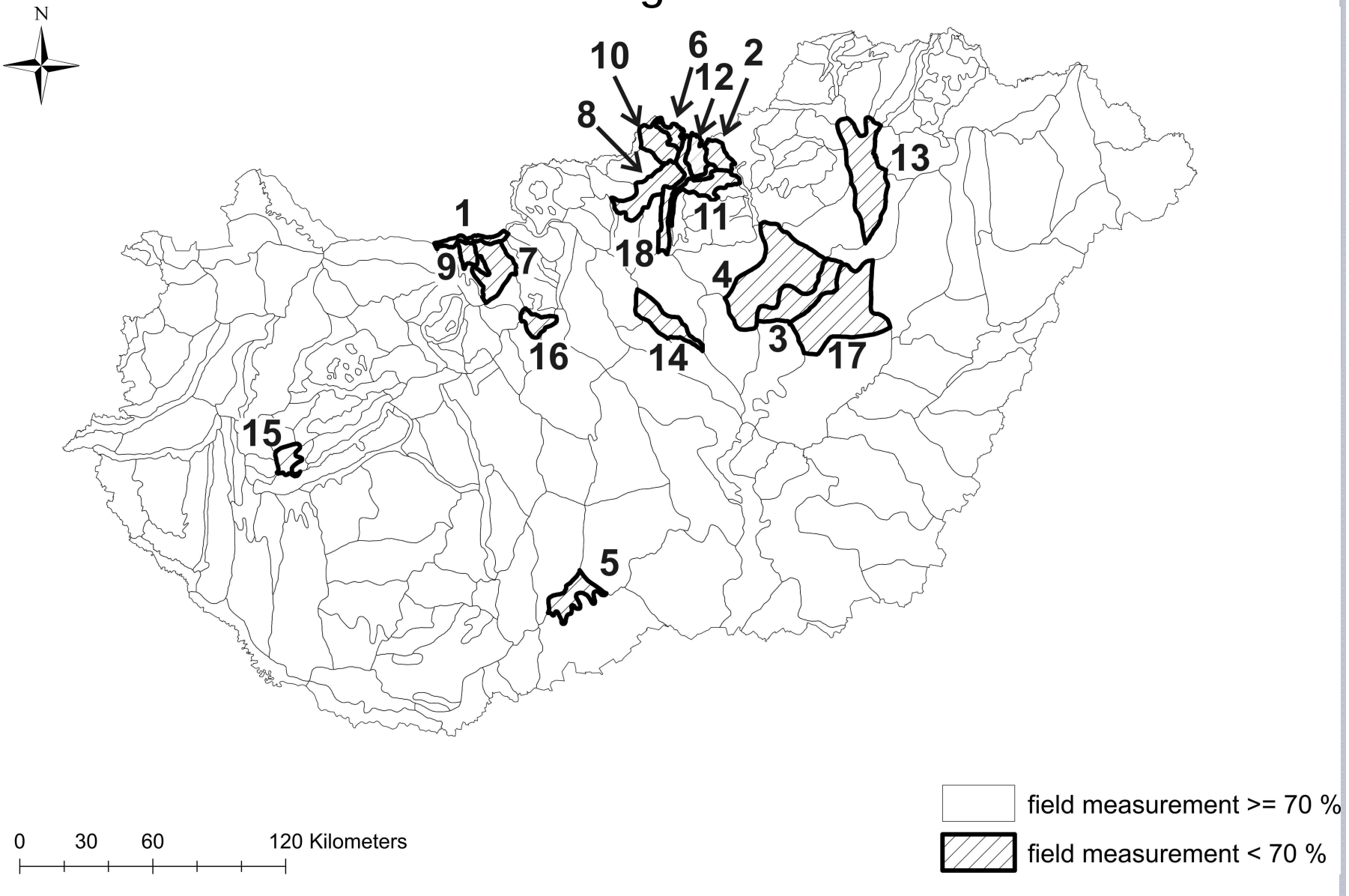


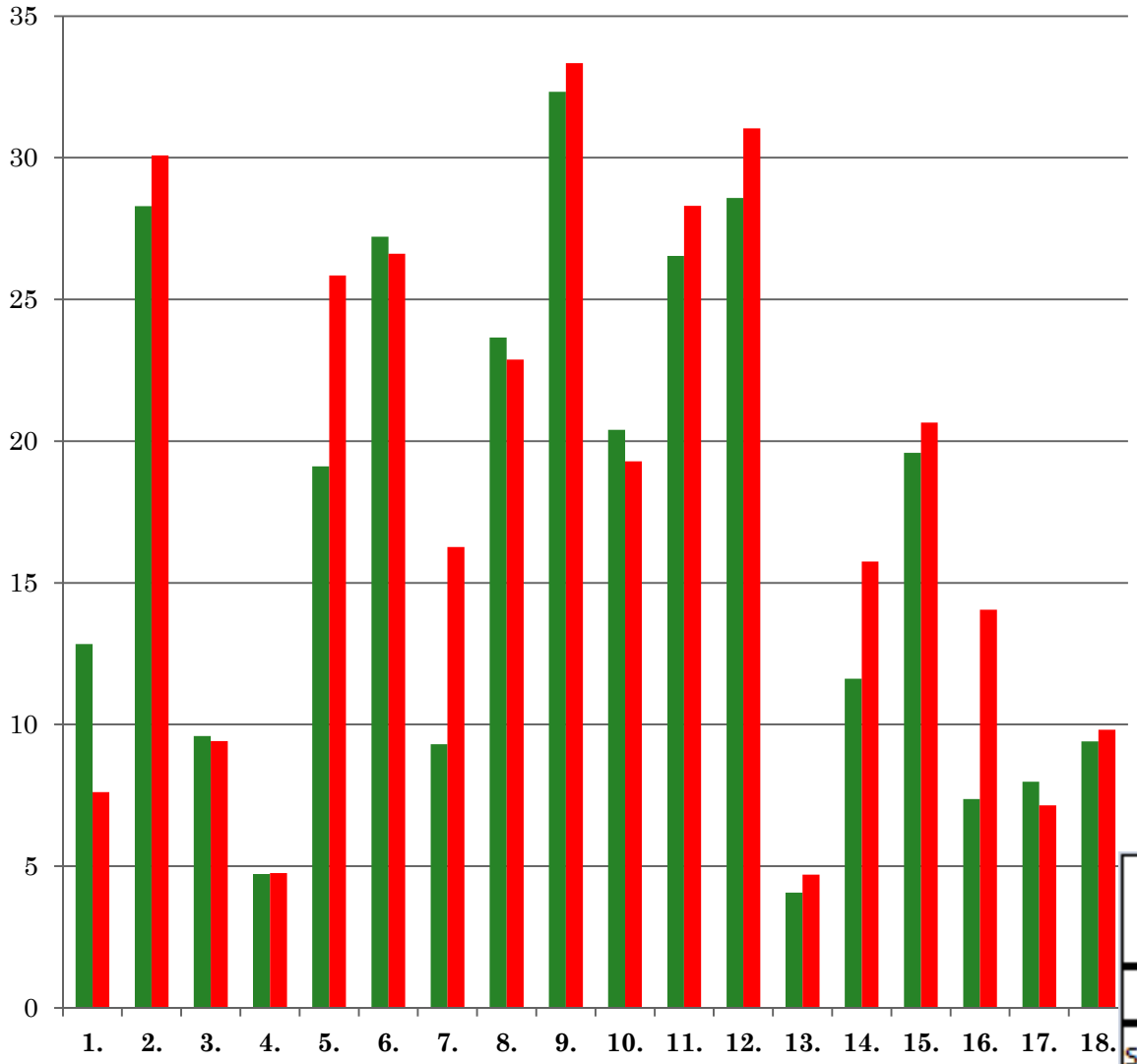
The naturaleness of Hungarian landscape units based on:

A, hemeroby based on aggregated CLC classes

B, 2. level CLC classes

„No data” landscape units of Hungary, where the field measurement of the vegetation less than 70%.





difference between the 2 calculation (%)	
average	2,35
standard deviation	2,44
max	6,95
min	0,03

Thank you for your kind attention!