

Anthropogenic pressure: quantifying and clustering human structures in “sandstone” protected areas

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Introduction

- Land cover changes have been driven by human activities
- Human impact affects protected areas as well
- Protected areas are here for minimizing negative influence
- „Landscape monitoring“ is a long term project lasting from 2018 to 2022
- An analysis of the development of the landscape (land use / land cover and anthropogenic structures) in all large-scale PA (protected landscapes areas and national parks) and in selected NATURA 2000 sites
- In this presentation, we focus on quantifying and comparing anthropogenic pressure in selected “sandstone” areas

Materials and methods I

- We used data including built-up and recreational areas, roads, streets and paved roads (polygon features larger than 0.2 ha were mapped)
 1. Data were derived from topographic maps and aerial images
 2. Computation of relative distribution (% of grid, m per m² in grid) of anthropogenic features and standardization of values to 0-1 range
 3. Computation of Euclidean distances from the anthropogenic features using average values for each grid to capture influence on the whole study area
 4. Weighting:
 - built-up areas and distances from them by value of 3 (as the most significant anthropogenic structure)
 - roads, streets and recreational areas and distances from them by value of 2
 - paved roads and distances from them were weighted by value of 1 (as also significant feature for heterogeneity of the landscape)
 5. Calculation of weighted mean for each grid
- We used 500x500 m grid to visualize our data and analysis

Materials and methods II

- Our outputs:
 1. Weighted “indices” were compared between 1950s/60s and nowadays
 2. Index dealing with rock formation using distances from fragmentation geometry (built-up and recreation areas, roads) and weighted by vertical heterogeneity.
 3. Cluster analysis based on standardized values of anthropogenic structures for each grid (k-means clustering)
 4. Anthropogenic pressure versus habitat suitability (relationship between habitat suitability and anthropogenic pressure to identify valuable and problematic locations regarding nature protection and anthropogenic pressure, we used MaxEnt modelling and seven species (*Bubo bubo*, *Canis lupus*, *Glis glis*, *Falco peregrinus*, *Lacerta viridis*, *Lynx lynx*, *Salamandra salamandra*))

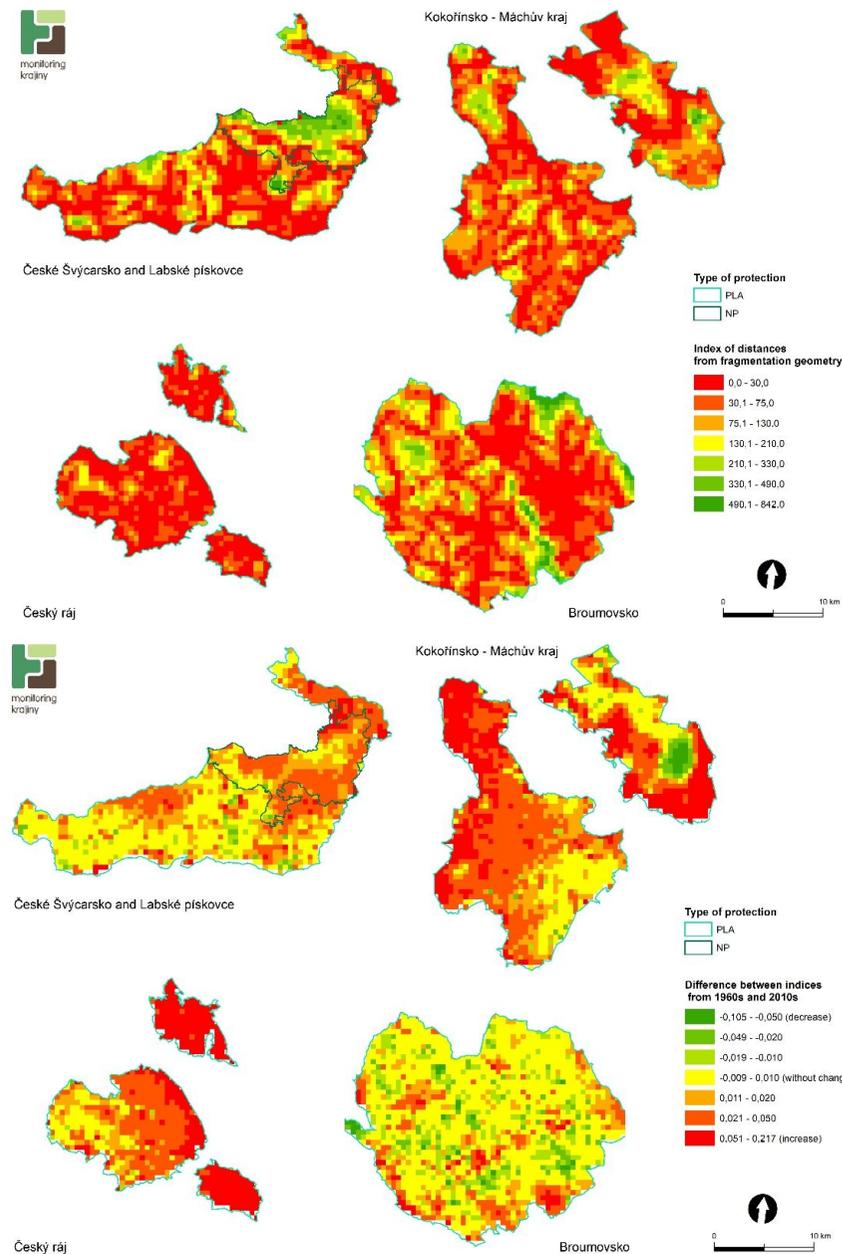
Materials and methods III

- We worked with five large-scale areas – protected landscape areas (PLA) and national park (NP) with sandstone areas
 - Broumovsko PLA
 - České Švýcarsko NP
 - Český ráj PLA
 - Kokořínsko-Máchův kraj PLA
 - Labské pískovce PLA

Results: indices

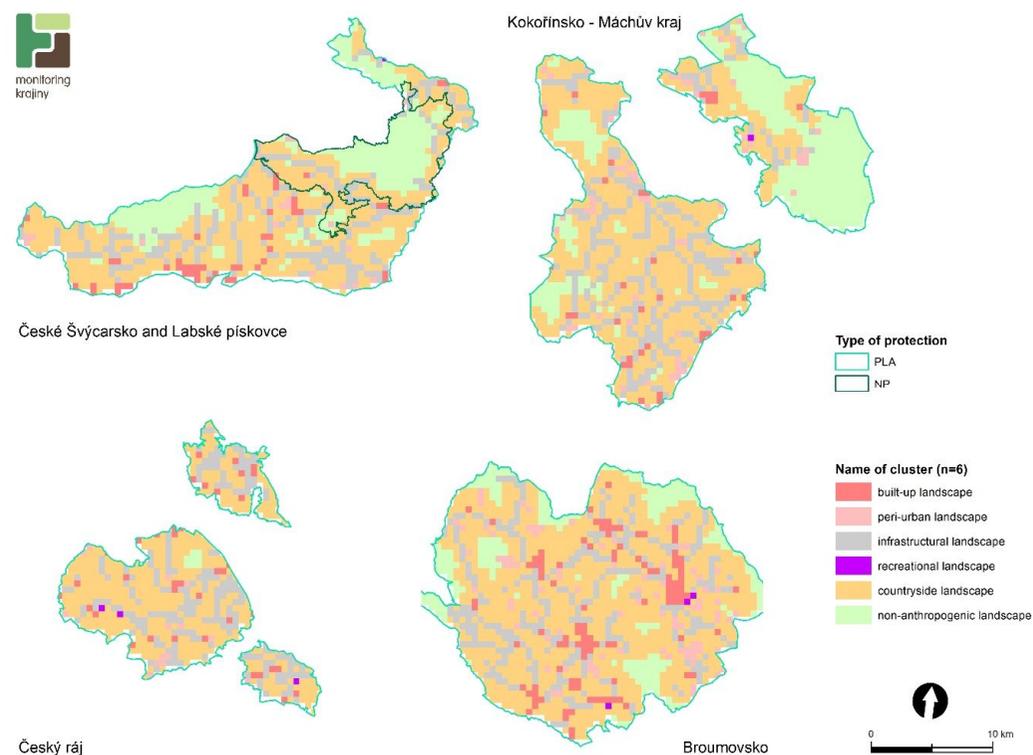
- Increase especially in Český ráj and Kokořínsko - Máchův kraj
- Smaller increase in Labské pískovce and Broumovsko, the vast areas of these protected areas without significant change
- Lower values of index of distances from fragmentation geometry in rocky areas

	Index 2010s	Index 1960s	Index DIFF
Broumovsko	0.4700	0.4677	0.0023
České Švýcarsko	0.3979	0.3764	0.0215
Český ráj	0.4963	0.4502	0.0461
Kokořínsko - Máchův kraj	0.4418	0.4077	0.0341
Labské pískovce	0.4661	0.4530	0.0131



Results: clusters

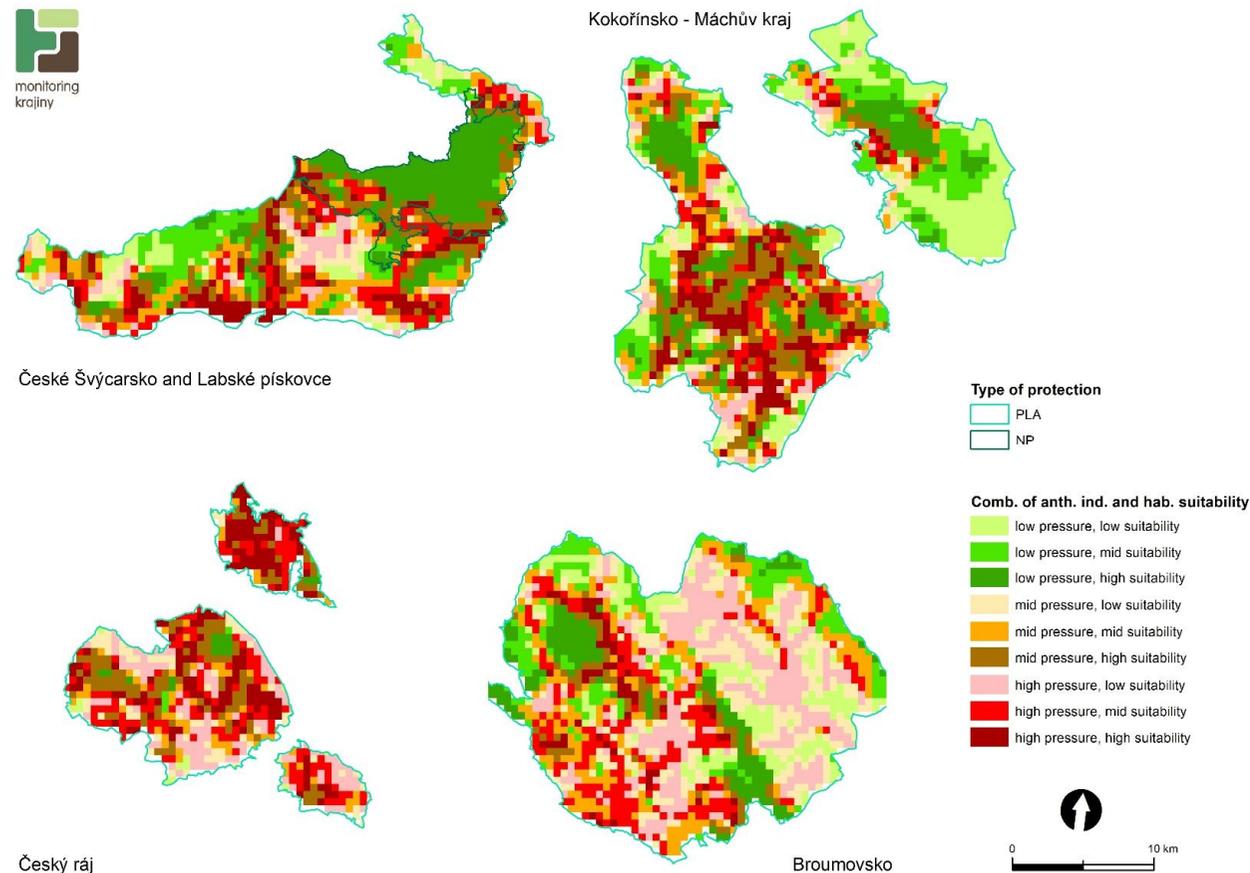
- Visualising of six clusters
- České Švýcarsko is the most natural
- Broumovsko and Český ráj are cultural landscapes with the highest share of built-up areas
- Labské pískovce is more heterogeneous – from built-up areas to relatively large non-anthropogenic areas
- Settlements in Kokořínsko-Máchův kraj are significantly smaller, also non-anthropogenic areas are the second largest



	Countryside landscape (%)	Infrastructural landscape (%)	Non-anthropogenic landscape (%)	Peri-urban landscape (%)	Recreational landscape (%)	Built-up landscape (%)
Broumovsko	56,9	17,5	13,8	5,2	0,2	6,5
České Švýcarsko	29,9	11,1	56,7	1,9	0,0	0,4
Český ráj	61,7	28,8	1,1	2,4	0,4	5,6
Kokořínsko - Máchův kraj	49,1	17,9	26,9	3,8	0,1	2,2
Labské pískovce	52,3	21,7	19,0	1,4	0,1	5,5

Results: Anthropogenic pressure versus habitat suitability

- Suitable areas in the parts of landscape with rocky formations
- Suitable areas are often surrounded by areas with higher anthropogenic pressure
- Problematic locations with higher suitability and pressure as well (e.g., Český ráj)
- České Švýcarsko seems well preserved as National park



Discussion – summary for study areas

- Broumovsko
 - Countryside landscape
 - High anthropogenic index
 - Valuable parts surrounded by locations with higher anthropogenic pressure
- České Švýcarsko
 - Relatively large less affected and suitable area
- Český ráj
 - Most affected area, only small suitable patches far from anthropogenic structures
- Kokořínsko – Máchův kraj
 - Many different types of landscape
 - Relatively small anthropogenic pressure, however valuable parts are fragmented by traffic infrastructure
- Labské pískovce
 - Various anthropogenic pressure – from built-up areas to relatively pristine locations
 - Without many areas of higher suitability for selected species

Conclusion

- Comparable method to set anthropogenic pressure
- Characterization of the anthropogenic pressure in landscape
- Combination of anthropogenic pressure and habitat suitability models
- Identification of valuable locations, gaps and threats